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elementary Electronics

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Designed with a creative difference by a darkroom craftsman!
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Complete plans on page 41

Plus Exciting Projects Like-

- VLF-Band FET/IC Receiver
- Cheapie Strobe Blinker
- SWL's Station Finder/Marker
- Neon Lamp Party Pepper-Upper

Plus-

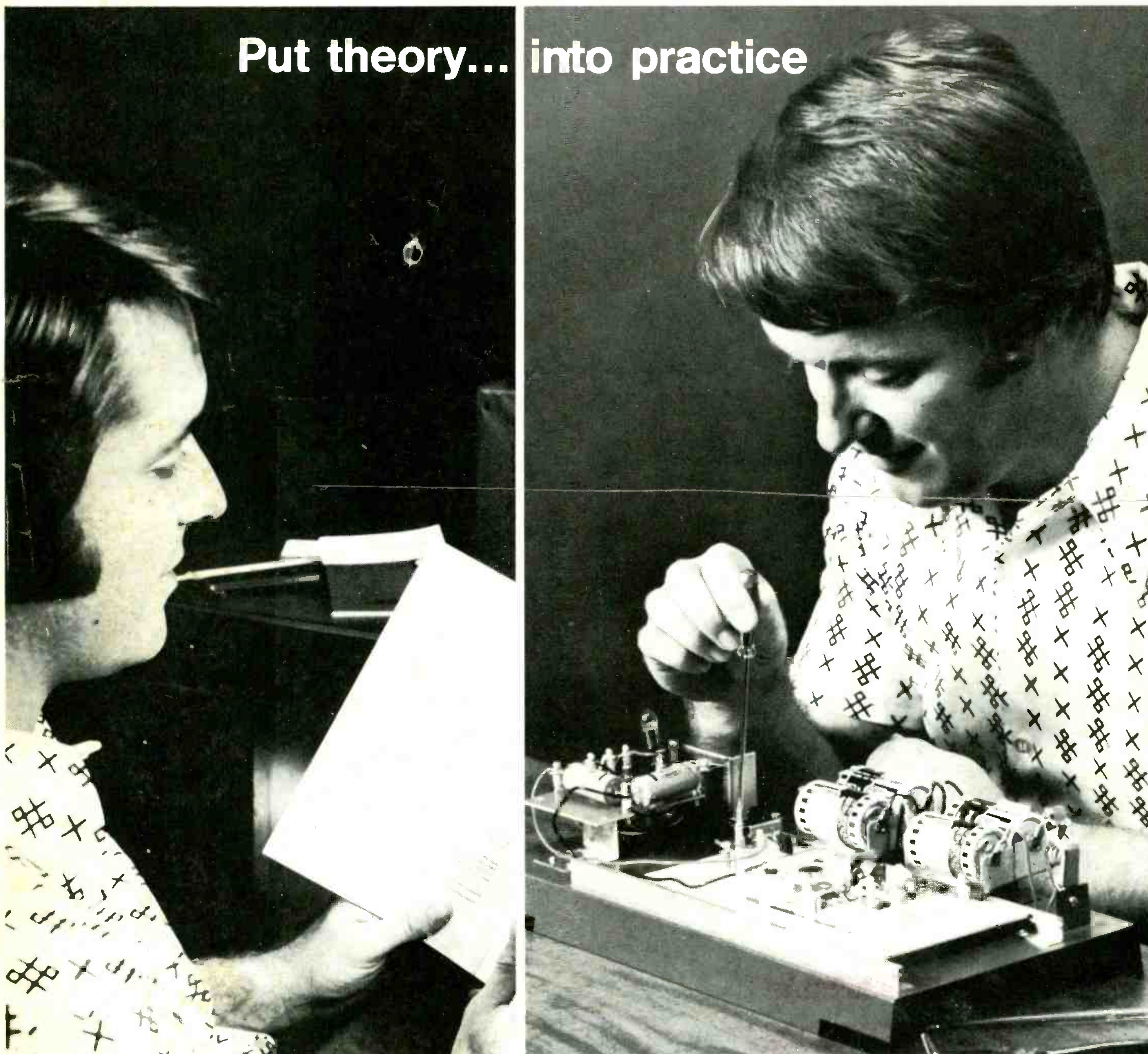
Lab Reports on the Revox A720 Digital FM Tuner/Preamplifier and Heath IC-2100 Electronic Slide Rule Kit • Features on How We Hear Hi-Fi, Old Time Vacuum Tubes and Electric Rent-A-Cars • plus our Regular Columns on CB Radio, New Products, A... Electronics News Tid-Bits • and much, much more!

A DAVIS PUBLICATION

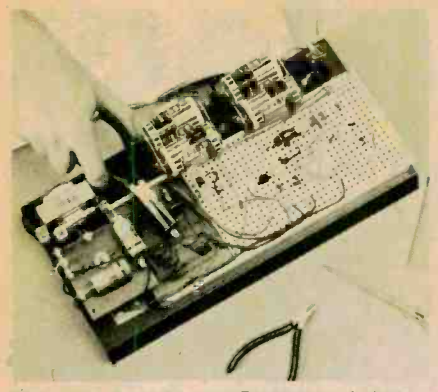
From CIE — Cleveland Institute of Electronics

learn by doing!

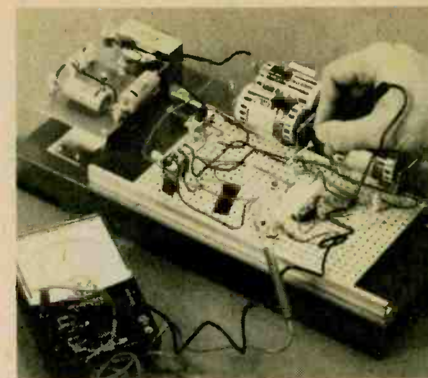
Perform more than 200 exciting experiments with CIE's fascinating ELECTRONICS LABORATORY PROGRAM!



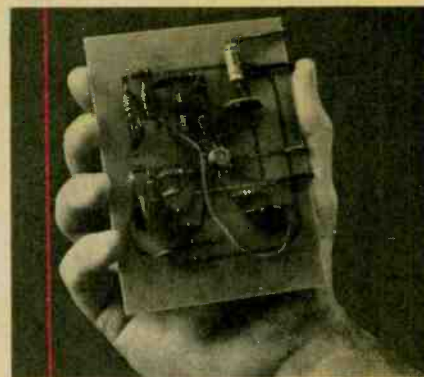
You get your own Experimental Electronics Laboratory... work with components comparable to those used by industry!



With CIE's Experimental Electronics Laboratory, you'll perform actual experiments and become adept at handling components. This valuable "hands on" experience helps you learn the "how" as well as the "why."



Testing and troubleshooting are an important part of your learning experience. Included in your laboratory is a precision "multimeter" to diagnose electrical and electronic troubles quickly and accurately.



Modern space-age components like this IC (integrated circuit) are professional quality and can be used again and again in many of your projects. Lesson by lesson, piece by piece your knowledge grows!

Prepare now for a rewarding career in Electronics . . . the Science of the Seventies.

Electronics miracles are changing today's world with breathtaking speed.

This growth in electronics technology has generated a need for electronics technicians trained in theory and practice to build the products, maintain them, and troubleshoot them during the Seventies and beyond.

Don't just wait for something to "happen" in your present job. Get ready now for a career you'll really enjoy . . . with the opportunity for a good income and the chance for advancement.

Practical experience with experiments
"Hands on" experience helps to reinforce basic theory. When you learn by doing, you discover the "how" as well as the "why." You'll find out for yourself the right way as well as the wrong way to use electronic components. How to construct your own circuits, to discover trouble spots and learn how to fix them.

CIE offers a number of laboratory courses where you learn Electronics by "doing it yourself." You work with your own hands on electronics components and lab equipment. This combination of "head and hands" learning *locks in* your understanding of the crucial principles you'll use on the job in your new career.

And you do it all at home, in your spare time, at your best study pace. CIE's outstanding lessons allow you to progress step by step. An instructional technique time-tested for over 40 years of specialized electronics independent home-study training.

Importance of an FCC License and our Warranty
If you want to work in commercial broadcasting . . . television or AM or FM broadcasting . . . as a broadcast engineer, federal law requires you to have a First Class Radiotelephone License. Or if you plan to operate or to maintain mobile two-way communications systems, microwave relay stations or radar and signaling devices, a Second Class FCC License is required.

Even if you aren't planning a career which involves radio transmission of any kind, an FCC License is valuable to have as Government certification of certain technical skills. It's a job credential recognized by some employers as *evidence* that you really know your stuff.

To get an FCC License, you must pass a licensing exam administered by the government. And we are confident you can successfully earn your license, if you're willing to put forth an effort, because the vast majority of CIE students have. In fact, based on continuing surveys, close to 9 out of 10 CIE graduates passed their FCC exams!

That's why we can offer this Warranty: when you successfully complete any CIE career course which includes FCC License preparation, you will be able to pass the Government FCC Examination for the License for which the course prepared you or you will be entitled to a full refund of an amount equal to the cash price of tuition for CIE's Course No. 3, "First Class FCC License," in effect at the time you enrolled. This warranty is good from the date you enroll until the last date allowed for completion of your course.

That's it! We *warrant* that you will get the License you trained for.

You'll have attractive job opportunities
There have already been many exciting developments and breakthroughs in Electronics and some people might assume there will be no new frontiers . . . no new worlds to conquer. Not so.

Electronics is still growing. In nearly every one of the new and exciting fields of the Seventies you find electronics skills and knowledge in demand. Computers and data processing. Air traffic control. Medical technology. Pollution control. Broadcasting and communications. Once you have the solid technical background you need, you can go after the career field you want . . . work for a big corporation, a small company, or even go into business for yourself.

Yes, Electronics can be the door to a whole new world of career opportunities for you. And CIE training can be your key.

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Discover the opportunities open to people with electronics training. *Learn* how CIE career courses can help you build new skills and knowledge and prepare you for a meaningful, rewarding career. We have courses for the beginner, for the hobbyist, for the electronics technician, and for the electronics engineer. Whether you are just starting out in Electronics or are a college-trained engineer in need of updating (or anywhere in between), CIE has a course designed to fit your background, experience, and future goals.

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EL-57

Circle No. 24 On Reader Service Card

e/e elementary electronics

Dedicated to America's Electronics Hobbyists

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May-June 1975
Volume 15, No. 3

Cover photo by Walter Herstatt

AUTHORS IN THIS ISSUE

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★ AMPLIFIER
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★ SCHOOL INQUIRIES INVITED
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YOU DON'T HAVE TO SPEND HUNDREDS OF DOLLARS FOR A RADIO COURSE

The "Edu-Kit" offers you an outstanding PRACTICAL HOME RADIO COURSE at a rock-bottom price! Our Kit is designed to train Radio & Electronics Technicians, making use of the most modern methods of home training. You will learn radio theory, construction practice and servicing. THIS IS A COMPLETE RADIO COURSE IN EVERY DETAIL.

You will learn how to build radios, using regular schematics; how to wire and solden in a professional manner; how to service radios. You will work with the standard type of punched metal chassis as well as the latest development of Printed Circuit chassis.

You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector, Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for television, Hi-Fi and Electronics.

Absolutely no previous knowledge of radio or science is required. The "Edu-Kit" is the product of many years of teaching and engineering experience. The "Edu-Kit" will provide you with a basic education in Electronics and Radio, worth many times the low price you pay. The Signal Tracer alone is worth more than the price of the kit.

THE KIT FOR EVERYONE

You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

PROGRESSIVE TEACHING METHOD

The Progressive Radio "Edu-Kit" is the foremost educational radio kit in the world, and is universally accepted as the standard in the field of electronics training. The "Edu-Kit" uses the modern educational principle of "Learn by Doing." Therefore you construct, learn schematics, study theory, practice trouble shooting—all in a closely integrated program designed to provide an easily-learned, thorough and interesting background in radio.

You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector Circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method 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 twenty different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable, electrolytic, mica, ceramic and paper dielectric condensers, resistors, tie strips, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, coils, 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. Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tracer and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.

FREE EXTRAS

• SET OF TOOLS

- SOLDERING IRON
- ELECTRONICS TESTER
- PLIERS-CUTTERS
- VALUABLE DISCOUNT CARD
- CERTIFICATE OF MERIT
- TESTER INSTRUCTION MANUAL
- HIGH FIDELITY GUIDE • QUIZZES
- TELEVISION BOOK • RADIO TROUBLE-SHOOTING BOOK
- MEMBERSHIP IN RADIO-TV CLUB: CONSULTATION SERVICE • FCC AMATEUR LICENSE TRAINING
- PRINTED CIRCUITRY

SERVICING LESSONS

You will learn trouble-shooting and servicing in a progressive manner. You will practice repairs on the sets that you construct. You will learn symptoms and causes of trouble in home, portable and car radios. You will learn how to use the professional Signal Tracer, the unique Signal Injector and the dynamic 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 Consultation Service will help you with any technical problems you may have.

FROM OUR MAIL BAG

J. Stataitis, of 25 Poplar Pl., Waterbury, Conn., writes: "I have repaired several sets for my friends, and made money. The "Edu-Kit" paid for itself. I was ready to spend $240 for a Course, but I found your ad and sent for your Kit."

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

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

PRINTED CIRCUITRY

At no increase in price, the "Edu-Kit" now includes Printed Circuitry. You build a Printed Circuit Signal Injector, a unique servicing 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 various parts are merely plugged in and soldered to terminals.

Printed Circuitry is the basis of modern Automation Electronics. A knowledge of this subject is a necessity today for anyone interested in Electronics.

Progressive "Edu-Kits" Inc., 1189 Broadway, Dept. 572DJ Hewlett, N.Y. 11557

Please rush me free literature describing the Progressive Radio-TV Course with Edu-Kits. No Salesman will call.

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CIRCLE 17 ON READER SERVICE COUPON

Hey, look me over

Showcase of New Products

CB Base with Handset

E. F. Johnson has unveiled its latest development in Citizens Band communications, the "Messenger 132," which extends the radiotelephone operating concept to base station use. The new base station model offers all the advantages of the handset design, including the option of private listening. If the user selects, the speaker is automatically silenced when he lifts the handset to permit listening without disturbing others. The handset also provide increased clarity under noisy conditions, such as in a busy office or in the home with others using stereos and TVs. When group listening is desired, a switch on the front panel provides simultaneous handset and loudspeaker operation. Also featured on

Circle No. 73 On Reader Service Card

the new Johnson Messenger 132 base unit is an illuminated meter that indicates received signal strength as well as relative RF power output. A PA function allows paging when the radio is used with a remote speaker. With the PA switch in the "on" position, the radio can also be used for remote listening of incoming radio calls. The unit is equipped with all 23 CB channels and has a backlighted channel selector that changes from white to red when the radio is in the transmit mode. Sells for $289.95. Full details on the new Messenger 132 base station are available at Johnson dealers or by writing directly to the E. F. Johnson Company, Waseca, MN 56093.

IC Tool

Insert or extract ICs quickly and easily with the Pul-N-Sertic Integrated Circuit Tool from GC Electronics. Pul-N-Sertic (Cat. No. 9481) provides maximum protection to IC leads and also acts as a heat sink when desoldering ICs. Made of rugged, high-impact plastic, Pul-N-Sertic

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Experiment in the fascinating new field of "Kirlian" electrophotography —images obtained on film without camera or lens by direct recording of electric charge transmitted by animate & inanimate obects. Each "aura" differs—animate aura said to change corresponding to physical changes. Kit incls portable darkroom, double transformer isolated from power source; instrs.

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4¼" REFLECTOR W/CLOCK DRIVE #85,107EK .... $189.50 FOB
6" REFLECTOR (48X to 360X) #85,187EK .... $249.50 FOB
6" REFLECTOR W/CLOCK DRIVE #85,086EK .... $285.00 FOB

3-CHANNEL COLOR ORGAN KIT

Easy to build low-cost kit needs no technical knowledge. Completed unit has 3 bands of audio frequencies to modulate 3 independent strings of colored lamps (i.e. "lows"-reds, "middles"-greens, "highs"-blues. Just connect hi-fi, radio, power amp etc. & plug ea. lamp string into own channel (max. 300w ea.). Kit features 3 neon indicators, color intensity controls, controlled individ SCR circuits; isolation transformer; custom plastic housing; instr.

Stock No. 41,831EK .... $18.95 Ppd.

AM RADIO FITS IN/ON YOUR EAR!

Wear it inconspicuously everywhere, listen as you work (lawn, yard, office), watch (game, beach) or wait. Instant music, news sports. No gimmick, our 6/10 oz. technological wonder has integrated circuit, 11 transistors, patented ferrite antenna/tuner/volume dial. Uses normal silver oxide hearing aid batt. (incl) for approx. 100 hrs. playing. New batt. to slip in avail. at drug stores (about 50¢). No lengthy wires, bulky cases, or power-packs!

Stock No. 42,275EK .... $14.95 Ppd.

The MOST POWERFUL SOLAR CELL!

World's biggest (3" dia.), strongest silicon cell delivers over 1 amp. @ .5v D.C. or 1/2W. 5 times more efficient per cost than ever before! Only 1 mil thick. Tab leads for any circuit, 100's of applications. Hook in series for more voltage; parallel—more current. Real breakthrough!

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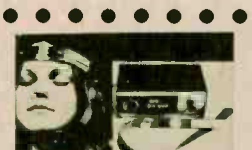
No. 1649EK (5½ LB.) .... $299.00 Ppd.
BIG EAR "TOY" MODEL #80,176EK .... $ 32.25 Ppd.

KNOW YOUR ALPHA FROM THETA!



For greater relaxation, concentration, listen to your Alpha-Theta brainwaves. Ultra-sensitive electrode headband slips on/off in seconds—eliminates need for messy creams, etc. Atch'd to amplifier, filters brainwaves, signals beep for ea. Alpha or Theta wave passed. Monitoring button simulates Alpha sound; audio & visual (L.E.D.) feedback. Reliable, easy-to-use unit comparable to costlier models. Completely safe. Comprehensive instruction booklet.

No. 1635 (8x3x4"; 24 oz.) $134.50
LOW COST "Starter" UNIT, No. 71,809 .... $55.00
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CIRCLE 8 ON READER SERVICE COUPON

HEY, LOOK ME OVER

CIRCLE 63 ON READER SERVICE COUPON

is ideal for use in the repair shop, kit building, project building or just plain experimenting. Get more information on Pul-N-Sertic (suggested retail price: $8.50) and other wiring aids directly from GC Electronics, 400 South Wyman, Rockford, IL 61101.

Smoke and Fire Detector

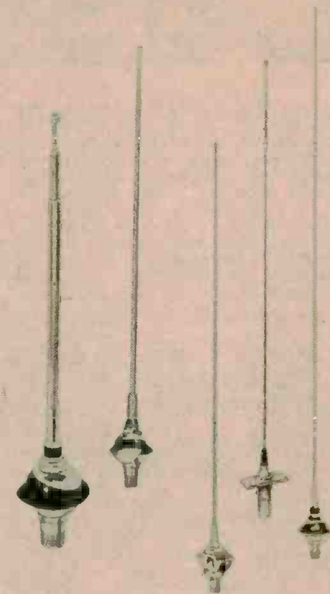
The Earli-Gard Smoke and Fire Detector is capable of sensing potential danger from fire in its earliest stage . . . before smoke, flame or intense heat. It sounds an alarm before other, less expensive heat or visible smoke detectors would be activated. The Earli-Gard device works on the ionization detection principle and sounds a vigorous alarm when it senses the decomposition present in a fire's incipient stage. The compact unit (6 x 4 x 2-in.) automatically compensates for changes in humidity, temperature and atmospheric pressure. And since the power source is household current, there are no batteries to replace. Also, a built-in indicator lamp signals that the unit is energized. The Earli-Guard Smoke and Fire Detector is available in two ver-

CIRCLE 66 ON READER SERVICE COUPON

sions, direct-wired or cord-connected. Up to six direct-wired units can be interconnected for simultaneous alarm. The cord-connected version has an 8½-foot power cord which may be plugged into any receptacle. Suggested retail price: $83.75. To find out more about the Earli-Gard Smoke and Fire Detector, contact a local electrical contractor, or write Square D Company, Dept. SA, Lexington, KY 40505.

UHF Disguise Antennas

A new series of high performance UHF communications antennas for security work features a ⅝-wavelength design that produces 2.5 dB gain when compared with conventional ¼-wave designs. Also featured is a special high conductivity copper-nickel plating which reduces power losses and delivers more signal. These Antenna Specialists antennas are rated for use with up to 100 watts power, and stub tuning allows a wide 3-MHz bandwidth for multi-channel operation. Frequency ranges available are 406-420 and 450-512 MHz. The antennas give the exact appearance of conventional broadcast receiving antennas, including exact replicas of the car manufacturers' mounts. The new model ASP-820 features a universal swivel mount for a ⅞-in. hole, while the model ASP-821 fits 1974 full size Plymouth Fury, Dodge and Chrysler and '70-'73 Plymouth Fury. Model ASP-822 fits 1970-74 Fords and Mercurys. The ASP-820, ASP-821 and

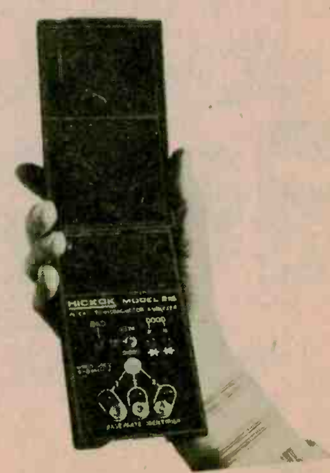


CIRCLE 68 ON READER SERVICE COUPON

ASP-822 antennas (suggested prices: $42.00, $48.50, and $49.50) can be used with the new model ASP-829 UHF/AM broadcast coupler (suggested price: $26.75). The coupler allows simultaneous use of both the UHF communications system and a standard AM broadcast receiver. The new disguise antennas are additions to a complete line specifically designed for undercover operations and available by writing to The Antenna Specialists Company, 12435 Euclid Avenue, Cleveland, OH 44106. Ask for brochure SD-580.

Automatic Semiconductor Tester

Hickok's new Model 215 Semiconductor Tester is a pocket-size, self-contained test instrument capable of checking



CIRCLE 70 ON READER SERVICE COUPON

when Siltronix SSB/AM gives you all of it?

Citizens Band radio has a lot more to offer than 23 channels and a weak signal.

Siltronix single sideband CB sets can double or triple your range by giving you more efficient use of your communications power. And they give you twice as many modes to get through on.

And Siltronix CB sets wrap up those 46 modes of single sideband talk power together with full AM capability to give you everything CB radio has to offer in one compact rig.

Sure Siltronix SSB/AM costs more. About a third more than a good AM rig. For that you get over 12 watts of input power punch and twice the number of modes plus AM to boot.

Like three for the price of one.

Believe us, SSB works better. A whole lot better. But you don't have to take our word for it. Check the amateur bands and you'll find that the hams are all talking on SSB—almost to a man.

Why buy just a piece of CB? Go single sideband with the leader and get in on all the action the band has to offer. See your Siltronix dealer today.

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A Cubic Corporation Company
269 Airport Road • Oceanside, CA 92054
Telephone: (714) 757-8860

Join the SILTRONIX SIDEBANDERS — See your SILTRONIX dealer.

Bell & Howell Schools announces two ways to learn new skills in electronics without ever going to class or giving up your job!

Pick the one

Here are two fascinating home-learning adventures that say, "Don't envy the man with skills in electronics... become one!"

If you had to drop everything and go off to school to learn new skills in electronics, there's a chance you might not do it. But Bell & Howell Schools' excellent home training has already proved to tens of thousands that you don't have to drop anything...except the idea that classrooms are the only place you can learn!

You can keep your job, your paycheck and your way of life *while* you're learning. Because these programs allow you to pick the training schedule that best fits in with your other activities. It's *that* convenient.

I. AUDIO/ELECTRONICS

The first learn-at-home program including 4-channel technology. Explore this totally unique sound of the 70's as you experiment with testing equipment and build a sound center featuring Bell & Howell's superb quadraphonic equipment!†

Learn about 4-channel sound—without a doubt the most impressive technical advancement in sound realism in years. A development by which separately-recorded channels literally wrap a room in sound.

And now, for the first time, you can also discover this latest achievement in audio electronics with a fascinating learn-at-home program that explores the whole area of audio technology including 4-channel sound reproduction. A program that could lead you in exciting new directions with professional skills and technical know-how.

You actually build and experiment with Bell & Howell's high-performance 4-channel audio center ...including amplifier and FM, FM-Stereo tuner.

Understanding today's audio technology requires practical experience with high caliber equipment. And with the Bell & Howell amplifier and tuner, you've got the technological tools you need to gain the knowledge and skills that could open up opportunities for you in the audio field. Of course, we cannot offer assurance of income opportunities.

The sophisticated amplifier gives you the circuitry you need to conduct the comprehensive experiments necessary to master audio technology. Like signal tracing low level circuits, troubleshooting high power amplifier stages, and checking the operation of tone control circuits.

You'll investigate the technology behind this amplifier's full logic, 4-channel decoder and learn how full logic decoding produces outstanding front to back separation.

The tuner you build has both superior performance specs and state-of-the-art features such as: all solid state, FET front end for superior sensitivity, crystal IF filters for wide bandwidth, and a superior stereo multiplex circuit for excellent stereo separation.

You cover the full range of electronic fundamentals.

But make no mistake. This learn-at-home program is not just about 4-channel sound. It covers the full range of electronic fundamentals leading to understanding audio technology. So when you finish, you'll have the occupational skills to become a full-service technician, with the ability to work on the full range of audio equipment such as tape recorders, cassette players, FM antennas, and commercial sound systems. Get complete information on this unique program by checking the appropriate box on the card—mail it today!

†Cabinets and speakers available at extra cost.

you want!


Simulated TV picture/test pattern.

II. HOME ENTERTAINMENT ELECTRONICS

Gain new skills in Home Entertainment Electronics in an unusual learn-at-home program that includes the new generation color TV you build yourself!

This is the first program of its kind to include the study of digital electronics. And what better or more exciting way to learn about it than to actually build and test a 25" diagonal color TV employing digital electronics?

You'll probe into the digital technology behind all electronic tuning and channel numbers that appear on the screen. An on-screen digital clock that shows the time to the second. You'll also gain a better understanding of the exceptional color clarity of the Black Matrix picture tube, as well as a working knowledge of "state-of-the-art" integrated circuitry and the 100% solid-state chassis.

As you build this remarkable, new generation color TV, you'll not only learn how advanced integrated circuitry works, but how to detect and troubleshoot problems in any area.

Sound good? Then mail the postage-paid card today for more details.

Whichever program you choose, you'll get to build and experiment with your own electronics laboratory.

"Hands on" working experience with the latest equipment is the key to Bell & Howell Schools' home training. That's why in both programs we start you off with a set of equipment called the Lab Starter Kit, including a fully-assembled volt-ohm meter designed to help you experiment with and better understand basic electronic principles. So you don't just read about electronic principles, you actually make them work!

Next, in step-by-step fashion, you'll assemble Bell & Howell's exclusive Electro-Lab® electronics training system. It includes a special design console that enables you to assemble test circuits. A digital multimeter for accurately measuring voltage, current and resistance. And a solid-state "triggered sweep" oscilloscope which will allow you to analyze the functioning of tiny integrated circuits. Putting these instruments together will give you experience in wiring, soldering and assembling. Then, further on, you'll use the lab equipment for experience in electronic testing, troubleshooting and circuit analyzing.

We try to give more personal attention than other learn-at-home programs.

Both of these programs are designed so that you can proceed through them smoothly, step by step. However, should you ever run into a rough spot, we'll be there to help. While many schools make you mail in your questions, we have a Toll-Free Phone-In Assistance Service for questions that can't wait. Bell & Howell Schools also holds In-Person "Help Sessions" in 50 major cities at

various times throughout the year. There you can talk shop with your instructors and fellow students and receive additional assistance.

Get details on one or both of Bell & Howell Schools' home-learning adventures...

Mail the postage-paid card today for more information!

Taken for vocational purposes, these programs are approved by the state approval agency for Veterans' Benefits.

"Electro-Lab®" is a registered trademark of the Bell & Howell Company.

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If card is missing, write:

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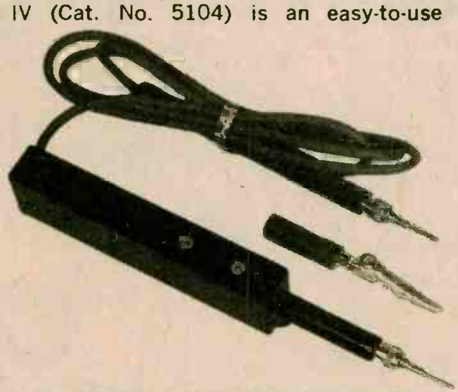
HEY, LOOK ME OVER

NPNs, PNPs, FETs, diodes, SCRs and uni-junctions. The Model 215 instantly and automatically determines proper lead configuration, and indicates in bright LED displays if the semiconductor is good or bad. If good, it further identifies which lead is the base (gate for FETs) and whether NPN PNP. Solid state CMOS circuitry assures reliability and greatly extends the life of the two 9-volt batteries that power the compact unit. Suggested retail price: $138.00. For more information, write to Instrumentation & Controls Division, Hickok Electrical Instrument Company, 10514 Dupont Avenue, Cleveland, OH 44108.

Four Function Tester

Now, check digital logic, continuity, voltage and polarity with one instrument—the Probe IV from GC Electronics (suggested retail price: $25.00). The Probe IV (Cat. No. 5104) is an easy-to-use



CIRCLE 63 ON READER SERVICE COUPON

pocket-size tester that operates on 2 AAA batteries. It features solid-state circuitry, 3 to 600 volt AC-DC operation, voltage indicating LED and a 48-inch insulated wire lead with test probe and alligator clip adaptor. Probe IV is completely safe to use and comes with its own self-protective vinyl carrying pouch. Get more information by writing to GC Electronics, 400 South Wyman, Rockford, IL 61101. *(Continued on page 37)*

DX central reporting

A world of SWL info!

BY DON JENSEN

☐ Here today, gone tomorrow. Nothing changes quite so fast as the shortwave broadcasting picture. Frequencies, schedules, propagation conditions vary and the broadcaster you were hearing regularly becomes an infrequent visitor. New stations come on the air, others vanish without warning. But the biggies, the major European international broadcasters, have tended to be SWLing anchors, being heard well year after year.

The year 1975, however, is bringing changes even among these stable stations. It is too early to predict whether these events will have a snowballing effect. Much will depend on the European economy, since money matters seem to have brought about the current situation. Let's look at what has happened so far.

The first blow was the announcement by West Germany's official voice, *Deutsche Welle*, that its ten-year English language service to North America would end.

The decision to close DW's English service to the U.S. and Canada was announced by Walter Steigner, the station's general manager. The decision came, Steigner said, following a lengthy report by a British Broadcasting Corporation communications expert, James Monahan. Monahan's report concluded that there were not enough *Deutsche Welle* listeners to justify broadcasting to North America in English.

That conclusion is—to say the least—debatable. And so, as might have been expected, DW's head of the North American department, Konstanz Schmoelder took issue with his boss's position. He cited a survey, probably the only such study made in recent years, by a Florida university professor which concluded that there are "2.5 million Americans who listen to shortwave broadcasts for political content."

Apparently programs in other languages are not affected so far.

The tight money situation also has rocked the Gibraltar of SW broadcasting, the BBC. Faced with predictions of nearly $40 million worth of red ink, the British Broadcasting Corporation announced massive cuts in its operations. These include the merging of BBC medium wave home service networks, a decrease in TV broadcasting hours and a requested increase in radio license fees (common in countries with state-run broadcast services which are non-commercial) from $27 to $39 a year. But these economy measures are expected to trim only $2.3 million from the budget. This, coupled with the views of the BBC's

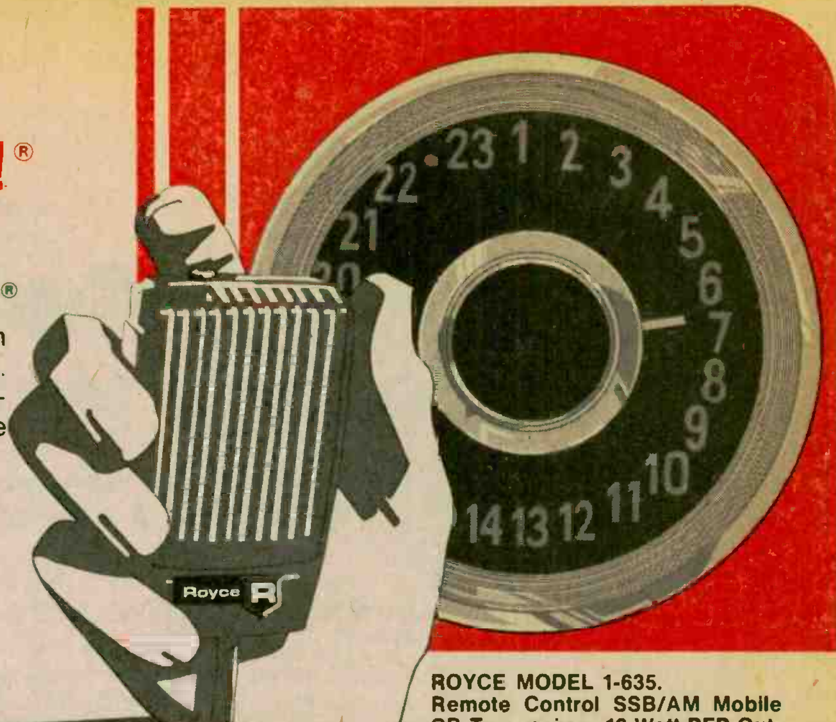
(Continued on page 37)

Never take your eyes off the road again!

New Chan-L-Matic!® Only Royce has it!

Exclusive with Royce! Chan-L-Matic!® You switch channels automatically from a remote switch on the microphone. Here is the greatest safety and convenience device ever invented for the CB user.

Chan-L-Matic® is on both of these great new Royce transceivers!



ROYCE MODEL 1-635. Remote Control SSB/AM Mobile CB Transceiver. 12 Watt PEP Output-25 Watt PEP Input.

Exclusive Royce Chan-L-Matic.® Plus "Warntron"® protection circuit. Greatly minimizes damage to RF output transistors. If an open, short or excessive SWR occurs in your antenna system, a warning light flashes on the front panel. And, power to the driver and final transistor circuits are automatically reduced or removed. NEW MOS-FET RF receiver amplifier circuit. Pinpoint receiver tuning. Fully variable RF gain control. Full 3-stage RF noise blanker. Plus features that competition just can't match, at any price. *See the Model 1-635 before you buy any mobile CB!*

Suggested Retail Price **$439.95**

Patent pending on Chan-L-Matic device. "Chan-L-Matic" and "Warntron" are registered trademarks of Royce Electronics Corporation.

ROYCE MODEL 1-606. Remote Control 23 Channel Deluxe CB AM Transceiver.

Exclusive Royce Chan-L-Matic.® And, "WARNTRON"® protection circuit. Greatly minimizes damage to RF output transistors. If an open, short or excessive SWR occurs in your antenna system, a warning light flashes on the front panel. And, power to the driver and final transistor circuits are automatically reduced or removed. Continuous frequency selection. Full 3-stage RF noise blanker. Larger S-RF meter for reading RF output power and signal strength. Fully variable receiver tone controls. Plus many other features you won't find on any transceiver at any price. *See it at your CB dealer's today!*

Suggested Retail Price **$229.95**

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CALL (816) 842-0252 • TELEX: 426-145

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Speech Compression is built-in every Johnson CB radio. State-of-the-art circuitry electronically selects voice frequencies that penetrate noise and interference . . . then boosts the level of modulation to give your signal that powerful "Johnson sound." It's one of many engineering advances – like receiver "steep skirt" filtering to cut interference and automatic threshold limiting to slice out noise – that gives U.S.-made Johnson CB that extra edge of performance. Performance that's backed by a full 1-year parts and labor warranty with over 700 authorized service centers nationwide.

Messenger 250
100% solid-state base station

Messenger 123B 23-channel
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Messenger 130 and 132
"The radiotelephone CB System"
with private listening option

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CIRCLE 33 ON READER SERVICE COUPON

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16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
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61	62	63	64	65	66	67	68	69	70	71	72	73	74	75

We would like to know about you. Please help us by placing an "X" in the appropriate boxes. • Do you own a CB transceiver? 76 ☐ Yes 77 ☐ No • If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. 78 ☐ Base Station 79 ☐ Mobile Unit 80 ☐ Portable • Do you use CB in your work? 81 ☐ Yes 82 ☐ No • 83 ☐ Please enter my subscription for 8 issues at $3.98 and bill me.

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Got a question or a problem with a project—ask Hank! Please remember that Hank's column is limited to answering specific electronic project questions that you send to him. Personal replies cannot be made. Sorry, he isn't offering a circuit design service. Write to:

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

Practice Makes a Hobby

Hank, I'm new to shortwave listening. I just purchased a Realistic DX-160 receiver and strung a 65-foot long-wire antenna which includes a short length of wire for lead-in. This is the best I can do from my house. Is there some other type of antenna I could use for better DXing?

—E. F., Joliet, IL

You're kidding! With a DX-160 and 65 feet of long wire you should be busier than a one-arm paper hanger with all the DX rolling in. You should be able to print your own club bulletin. Get proficient with what you have before you go any further in antenna improvement.

Bucks Count

I am building a 40 meter one-tube transmitter from a schematic in a book. This schematic calls for a 0-200 DC microammeter with a 3.5-ohm shunt resistor to convert the meter to a 0-40 DC milliammeter. Since milliammeters are less expensive than microammeters, can I omit the shunt resistor and use a milliammeter instead?

—P.Z., Buffalo, NY

You bet. See, that book is teaching you a lot!

Hi Boost

My cassette prerecorded tapes sound screechy in my car tape player. They sound good in the home player. Why?

—A. A., Brookfield, CT

Five will get you ten that they are Dolby encoded. The encoding boosts the highs which sound terrible in playback units without Dolby. Turn your tone control down a bit and kill some of the high frequencies.

Come Fly With Me

Hank, do you know where I can get a low-cost R/C model plane?

—R. K., Chesapeake, VA

Try the yellow pages of your phone book under the listing of Hobby Supplies. You should have no problems.

The Drive is On

What's a direct-drive turntable?

—A. T., Fairlawn, OH

The platen (the part that turns and on which the record rests) is an integral part of the drive motor itself with the result that the platen is the only moving part in the entire turntable. Of course, if the tonearm is automatic, a drive system picks up some power from the platen to drive the tonearm mechanism. Lately some direct-drive turntables are appearing. The record changer mechanism is also powered from the platen. Somehow, in my mind, this defeats the purpose of the direct-drive idea.

Just Ask

How do I get to use those amateur 2-meter relays I hear so much about?

—H. A., Van Nuys, CA

I didn't know until I asked that question last night on 2-meters. Cost is only $10 to $25 a year. Prices will vary. There are some limitations, but if you work it right during the wee hours of the morning, you can relay through several relay stations at the same time and go a thousand miles on 2-meters. Think I'll dust off my ticket and start hamming again.

It Adds Up

Can you or have you rated calculators?

—E. M., Wichita, KS

Nope and nope! Calculators are best evaluated by the person who needs one. First decide what you need. Addition, subtraction, multiplication, division, root extraction, memory, mathematical functions, metric conversion, whatever. Then look for the cheapest unit that has everything you need. Check best price and buy. For more information see "Pick and Choose a Pocket Calculator" in the Nov./Dec. 1974 issue of ELEMENTARY ELECTRONICS.

He's in a Rush

Can you send me an answer to my question on the double? I can't wait to read it in your column!

—G. B., Bowdle, SD

Let me say for the humpteenth time that *I cannot answer questions via the mail!* And in your case, I cannot answer your question in this column because you forgot to include it in the letter.

Starting Young—Good!

Hank, please don't kid me. I am twelve years old and just discovered electronics. I want to know where I can get a book on oscilloscope patterns so I can learn to understand them. Can you help?

—P. G., North Bergen, NJ

Sure, kid. Visit your local library. It's filled with books that cover every aspect of introductory electronics. Also, read the Bookmark column in this magazine. If you don't see the kind of book you want, write to the book publishers listed and tell them you want their book catalog. They'll send you one, and what you want is sure to be in there.

String a Line

I have a six-band portable receiver that's good for listening on all bands without an external antenna. However, when I try for DX, all I can get is hiss. Do I need a booster?

—H. N., Inglewood, CA

You need an antenna. You're pulling in only the locals on a whip or ferrite rod. Get with it, go long wire on shortwave.

First Roll it Down

Please tell me how to use a standard inexpensive walkie-talkie mobile from my car.

—H. A., Douglas, AZ

Stick the antenna out the window.

That's Life

The last four digits of my subscription number to ELEMENTARY ELECTRONICS are identical to my CB call. Can you tell me where you obtained a CB call book? Everyone tells me there is no such book.

—R. C., Marysville, PA

There ain't no such book except for the FCC files to which we have no access. I guess fate, ESP, or whatever, matched up the numbers of your CB call and subscription number. Did you ever take a trip to Las Vegas?

Slam, It's Off

I installed an AM/FM cassette tape unit in my car two months ago and it worked fine until this week when it became erratic. When I close the car door hard, it turns off sometimes. Is something wrong with the car's wiring?

—S. S., Piedmont, SC

What happens is you may have skipped installing the rear strap bracket from the top of the dash to the rear of the radio. This mounting strap is very important to obtain a good electrical ground from the unit's chassis to the car frame. Without it the radio will shake loose. Install the bracket and your problems may be ended, otherwise look inside the player unit. The car's wiring is probably good.

No Fixie CBie

I've raised the power of my CB walkie-talkie transceiver from one milliwatt to about 5 watts. Now, how can I alter the antenna for maximum efficiency?

—R. S., Corte Madera, CA

Try sticking it in a full rain barrel. This way you stay out of the slammer. Don't believe me—ask the FCC fuzz!

You Don't Have to Lump It

I have a lot of trouble removing lumps of solder from PC boards. Should I use a wick or a desoldering bulb?

—M. F., Paducah, KY

I prefer a desoldering bulb or plunger type mechanism. It's quicker and cleaner. The wick is fair, but takes too long on large blobs of solder. The extra heat required may lift the copper foil from the board.

Zap, Zap, Zap

Has anyone made a laser unit for burning off the copper from a foil laminate so printed circuit boards can be made without chemicals?

—D. S., Santa Clara, CA

Yes, but the plans were buried with the inventor after he accidentally cut himself in half.

Fixing Fixtures

Since speaker wire is a lot cheaper than lamp line cord, can I use it to wire electrical fixtures?

—M. A., Elmsford, NY

Don't do it! Speaker wire is a mite smaller in copper size. Also, I'm not sure, but most wire of this type is not "UL Approved." In fact, it's made for low-voltage work. Stick to line cord or any substitute offered by your local electrical supply house.

Plastic Shaft

I replaced a potentiometer in my TV set with an almost identical unit. The difference being that the original had a plastic shaft. The new unit has a metal shaft. The TV works fine. Is everything okay? My wife worries.

—G. A., Geneva, AL

The plastic shaft is used to isolate the TV innards from the outer metal shell and people. If the TV set is housed in a metal cabinet, be sure the shaft does not touch the metal. Also, keep a plastic push-on knob on the shaft at all times. Do not use a knob with a set screw—the screw is a good conductor.

Iron Age

My wife's one-year-old (out of warranty) steam iron doesn't spritz steam anymore. What can I do about it. I know it isn't an electrical problem, but you must know something about irons, Hank.

—R. K., Lombard, IL

We must have the same irons, but I got mine to "spritz" without costly repairs. Take the iron apart carefully and you'll be able to remove the plastic boiler innards that is replaceable. In fact, my iron had ordering information printed on it. Replace this plastic water boiler and spritz on. Regards to the Mrs.

I Hear Music—Squawkkkk!

My transistor radio does not work in my office area, but it works fine out-of-doors and at home. Why?

—E. G., Schenectady, NY

Iron building construction and buildings with air conditioning insulation very seldom permit satisfactory operation of inexpensive portables. Besides reducing the overall signal level of all stations, fluores-

(Continued on page 25)

Only NRI offers five choices in TV/Audio Servicing

NRI can train you at home to service and repair commercially-built color and black-white TV, hi-fi equipment, AM-FM radios and sound systems. You can choose from 5 courses, starting with a basic servicing course with 65 lessons . . . up to a Master Color TV course, complete with 25" diagonal solid state color TV in handsome woodgrain cabinet. All courses are available with low down payments and convenient monthly payments to fit your budget. And all courses provide professional equipment along with NRI-designed kits for hands-on training. With the Master Course, for instance, you receive your own 5" wide band, solid-state triggered sweep oscilloscope, TV pattern generator, 3½ digit digital multimeter, and a high quality NRI 25" diagonal solid state television receiver expressly designed for color TV training.

YOU PAY LESS WITH NRI TRAINING AND YOU GET MORE FOR YOUR MONEY

NRI employs no salesmen, pays no commissions. We pass the savings on to you in reduced tuition costs and extras in the way of professional equipment, testing instruments, etc. You can pay more, but you can't get better training.

Step into the digital age with NRI's Complete Computer Electronics Course

Digital electronics is the career area of the future . . . and the best way to learn it is with NRI's Complete Computer Electronics Course. You can become a computer or digital technician with NRI's unique and fascinating home training . . . while you build and use a real digital computer in your home! This is no beginner's "logic trainer". It's a complete programmable digital computer. And it's just one of ten kits you receive, including a professional digital multimeter for experiments and precise measurement. It's the quickest and best way to learn digital logic, and computer operation.

NEARLY ONE MILLION STUDENTS IN 60 YEARS HAVE LEARNED AT HOME THE NRI WAY . . .

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Radio Shack® "Range Busters"

SSB/AM CB at its Best!

You can't beat the extra power and extra reliability of SSB when you're using CB 2-way radio. And if you're in a heavy-CB-usage area, SSB really multiples the chance of getting through. It's added insurance when you need it. You can get immediate delivery on both these great Realistic® SSB sets. There's only one place you can find them . . . Radio Shack!

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BASE/MOBILE TRC-46

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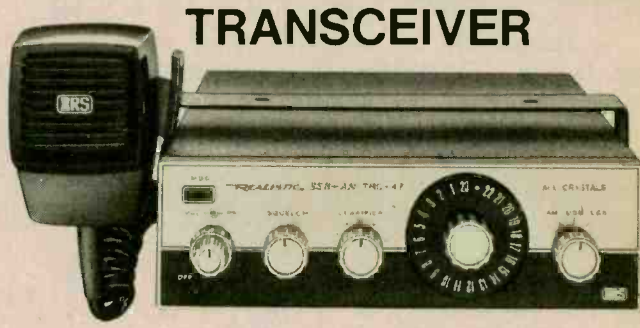

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CIRCLE 4 ON READER SERVICE COUPON

ASK HAND, HE KNOWS!

(Continued from page 19)

cent lamps add masking noise, as does rotating machinery. In fact, as I type this, the freight elevator is moving. It gives off a characteristic static profile over my transistor radio. You'll find that the performance improves considerably as the transistor radio is brought near a window.

Never Buy Toys for a Man's Job

My channel 14 walkie-talkie interferes on our television set, making it snowy. What could cause this?

—S. V., Squamish, BC.

Overmodulation is usually the reason, coupled with poor design. Your unit is generating harmonics, or just plain old noise, spilling past the channel limits and doubling, tripling up to higher and higher frequencies. I'm for reducing all Part 15 transceivers to Part 7.5—that's right, break them in half.

Find Out For Yourself

Would 8 size D or C, or perhaps AA cells be equivalent to a 12-volt car battery, or would the current be too low?

—J. S., Superior, WI

Connect an ordinary 12-volt car lamp to 8 D-cells connected in series and observe the strength of the lamp's light and how long the dry cells last. Imagine what oomph a car starter would need! By now you should have guessed that D-cells deliver a very small fraction of the total power of a car battery. Also, a car battery compared to an equivalent dry cell bank would be more efficient and much lighter. If you must gang up batteries, think of using motorcycle batteries—they're mini-car batteries and are rechargeable too!

Junior Junkman

Do you know of any place where I can obtain any Japanese electronic surplus equipment? An outfit in Japan, maybe? Hank, I am serious—no jokes, please!

—B. S., Oconto, WI

I'm not kidding when I say that the American marketplace is cluttered with Japanese junk right now. All those used and discarded amplifiers, radios, transceivers, etc., that were dumped as trade-ins for new goods are now on our side of the Pacific. Why look to import? Honestly, I don't know where you can turn to unless you advertise.

Play Ball

To record code on cassettes for practice purposes, I rigged my signal generator through a code key and into a cassette recorder. The hookup was made with ordinary zip-cord (which was all I had). After pounding way for awhile, I realized I had forgotten to turn on my generator. Just for the heck of it I played the tape back, but instead of the usual soft hissing of an erased tape, I heard a baseball game broadcast from radio station KRLD (1080) in Dallas! I repeated the procedure several times and each time I recorded the baseball game. The recorder had no built-in radio and there was no radio playing in the house. What caused this?

—H. J., Mesquite, TX

Your entire hookup external to the cassette served as an antenna picking up a strong local signal. Some non-linear element either in the external circuit or cassette player rectified the signal and filtered it into a recordable audio signal. This happens often in unshielded input circuits feeding high impedance inputs. Load down the input circuit with a 470-ohm resistor and see what happens.

Can You Help Out?

(Okay, boys, anyone wanting information from our readers can send me a brief note. *I mean keep it brief!* Space permitting, your request for help will be published in this column. Hank.)

●

▲ Hey, fellows, Dennis Sterns of Box 8, Energy, IL 62933 would like a copy of the Heath CB-1 CB transceiver manual. Can anyone help out?

●

▲ Can anyone near George C. Kenney, 85 Meridian Street, Bricktown, NJ 08723 fix his Polytronics-11 CB unit, or know of someone who can help?

●

▲ Randall Alnord wants the manual for his Midget Scope Model 533M. If anyone can help or tell him who the manufacturer is, write to him at 415 Walnut Street, Wiconisco, PA 17097.

●

▲ Who has information on an Aircraft Radio Transmitter, Type CCT-52209, 4 to 5.3 Mc, 28-volt DC, a unit of Model ATA Aircraft Radio Equipment manufactured by Stromberg-Carlson for the Navy? If it is you, John Goodnight, Rt. 4, Box 683, Kannapolis, NC 28081 would like to have it. He sends his thanks in advance.

●

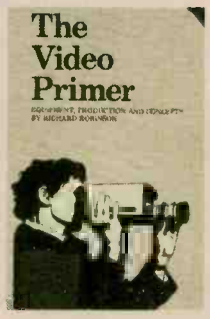
▲ If anyone has information on the Model RX-127 110-volt, 60-cycle, 30-watt "Rangexpander" made by TriTronic Industries of Cleveland, please send it to Joe Mortsea, Jr., 18 Grant Avenue, Carteret, NJ.

●

▲ Eric Scheffield would like to know where to obtain heavy-duty DC motors that are used in kids' electric riding cars. Write to 4600 Marshall Drive W., Binghamton, NY 13903. ■

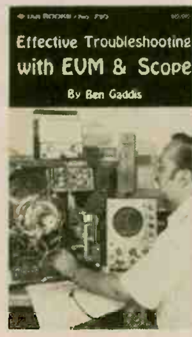
BOOKMARK
BY BOOKWORM

TV Home Style. Making your own television shows is easier, faster, and cheaper than making home movies. Richard Robinson proves this point in his new book, *The Video Primer: Equipment, Production, And Concepts*. Once you've purchased the equipment, it costs ten dollars to record a half hour of television—compared to three times that much for 8 mm film. With video you can immediately rewind the tape and play back what you've just recorded—sound and picture—through any TV set. This is essential to beginners and those already making tapes. To fill that need, the text presents video on a how-to-use-it, how-it-works, how-it-can-be-exploited level. Every chapter, from tape editing to lighting set-ups, explores an area which must be understood and appreciated in order to make the best possible video. The book also presents the information needed to deal with video as tactile technology. Fully illustrated, the book contains extensive appendices, including a glossary, an equipment buyer's guide, a selected bibliography, diagrams for setting up equipment, and sample production and shooting forms. For more information, write to Links Books, 33 West 60th Street, New York, NY 10023.



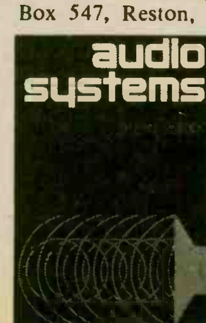
Soft cover
380 pages, $7.99

Tangoing Pair. *Effective Troubleshooting with EVM and Scope* by Ben Gaddis is the *one* book that shows how to become a whiz at troubleshooting almost any kind of electronic circuit using just two basic test instruments! Really makes it easy to understand the *two* most important electronic troubleshooting instruments. This complete course on the theory and operation of the scope and EVM will eliminate looking from one book to another for information on what these instruments can do and how to use them—singly or as a complementary pair! For years, the VOM and scope have been to the technician what the hammer and saw are to the carpenter—the basic tools of his trade. This book simplifies the theory and use of the versatile VOM, providing a framework for understanding the new electronic versions of the instrument—all kinds of EVMs: VTVMs, TVMs (transistor voltmeters), and FETVMs (field-effect transistor voltmeters). The complete theory of EVMs is provided to help the reader evaluate them and understand the measurements that can be made with them. Novice and pro alike will appreciate the big section on tested and proved time-saving troubleshooting techniques with the EVM, which shows the *logic* behind electronic troubleshooting and how the EVM fits in. Equally thorough coverage of the oscilloscope is provided. The scope gives both quantitative and *qualitative* indications. But understanding these requires a knowledge of how to interpret them. This book includes a wide range of waveforms that are thoroughly explained and illustrated. All kinds of waveforms from all kinds of equipment are covered, with special emphasis on TV waveforms, useful in trouble analysis. Here is a book that will *de-mystify* all the loops, waves, lines, and patterns of the scope screen. For more information and catalog, write to TAB Books, Blue Ridge Summit, PA 17214.



Soft cover
238 pages, $5.98

High on Fi! Every facet of audio systems has changed and become more sophisticated in the last five to ten years. The student studying audio systems will have an opportunity through a new book to begin a course of study with the most up-to-date material currently available. As you can guess, the title is *Audio Systems* and it's by Clyde N. Herrick. Audio Systems covers such new developments as quadraphonic sound, new or electronic music, the bipolar and field-effect transistor, the integrated circuit, and the light-dependent resistor. All types of sound systems—stereo components and public address, broadcasting, telephone, and theater systems—are covered, as well as electronic organs, carrier current systems, and new music. Published by Reston Company, Inc., Box 547, Reston, VA 22090.



Hard cover
274 pages, $14.95

(Continued on page 36)

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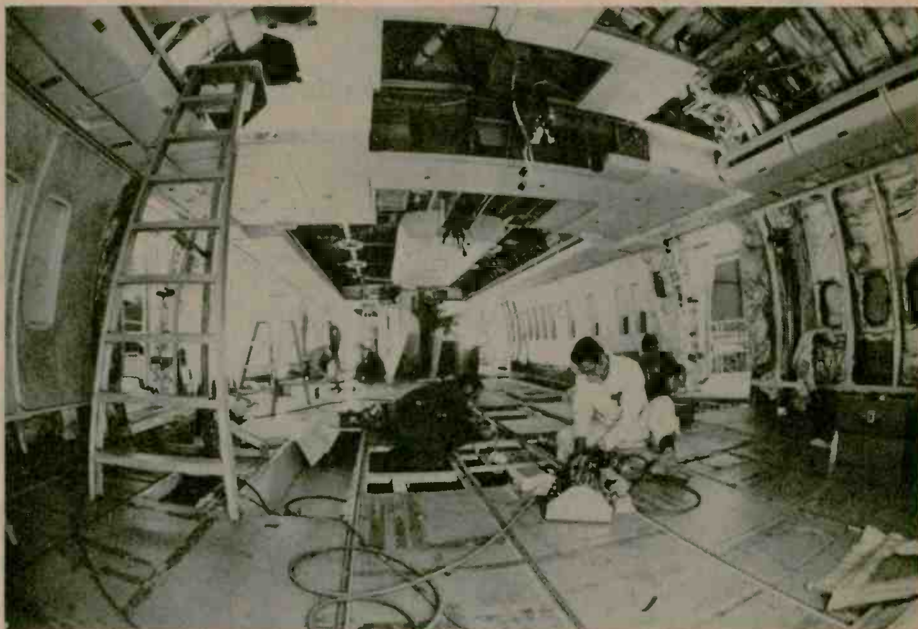
newscan

Electronics in the News!

Better Than New



Stripped cabin of a Boeing 747 resembles a tunnel as mechanics probe sub-surface areas of the aircraft. Some 300 technicians, plus a large number of support personnel, worked around the clock for eight days to make the 747 "better than new"!

A jumbo jet takes a jumbo-sized job to give it a heavy maintenance check. When a United Boeing 747 wide-body aircraft checked in at the airline's repair base at San Francisco International Airport, 300 technicians and a large number of support personnel were on hand to greet it. Crews then worked three shifts on a 24-hour day schedule and took 10 days and 19,000 man-hours to give the $23 million jetliner a thorough inspection and accomplish necessary repairs, scheduled modifications and a complete paint job.

This first 747 to undergo the heavy maintenance had 14,500 flying hours on its log when crews pulled it into the maintenance docks. The crews found nothing to write home to mother about, and that's good news. The structural inspection of the 747 (a 3,000-hour undertaking) showed surprisingly little wear and tear on the aircraft. Considering that the jetliner has been airborne the equivalent of a full year and a half, it's amazing that repair or replacement of parts was light.

There was only negligible corrosion on the fuselage skin, scuff marks on cabin walls, some popped rivets, and corrosion in the galley and lavatory areas of the cabin.

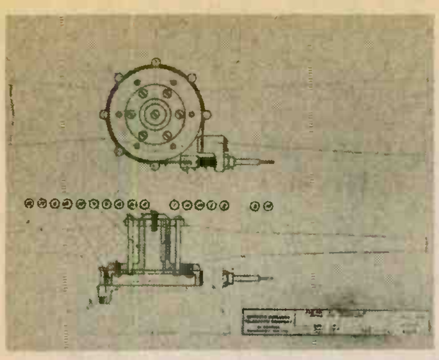
In addition to structural inspection, which involved removing bulkheads, floorboard and ceiling panels to gain access to vital lines and sub-surface components, the maintenance program included a thorough check of cockpit instruments, complete electronics checkout, replacement of landing gears, refurbishing of the cabin, and painting of United's new colors on the aircraft.

The preparation for the 747 visit paid off, and the aircraft was dismantled and put together on schedule. The plane has proved itself a good aircraft in its first years, and with the maintenance work done on it, it is going back to the line as an even better aircraft.

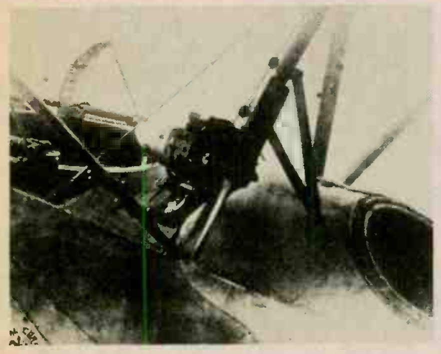
Prop Topic

Did you ever hear of an airplane with a combination radio transmitter and receiver which was powered by a windmill generator attached to the wing? Believe it or not, such a device was designed in 1917 and used by American flying squadrons in France during World War I. This unusual communications unit is only one of the little-known facts about the early days of radio which was recently revealed in a pile of old drawings that have been acquired by RCA from an antique dealer in Somerset, NJ. These illustrations were part of the original engineering and manufacturing files of the Marconi Wireless Telegraph Company of America which was formed in 1899 and chartered by the State of New Jersey. Shortly after RCA was formed in 1919, the corporation took over the entire business and assets of the American Marconi Company.

A 1917 drawing by one of Marconi's associates details specifications for an early airplane radio transmitter-receiver. The most unusual aspect of this two-way unit was that the engineer designed it to be



In the days when World War I ace Eddie Rickenbacker flew the skies over France, this windmill gadget was used to power the radios of military planes.



powered by a wing-mounted, wind-driven generator. It seems that even fifty-nine years ago radio pioneers were exercising their ingenuity in finding appropriate energy sources for specific applications.

Stick It in Your Ear

School teachers have it easy compared to some industrial workers in Buffalo. The screech of chalk against blackboard is short in time and intensity whereas in industry it's long and too loud. As a matter of fact, at Western Electric's Buffalo Works, some very big and noisy machines draw copper wire to smaller diameters than human hairs and the people who work near these machines must be protected from their sounds. All in all, including workers in wire-drawing and other operations, some 1,000 Buffalo Works people need to cover their ears to protect their hearing while they work.

Until recently, noise reduction, or "attenuation" as it's called in the trade, was provided through company-supplied ear plugs or ear muffs. Although both protective devices afforded workers adequate protection from noise, industrial hygiene engineers were always looking for a way to improve their fit and wearability. Supervisors charged with the responsibility of seeing that workers wear hearing protection found that the plugs were difficult to see, and sometimes workers found the muffs uncomfortable.

Then, industrial hygiene engineer Jack Murray, who specializes in noise attenuation at Buffalo, came across a new ear protection device. Manufactured by various suppliers, the new gadget can best be described as a customized ear plug. It fits into the ear, where it blocks the hearing canal, but the most important thing about it is that it is individually fitted to the wearer.

When purchased by Western Electric for its employees, the new ear protector is a silicone putty. People trained by the manufacturer fit the putty into the ear, molding it to the exact contours of each ear for a precise, tight, comfortable fit. The device hardens into a durable rubber, held securely in place by the structure of the external ear. The workers have been enthusiastic about the new device. Most find it comfortable and effective. The supervisors, too, are enthusiastic, since it is easy to spot whether a worker is wearing the plugs, since color-coded nobs—red for right ear, blue for left—extend far enough to be easily seen.

It may not look like it, but both of these Western Electric Buffalo Works employees are protected from the noise made by the wire-drawing machines shown. Ray Was, in the foreground, is wearing the old style ear muffs that employees used to need, while Frank Wasko's hearing is protected by new custom-fitted ear plugs.

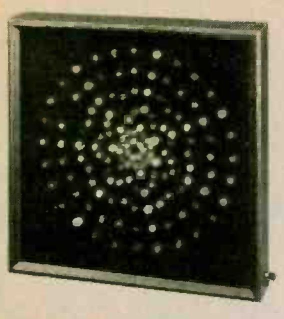
Another advantage of the new device is that, while providing excellent noise protection, it allows the wearer to hear normal sounds, like conversation or warning signals, *better* than the older style ear muffs or plugs.

Stick the Utility

You can keep your cool and conserve energy when electricity consumption on campus is being checked and controlled as regularly as are books in the college libraries. Richland and Mountain View Colleges monitor the power demands of 40 pieces of air circulation equipment once every minute with the help of IBM's System/7 computer. When the comfort of students and others won't be affected, the computer shuts down some of the equipment in sections of the buildings for short periods of time. Although still in the testing stages, the computer application technique appears to be reducing consumption of electrical energy by 10 percent at the two campuses. As control strategies and computer programs are developed further, these power

(Continued on page 34)

exciting new projects for '75



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Kit TD-1006 ....79.95*

NEW Portable Digital Multimeter

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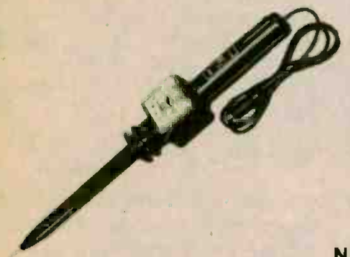
NEW DC-10MHz Oscilloscope

A great scope — a great value! Perfect for TV servicing. 10 mV vertical input sensitivity, time bases from 200 ms/cm to 200 ns/cm, internal or external digital triggering, two input channels. Mu-metal shielded tube with 8x10 cm graticule.

Kit IO-4530 ....299.95*



NEW 40 kV Metered Probe

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Kit IM-5210 ....17.95*
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NEW Emergency Car Strobe Light

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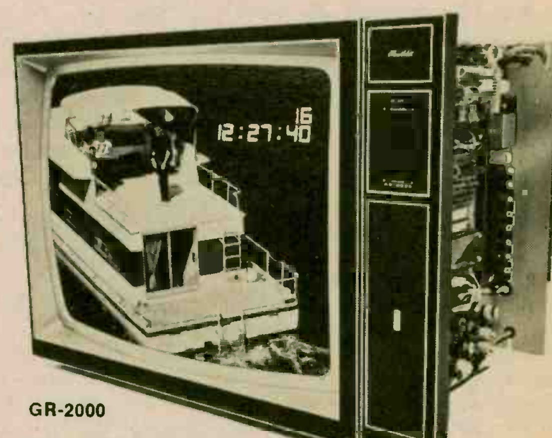
Kit GR-400 (17" diag.), with cabinet 489.95*
Kit GR-500 (19" diag.), less cabinet 499.95*
Kit GRA-2000-1, Digital Clock Module 29.95*



GR-2000

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Highly Acclaimed GR-2000 Digital-Design Color TV

The set that brought TV into the digital age — and still one of the finest made. Tuning is totally digital solid-state & the channel number appears right on the big, 25" (diagonal) screen. The optional clock module also displays the time on the screen. For the ultimate in convenience, add the optional wireless remote control. Can be custom mounted; optional cabinets start at $119.95*.

Kit GR-2000, less cabinet 669.95*
Kit GRA-2000-1, Digital Clock Module 29.95*

NEWSCAN

(Continued from page 29)

Anthony Schilling, of the physical plant staff at Richland College in Dallas, checks the status of an IBM computer that's helping conserve electricity on the campus. The System/7 monitors the power demands of 21 pieces of air circulation equipment every minute and shuts down some of the equipment in sections of the buildings for short periods of time when the comfort of students and others won't be affected.

reductions will approach 15 percent. Convert this percentage savings to your electric bill and you'll enjoy many more six-packs this summer.

The energy-saving control strategy is geared to a 15-minute consumption and peak demand interval. Utility companies use the peak demand achieved during that interval and the total consumption in kilowatt hours to determine rates for commercial customers.

The System/7's are programmed to anticipate a certain peak and then set a target level of consumption not to be exceeded during 15-minute periods. Consumption demand is controlled by shutting equipment off for brief intervals. The status of all controlled equipment is checked once a minute. A printout of target and actual values is available at predetermined intervals, providing guidelines for the development of more efficient operational procedures. What this means is that the schools are putting it to the utilities by working wisely within the billing rules. In time, the utilities will find a new set of rules to kill the advantage. But then, some Prof in the Accounting Department will come up with a new computer program. We're betting on the collegians.

(Continued on page 36)

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BOOKMARK

(Continued from page 26)

Review Briefs

• *Solid State Devices and Applications* by Frederick F. Driscoll & Robert F. Coughlin, published by Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; hard cover, 475 pages, $15.50: a college level text for the solid state experimenter who would like to learn by building and studying.

• *Diode Applications* by Courtney Hall, published by Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46268; soft cover, 95 pages, $3.50: many applications of diodes explained for the experimenter who wants to know.

• *RF & Digital Test Equipment You Can Build* edited by Wayne Green, published by TAB Books, Blue Ridge Summit, PA 17214; soft cover, 252 pages, $5.95: a collection of technical construction articles by qualified authors.

• *Solid State Ignition Systems* by R. F. Graf and G. J. Whalen, published by Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46268; soft cover, 136 pages, $4.50: a valuable book for the car owner who wants to install and service an electronic ignition system in his car. ■

NEWSCAN

(Continued from page 34)

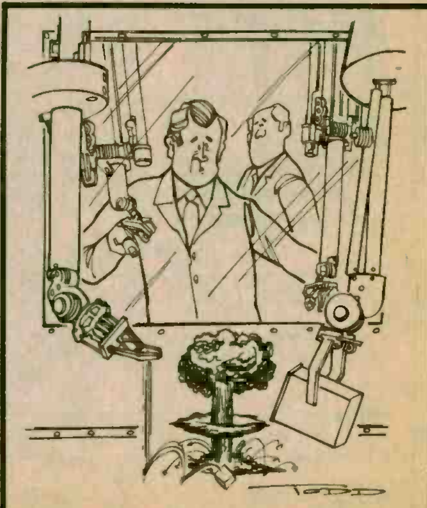
Air Cleaners Get Big

Production of electronic air cleaners, which can remove up to 95% of dirt, pollen, smoke and grime from indoor air, is expected to pass an annual rate of 200,000 in 1975. This forecast comes from the Air Conditioning and Refrigeration Institute (ARI). The more than 40 companies manufacturing electronic air cleaners for home and business have produced one million electronic air cleaners since the concept was introduced some 40 years ago.

Public concern over clean air is no longer limited to pollution control devices required by law on automobiles, industrial plants and power-generating stations. People are installing electronic air cleaners in their homes or specifying them in new houses. Many builders offer them as standard equipment.

Operators of restaurants, cocktail lounges, bowling alleys and other businesses serving the public are using electronic air cleaners to reduce the amount of outdoor air used for ventilation by cleaning cooking grease, tobacco smoke and other contaminants from the air. Electronic air cleaners can be installed in the air conditioning ducts of homes and businesses. Small console units with a built-in blower provide individual-room air cleaning for residences, and ceiling-mounted models are available for larger rooms in businesses serving the public.

Electronic air cleaners are "electrostatic precipitators" similar in concept to the precipitators used on power-plant smoke stacks. An electronic cell, installed in the air conditioning ducts, puts an intense electrical charge on dirt particles in the entering air. An electrostatic collector attracts the charged dirt particles, some invisible to the naked eye, from the air. The collected dirt and grime is periodically removed by washing the cell in a detergent solution. This can be done in a wash tub or dishwasher, or with a wash cycle available as a built-in option on cleaners. ■



"Good grief! I'm all thumbs today."

DX Central Reporting

(Continued from page 14)

Monahan on listenership, suggest shortwave may also be affected eventually . . . perhaps even the venerable and heretofore sacrosanct English language World Service.

The British and German situations place a big question mark on the previously announced joint project to build a powerful relay station on the West Indian island of Antigua to serve the western hemisphere.

In France, once a major power in international broadcasting but in '74 ranked 22nd in the world in terms of broadcast hours, the picture is even bleaker.

The overall picture is altered. The government's Office de Radiodiffusion-Television Française is gone, replaced by a new Société Nationale de Radiodiffusion and a shrunken broadcast service known as Radio France.

Full details aren't known but SNR's president, Mme. Jacqueline Baudrier, says changes may take up to two years to effect. One report out of France suggests that, of the SW services, perhaps only one abbreviated relay of French language home service will be retained on shortwave.

And finally, in Italy four coalition political parties have agreed upon a draft decree "reforming" the national radio and television services. What this means is uncertain, but in political jargon "reform" rarely means "expansion."

I'm Andy Johns and I live in Tyler, Texas. I'm 14 years old and have been a DXer and SWL for about a year. My receiver is a Realistic DX-160 and numbered among my radio conquests are Radio Voice of the Gospel, Addis Ababa, Ethiopia, and the Voice of Chile, Santiago, Chile.

Tip Topper. Belgium is one European nation that bit the bullet and cut back shortwave programming a number of years ago.

Belgium cannot really be considered a major European broadcaster, but although it maintains a fairly low SW broadcast profile, its future seems quite stable. Today, *Radio TV Belge* has two English language periods per day, 40 minutes in all.

The English program, "Belgium Speaking," featuring a press review, mailbag and, every fourth Monday, a DX Corner segment, is beamed to North America from 2255 to 2315 GMT and 0040 to 0100 GMT on 6,055 and 9,655 kHz. The same program goes out on 11,855 kHz; to South America during the earlier time slot, to the Far East at 0040 GMT. ■

Hey, Look Me Over

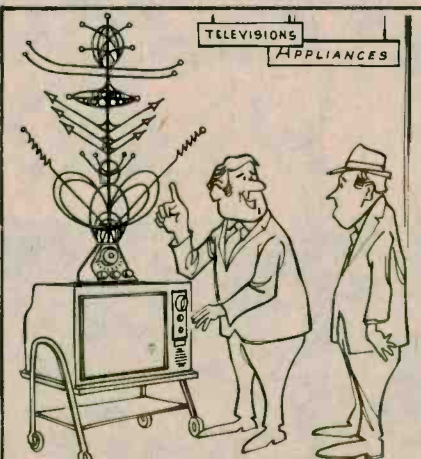
(Continued from page 14)

Super Glue Solvent

Now users of the one-ton-hold super glues can un-glue their mistakes and easily get their fingers un-stuck. A solvent now available from Edmund Scientific Co. quickly and safely releases the hold of super glue. It is safe for external use on human skin, even eyelids. Among its many uses are "un-gluing" parts that have been incorrectly bonded or that simply need re-alignment, as well as removal of excess glue from completed projects. A safety must if you're working with super glues, Edmund's solvent will release such products' possible bonding effects on skin, clothing, tools, and instruments. The solvent comes in a handy one-ounce bottle—$4.25 postpaid.

CIRCLE 71 ON READER SERVICE COUPON

It is available by mail from Edmund Scientific Co., 380 Edscorp Bldg., Barrington, NJ 08007. By the way, if you haven't worked with super glues, Edmund offers a clear product. One drop of Edmund's Super Glue holds a ton, literally. Its hundreds of bonding uses include assembly and repair of rubber, plastic, wood; affixing metal parts to glass; fixing parts for riveting. With it, you can mend china, bond silicone chips to ceramics, and much more. Edmund's Super Glue (1-oz. bottle, $7.55 postpaid) is impervious to most chemicals. ■



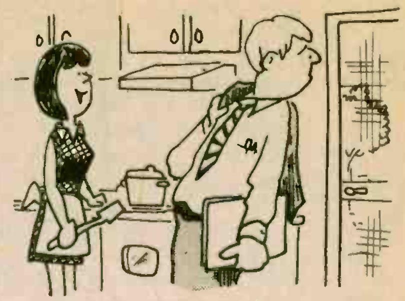
". . . and by using this indoor element, you're able to do away with those unsightly old rooftop jobs the wind blows down."

A BIT FAR OUT

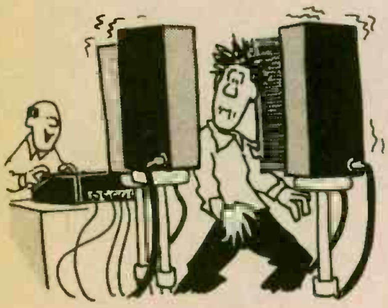
by Jack Schmidt

"What I'll never understand is why a man who can measure the speed of light can't be on time for supper!"

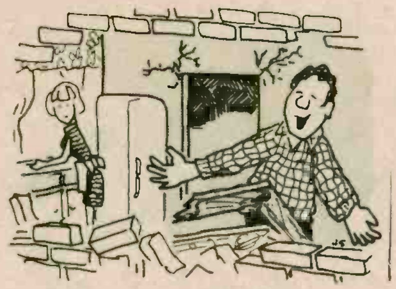
"This continually running meter analyzes diodes, resistance, transistors, frequency and the number of payments remaining."



"The kids are having so much fun in the pool . . . they're using your two-meter parabolic reflector for a raft!"



". . . doesn't that sound like you're the conductor right up there on the podium?"



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". . . and stop wasting your time broadcasting homing beacons into space!"

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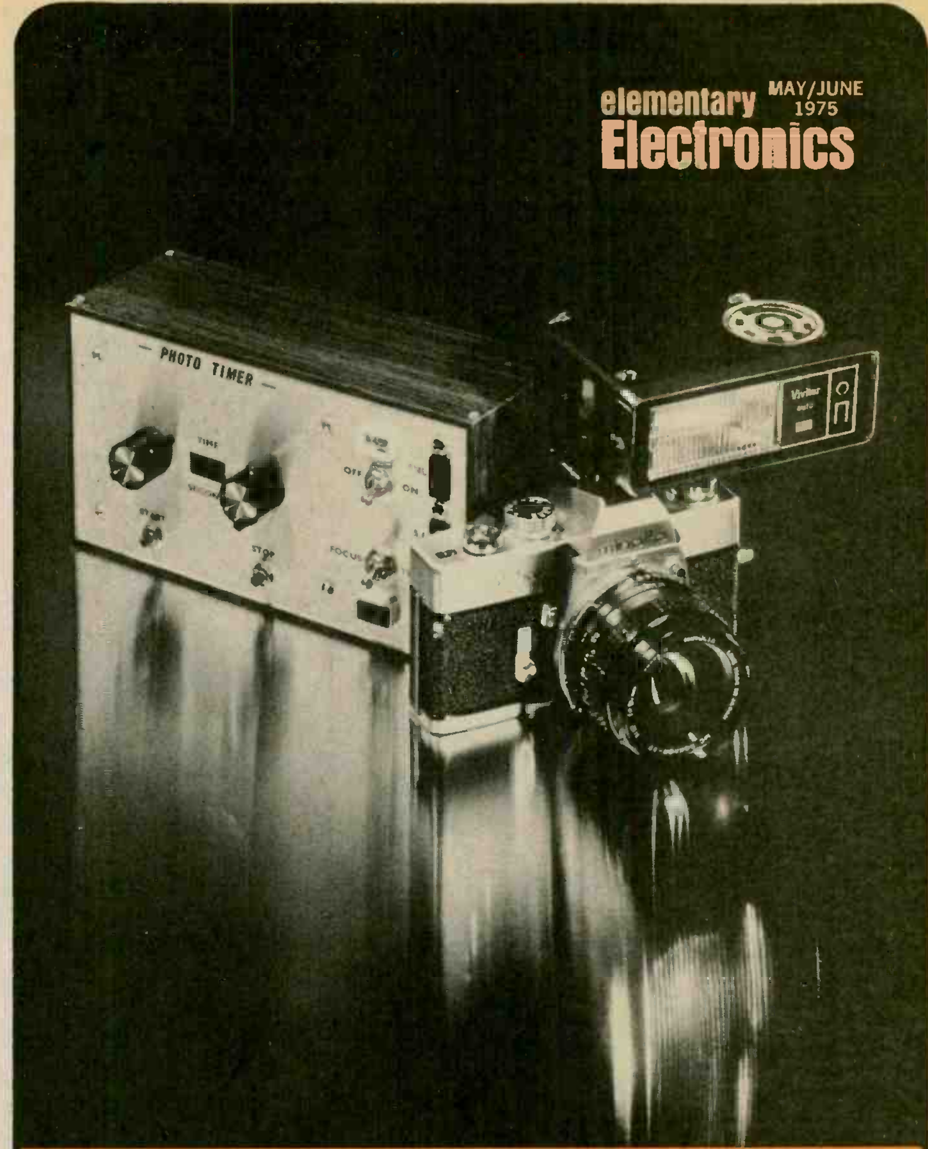


PHOTO TIMER

Designed for your creative difference by a darkroom craftsman. This precision tool does everything but turn off the lights!

by Adolph A. Mangieri

FEATURING illuminated digit-set dials, automatic reset, and safelight control, the PHOTO TIMER eliminates error-prone juggling of room light, safelight, and timer switches and dials. You can set the timer in complete darkness and you can be sure the safelight was off when you used your enlarger printmeter. The large easily-read dial indications make the timer a joy to use. The timer also includes push-to-start and push-to-stop buttons.

Using the 555 precision IC timer, the timer circuit is not affected by line voltage changes. Timing is adjustable from 1 to 119 seconds in one-second steps. Accuracy and repeatability depend only on the accuracy of the timing resistors and quality of the timing capacitor. The PHOTO TIMER is easily constructed at low cost.

Circuit Operation. The schematic diagram shows a 555 precision timer connected as a one-shot timer with automatic reset. The timing interval is determined by timing capacitor C1 and by timing resistors selected by switches S1 and S2. Assuming pin 5 of IC1 is disconnected from calibration pot R9, the time interval T (seconds) equals 1.1 times R (megohms) times C (microfarads). Timer-output at pin 3 controls both normally-off load relay K1 and normally-on load R6. If one load is de-energized, the other is energized and vice-versa.

With C1 initially held discharged by IC1, timing commences when start button S4 is depressed causing a triggering pulse at trigger pin 2. The relay closes instantly and C1 begins to charge through the timing resistor. When the voltage of C1 rises to two-thirds of the DC supply voltage, IC circuits are activated causing the relay to open and C1 to discharge completing the cycle with automatic reset. A timing cycle in progress may be terminated by depressing stop button S3.

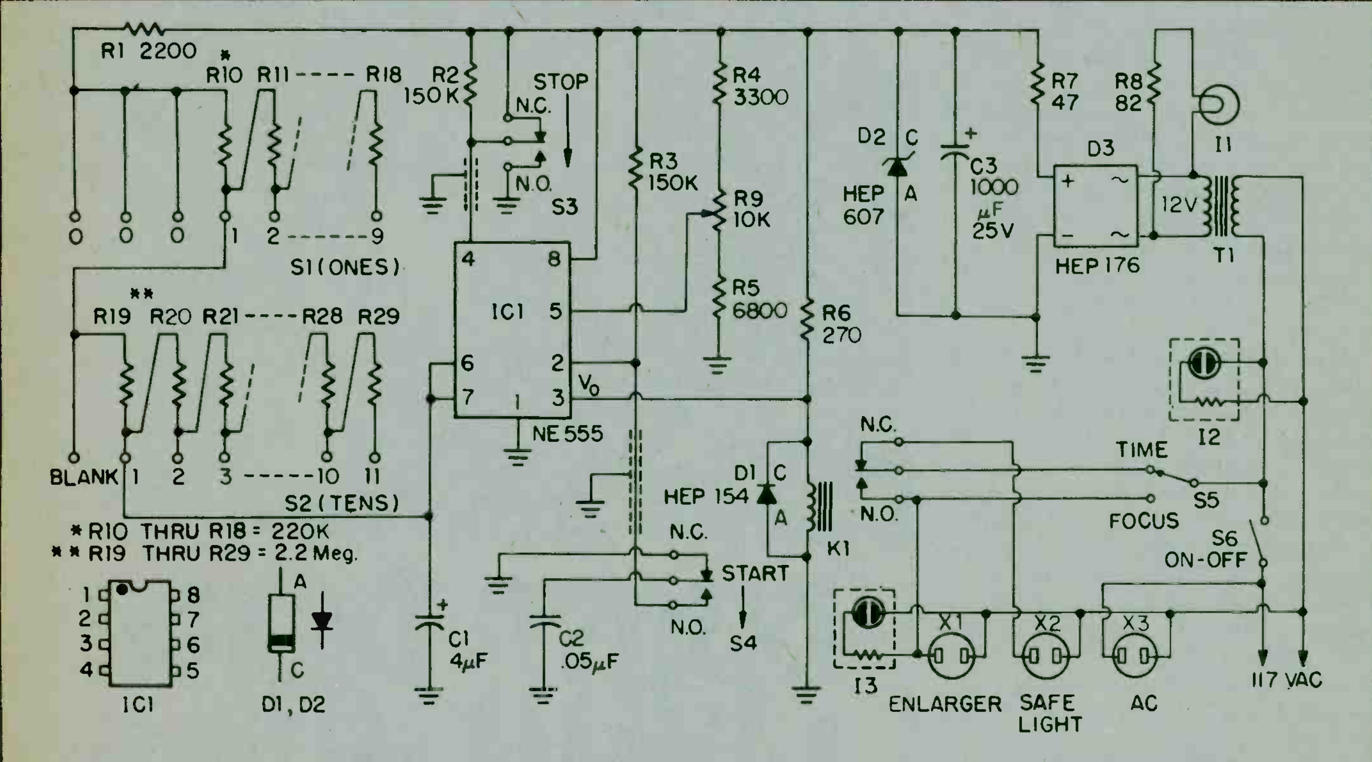
Calibration pot R9 varies the timing control voltage at pin 5 accounting for tolerances of timing capacitor C1. Provided with both normally-on and normally-off loads, the IC circuit draws a fixed load current from the power supply. Resister R7 sets the DC supply voltage to about thirteen volts. Voltage clamp zener diode D2 limits the supply voltage to safe values if the supply voltage should rise. Timing is not affected by changes in supply voltage. Rectifier diode D1 eliminates voltage spikes at K1 which would re-cycle the timer.

Construction. Build the PHOTO TIMER in a 9 x 5 x 3 in. metal cabinet. Begin construction by cutting out two 2½ in. dial discs from 1/16 in. thick red or white transluscent plastic. The discs are easily cut using a holesaw. Chuck the discs in a mandrel and true up the edges. Ream the center hole to clear the shafts of switches S1 and S2. Drill through a pair of small panel knobs and cement a knob to each disc using epoxy cement.

Drill suitably spaced (one disc diameter) slightly undersize holes in the panel and ream for a close fit for the shafts of the switches. Cut the perforated board to size and drill four holes for 6-32 x 2 in. spacer bolts which support the board behind the panel. Drill four matching holes in the panel, bolt the board directly against the panel, and locate and machine holes in the board to accept the switches. Cut out a ⅜ by ¾ in. window in the panel midway between the switch shaft holes. Complete machining of the panel and apply panel labelling and a clear protective coating.

Install switches S1 and S2 on the board, dial discs on the switch shafts, and trial mount the assembly on the panel. The dial discs should rotate with little wobble and no contact with the panel. If needed, enlarge a switch hole on the board to correct any disc tilt by shifting the switch slightly. Remove the circuit board assembly from the panel and affix the discs at the top end of the shafts. This simplifies application of dry transfer numerals at the edges of the discs while using the switches to index the disc for each position. Label the "ones" dial with three zeros and 1 through 9. Label the "tens" dial 1 through 11 leaving a blank space. You can remount the assembly on the panel and check and correct any badly aligned numerals.

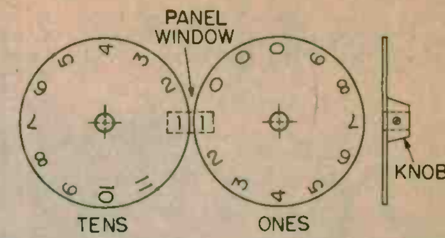
Using 1/16 in. aluminum, make the compartment partition supporting trans-



PARTS LIST FOR PHOTO TIMER

C1—4 uF, mylar capacitor, 50 VDC (Cornell Dublier WMF or similar)
C2—0.05 uF, capacitor, 100 VDC or better (Radio Shack 272-1086 or equiv.)
C3—1000 uF, electrolytic capacitor, 35 VDC or better (Radio Shack 272-1032 or equiv.)
D1—1 amp, 50 volt silicon rectifier (HEP 154) (Radio Shack 276-1101 or equiv.)
D2—15 volt, 1 watt zener diode (HEP 607) (Radio Shack 276-564 or equiv.)
D3—1 amp, 50 volt bridge rectifier (Radio Shack 276-1151 or equiv.)
I1—see R8 note or #47 panel lamp (Radio Shack 272-1110 or equiv.)
I2, I3—neon panel lamps such as Radio Shack 272-328
IC1—555-type integrated circuit (Radio Shack 276-1723 or equiv.)
K1—dpdt relay, 12-volt DC, 3-amp contacts, coil resistance 350 ohms, coil current 50 mA. (Radio Shack 275-206 or equiv.)
R1—2200-ohm ½-watt resistor (Radio Shack 271-000 or equiv.)
R2, R3—150,000-ohm, ½-watt reistor (Radio Shack 271-000 or equiv.)
R4—3300-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R5—6800-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R6—270-ohm, 1-watt resistor (Radio Shack 271-000 or equiv.)
R7—47-ohm, 1-watt resistor (Radio Shack 271-000 or equiv.)
R8—82-ohm, 3-watt ww resistor. Note—delete if 14 volt lamp such as #53 is substituted for I1.
R9—10,000-ohm trimpot (Radio Shack 271-218 or equiv.)
R10 to R18—220,000-ohm, ½-watt resistors, 5% or better
R19 to R29—2.2-megohm, ½-watt resistors, 5% or better
S1, S2—single-pole, 12-position switch, shorting type (Radio Shack 275-1385 or equiv.)
S3, S4—spdt momentary pushbutton
S5—spdt toggle switch (*FOCUS/TIME*) (Radio Shack 275-603 or equiv.)
S6—spst toggle switch to match S5 (ON-OFF)
T1—miniature transformer, 12-volts, 300-mA (Radio Shack 273-1385 or equiv.)
X1, X2, X3—AC chassis receptacles (Radio Shack 270-642 or equiv.)
Misc.—panel knobs, case 8½ x 4½ x 3-in. (Vector W30-86-46), perf board, push-in terminals; translucent plastic sheet 1/16-in. thick for dial, small knobs, line cord, IC socket, spacer bolts (4), wire, solder, etc.

IC-design photo timer features backlighted digit-set dials, pushbutton start and stop buttons, and safelight control. Modern circuitry provides high accuracy and repeatability over the 1 to 119 second timing range. Home darkroom using our photo timer is equipped with Omega B color enlarger.



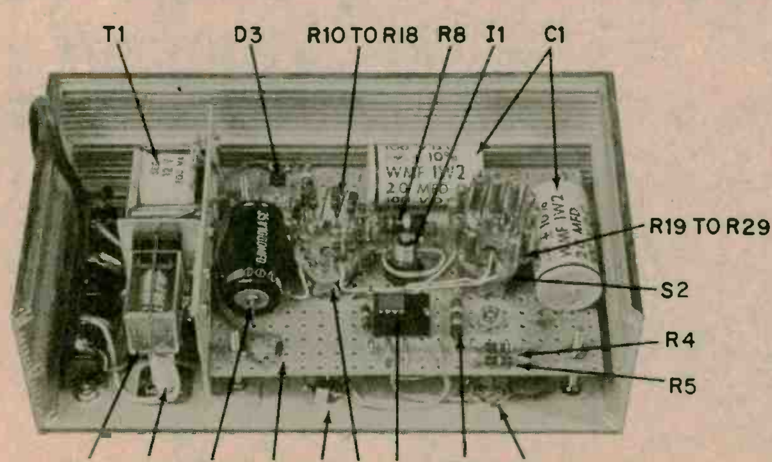
Digit-set discs can be made at home from a plastic sheet. Press-type numerals can be used for neat job after cutting out the discs if you draw a temporary base line for each double digit and use it to align numbers.

former T1 and relay K1. The partition is secured by two of the spacer bolts. Cut out a portion of the flange of the partition to avoid interference with the "ones" dial disc. Make a bracket to accept the socket of K1 and affix to the partition. Wire the AC sockets, neon panel lamps (supplied with external voltage dropping resistors), and toggle switches before installing T1 and K1. Wire the normally open poles of the DPDT relay in parallel to double the current rating.

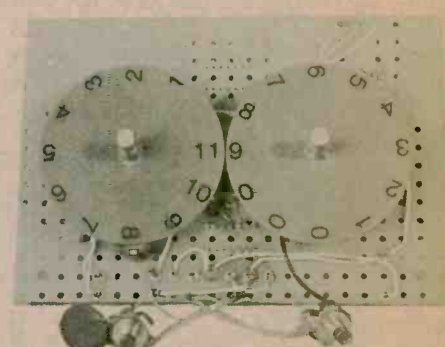
Install a large rubber grommet on the circuit board directly behind the panel window to accept panel lamp I1. Tint the lamp with red transparent lacquer. Complete wiring of the board using a socket for IC1. Carefully observe polarities of D1, D2, and C3. Use shielded wire for connections to pushbuttons S3 and S4. Install resistors R10 through R29 directly on the switches. It's usually a simple operation to defeat the switch detent stops on S1 and S2 allowing continuous rotation of the dials. Set the switches to pick up R10 and R19 and position and secure the dial discs for 11 seconds readout.

Capacitor C1 should be a mylar, polycarbonate, or polystyrene low-leakage, low-loss type. C1 was made up by connecting two 2 *u*F capacitors in parallel but you can use a single 4 *u*F capacitor. You can use a 5 *u*F capacitor by changing R10 through R18 to 180,000 ohms and R19 through R29 to 1.8 megohms.

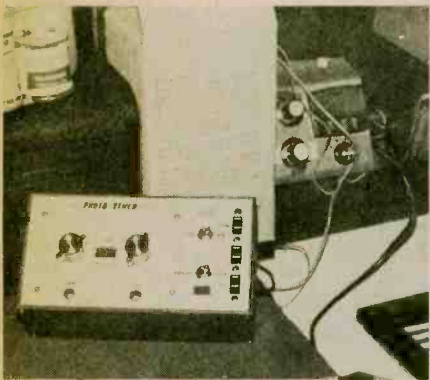
Checkout And Calibration. Using a VOM, verify the presence of approximately thirteen volts DC across C1, about fifty milliamperes current in R7, and about five volts AC across lamp I1. If you have substituted for T1, it may be necessary to resize R7 and R8 accordingly. To calibrate the PHOTO TIMER, plug a sweep second electric clock into socket X1. Turn S6 on and set S5 to time. Set the dials for fifteen seconds. Depress start button S4 and observe elapsed time on the clock. By trial settings, set R9 so that the clock runs for fifteen seconds. Next, set the dials for 119 seconds and observe elapsed time. If you have used high quality capacitors for C1 the interval should check close to 119 seconds with



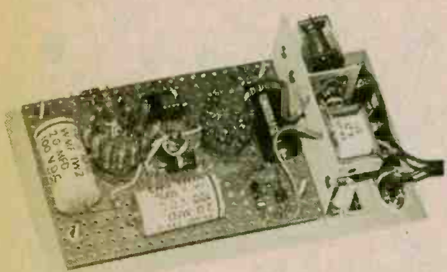
Major parts layout showing author's use of two 2-uF caps in parallel for C1.



Dial discs are labeled 0 to 9 (units) and 1 to 11 (tens) with discs positioned at top of switch shafts while using the switches to index the discs. Illustration shows 119 seconds. This system allows resetting to the exact time within the resolution and accuracy of the system's electronic timer.



Our amateur home darkroom includes the e/e Color Analyzer featured in the Sept.-Oct. '74 issue. It's located in the background to the right of the dry chemical (fixer) box.



Line (117 VAC) circuits and relay are placed at left side of the partition. Heavy-weight perforated board supports rotary switches S1 and S2. Timing resistors mount on switches.

some allowance for inaccuracy of timing resistors.

Put It To Work. Plug the enlarger into socket X1 and safelight into socket X2. Plug the enlarger exposure meter into socket X3. Set S5 to Focus when focusing or using the exposure meter. The safelight will now be off as is required for use with any enlarger exposure meter. To expose the print to the set time interval, switch S5 to Time and depress the start button S4. During exposure, the safelight will be off but will return automatically upon completion of the exposure. Panel lamp I3 will be on during the exposure interval. If you have inadvertently overlooked setting of the timer or lens opening and have initiated the exposure, you can terminate the exposure with return of safelights by depressing stop button S3.

By the way, photo fans, check out our B&W photo print analyzer coming soon in a future issue of e/e. It's the complement to our very popular "Darkroom Color Analyzer" project in the September-October 1974 issue of e/e. ■

DICKEY FLASHER

Cut through the party's gloom with flashing studs

by John E. Portune, WB6ZCT

Dickey Flasher is a real party stopper that will literally get you switched on—sequentially flashing neon shirt buttons or tuxedo studs. Dickey Flasher is inexpensive, easy to build and a real conversation starter for light social situations. Slip your hand into your pocket, turn on the switch and your shirt front begins flashing like a neon sign.

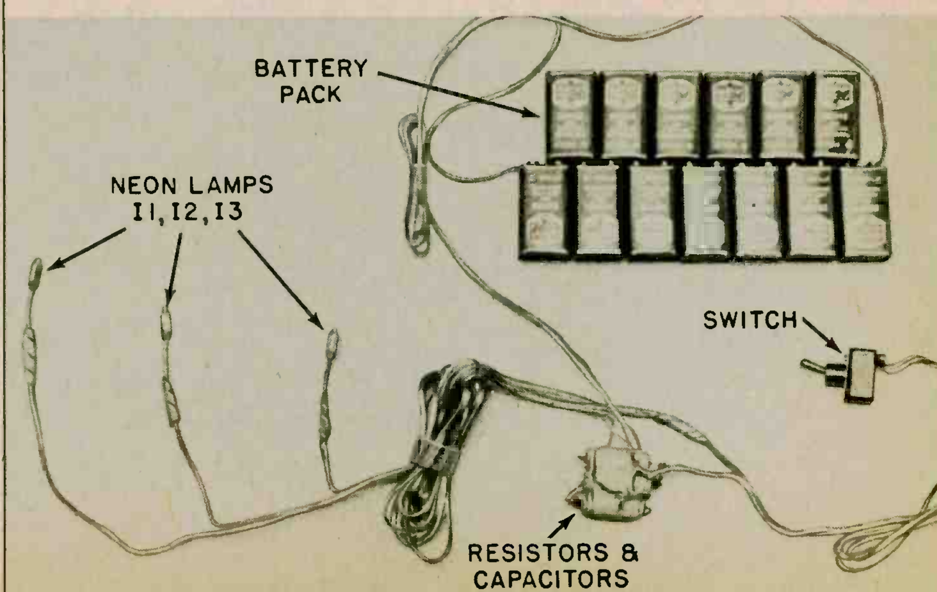
The circuit is a multi-neon-bulb version of the well-known simple neon relaxation oscillator. Less battery, the parts cost about two dollars. More commonly, one sees the circuit built as an amusing display novelty. The current drain is so low (about 200 microamps) that a small B battery will keep Dickey Flasher going continuously for months.

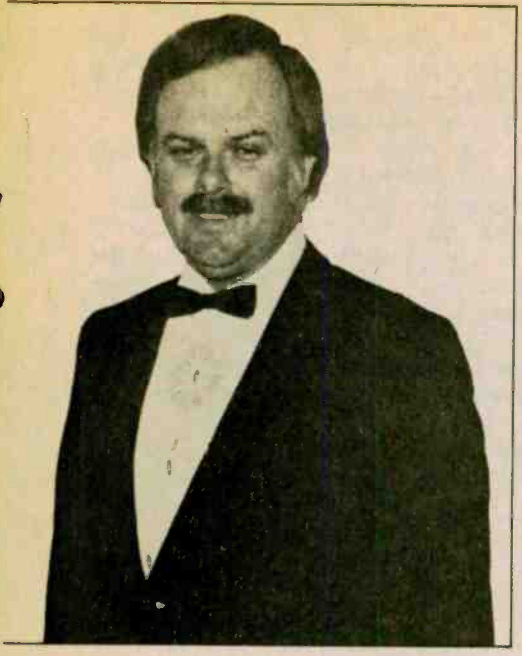
How It Works. Let's begin with the one bulb flasher as shown in the diagram. When switch S1 is closed, current flows through resistor R1 and begins to charge capacitor C1. The value of the resistor and capacitor determines the flash rate—0.5 megohms and 0.5 microfarads will give a flash rate of about 1 second. A lower value of either will make the unit flash faster.

But at the moment current begins to flow, the neon gas is effectively not in the circuit. A non-conducting neon is virtually an open circuit. When, however, the charge on the capacitor reaches the firing voltage of the neon (typically 60-70 volts) the neon fires, producing light, and becomes a short circuit. This quickly discharges capacitor C1 and extinguishes the neon lamp. The process then begins all over again with the charging of C1.

In the schematic drawing of the multi-bulb version of Dickey Flasher, the

Assembling Dickey Flasher is like wiring up a rat's nest. Actually, it is more a wiring harness than a boxed project simply because it is made to fit under clothing without the integral parts, except neon bulbs, exposed. Insulate all electrical connections against body perspiration. And make the cables long enough only to reach where they must go without too much extra length which may annoy the wearer.





action is basically the same. The only difference is that now there are several resistor-bulb legs connected in parallel across the battery, and the capacitors are connected in a ring between the legs. This succeeds in causing the charge-discharge process to transfer from leg to leg sequentially. More than three may be used; the number was chosen to replace the number of studs on a formal evening shirt or dickey for other occasions and situations it is possible to make five or more neon lamps fire in sequence.

Putting It All On. In making Dickey Flasher portable and concealable in one's clothing, the battery presents the biggest problem. NE-2 neon lamps require a minimum of about 80 volts DC to fire. A small 90-volt B battery, or two 45-volt units will work fine. But they are usually too thick and bulky to carry easily in one's pocket. To overcome this, a battery pack of ten or more common small 9-volt transistor radio batteries are snapped together in series using their own terminals back-to-back as connectors. (Incidentally this is not a bad way to replace hard-to-get B batteries in older tube-type portable electronic equipment.)

Taped together, the battery pack retains considerable flexibility and is slim; both are handy features if you have to sit down for a couple of hours during an evening. The cheapest 9-volt batteries you can find are quite satisfactory, the current drain is so low.

Group the capacitors and resistors together, soldering the leads directly and using tape to insulate everything. Connect the neon bulbs, the battery pack and the switch to this RC unit by appropriate length pieces of light, two-conductor speaker wire. In wearing Dickey Flasher, the batteries go in the right rear pocket, the capacitors and resistors in the left rear, the switch in the left front and the neons are pushed through the button holes. Another version of the flasher the author enjoyed had five bulbs built into a hat along with the resistors and capacitors. The battery and switch remained in pockets. Everything should be covered with tape; masking tape is the least expensive. Try to keep wires away from parts of the body where you perspire.

Getting the Most Laughs. Experience has shown that it is best from the point of view of entertainment not to let the bulbs flash all the time. Rather, arrive at the party with Dickey Flasher switched off. Then during conversation, quietly slip your hand into your pocket and turn on the lights without any outward show. You'll find that the reactions will be spectacular. Some will instantly dissolve in laughter, others will go blank not believing their eyes, and a few will try to ignore you. (The last group is the funniest!)

But no matter how and when you use Dickey Flasher you'll find this little group of lights well worth the small investment in sheer entertainment. ■

PARTS LIST FOR DICKEY FLASHER

B1—90 VDC battery made from 10 9-volt transistor batteries (Radio Shack 23-464 or equiv.)

C1, C2, C3—0.47 uF, 200-WVDC capacitor—printed circuit types are flattest (Radio Shack 272-1071 or equiv.)

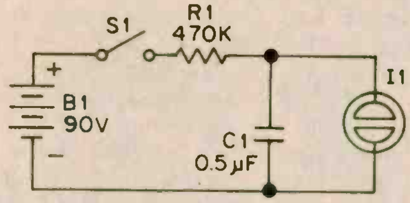
I1, I2, I3— NE-2 neon lamp (Radio Shack 272-1101 or equiv.) NE-2H (Radio Shack 272-1102 or equiv.) may be substituted for higher brightness provided B1 uses 13 9-volt batteries because of higher bulb firing voltage.

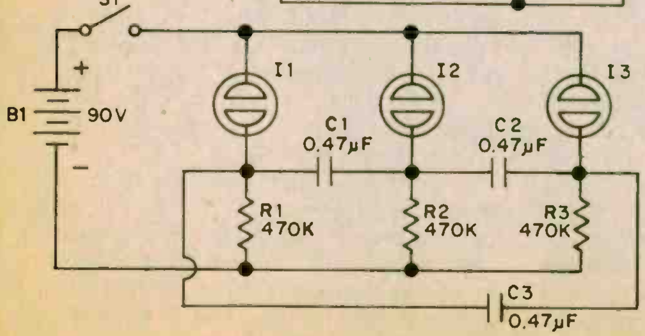
R1, R2, R3—470,000-ohm, 1/2 or 1/4-watt resistor (Radio Shack 271-000 series or equiv.)

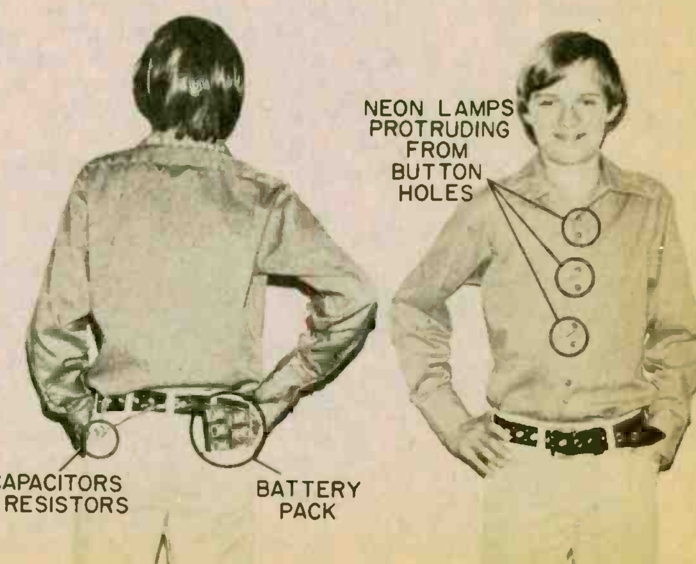
S1—On-off toggle, slide, or rocker switch, miniature types preferred (Radio Shack 275-603, 275-401 or 275-611 or equiv.)

Misc.—Wire, solder, masking tape, etc.

Below is a photo of the author's son wired and ready for fun with Dickey Flasher. You'll find building the project comparatively simple, and if it is your first project, you can be sure that Dickey Flasher will work first time.







The truth about... THE WORST HI-FI COMPONENT

by Alexander N. Retsoff

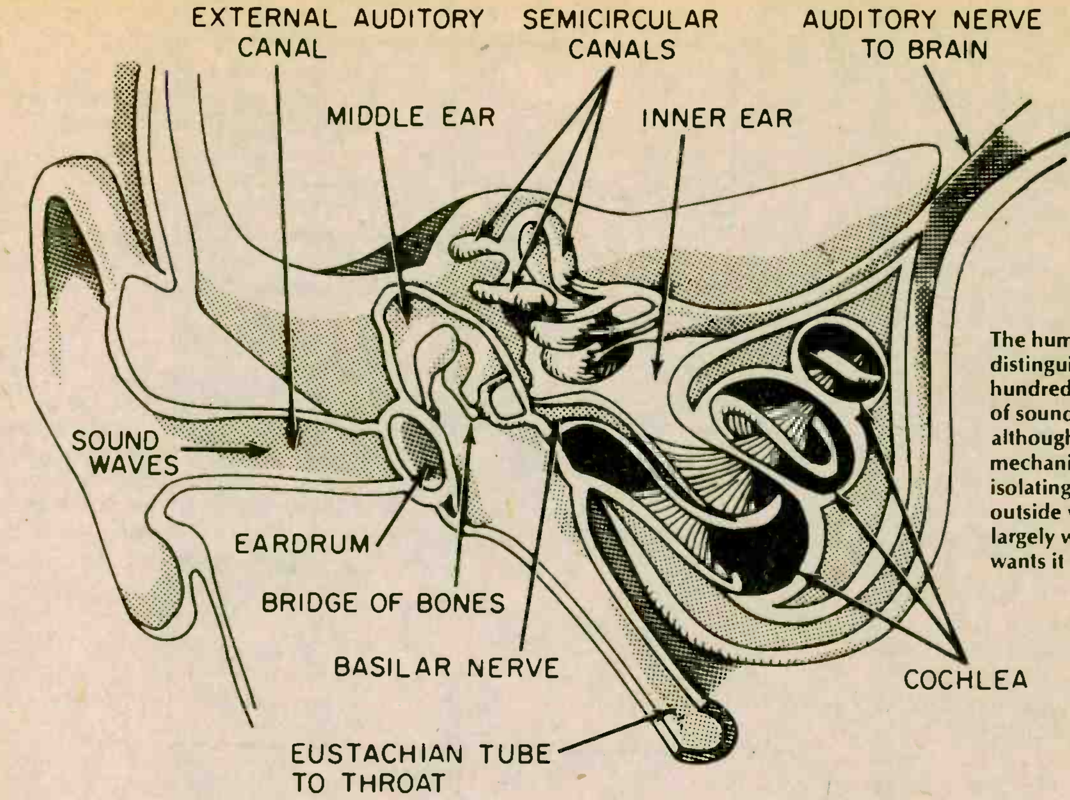
MOST AUDIOPHILES think of the loudspeaker as the weakest link in the audio chain that stretches from the recording studio to the living room. Condenser microphones are dead flat and have very low distortion, at least at reasonable sound-pressure levels. Discs and phono pickups have improved to the point where a 30 to 15,000 Hz response plus or minus a couple of dB is relatively standard, even for medium-grade units. Amplifiers are now so good that it is highly doubtful whether improvements in response and distortion could be audibly detected. But loudspeakers still have a somewhat ragged response and are fraught with various and sundry distortions—some large, some small. If you stop at the living room, you're probably right that the loudspeaker is the weakest link, although the room itself plays a large part in this weakness.

But the chain stretches one link further—to you, through your hearing, to your brain. From an engineering standpoint, that last link would appear to be the weakest one. The response is not flat. Further, the response varies with the sound-pressure level. Even the pitch shifts with the loundness—a sort of human frequency-modulation. Distortion is atrocious: when excited by only two frequencies, upwards of five dozen beats and cross-products appear. Amplitude linearity is lousy too: it takes a ten-fold increase in power just to double the loudness. Furthermore, quality control in manufacture must have been pretty poor. Your ear wears out, degenerating depending upon age and sex; and it is fickle, going into temporary malfunctions whenever your health isn't up to snuff. So from an engineering standpoint, the ear is the weakest link. But is it? Let's see.

How Your Ear Works. In engineering terms, your ear is a self-compensating barometric transducer with built-in frequency analyzer, connected to a high-speed computer with vast memory storage. Reduced to basics, sound is really a rapid variation in barometric (air) pressure. These variations are collected by your outer ear (the part you see) and funneled to the eardrum, a light movable membrane about a quarter-inch in diameter. The pressure variations cause the membrane to move in sympathy, very much as a microphone diaphragm does. The pressure is pretty small and the motion of the eardrum is slight (10 to 40 millionths of an inch). To keep it from rupturing due to the much, much stronger (but slower) changes in barometric pressure caused by the weather and by the local altitude, the ear is self-compensating. The back of the eardrum is vented to the outside world through the inch-and-a-quarter-long Eustachian tube which extends from the middle ear (in back of the eardrum) to the nasal cavity. When you have a cold and stuffy head, the tube gets clogged, the pressure doesn't equalize properly, and your ears "pop," especially if you go flying. Oh well, no engineering design is perfect. Pressure microphones are designed the same way, with a small air-leak in back, but microphones don't catch colds.

The motion of the eardrum (called the tympanic membrane) is coupled through the middle ear to the inner ear by a series of very small bones called, from their appearance, the hammer, anvil, and stirrup. These bones form a mechanical impedance-matching transformer between the eardrum (which is in air) and the cochlea of the inner ear (which is filled with fluid). Again, when you have a cold and the Eustachian tube is blocked, the middle ear fills with fluid and the ossicles (hammer, anvil, and stirrup) are impeded. You then have a hearing loss. When things are working properly, the stirrup moves the "oval window," transmitting the vibrations to the fluid of the inner ear. The fluid motion excites hair-like fibers on the basilar membrane in the cochlea. There are 24,000 fibers and they stimulate the nerve in the membrane, sending neural firings to the brain through the eighth nerve. It is generally thought that different "hairs" respond to different frequencies and so clue the brain as to pitch. In any event, the brain compares the nerve firings to its past memory and categorizes the sounds. All in all, quite a complex piece of engineering.

Dynamic Range. For a normal human, the dynamic range of hearing is unbelievably wide, more than 120 dB—that's a trillion to one in power. Compare that to the 60-dB or so dynamic range of a high-fidelity system, a mere million to one. At 1 kHz the threshold of hearing corresponds to a pressure of about 0.0002 dynes/cm^2, the so-called zero dB level. The threshold of feeling of pain is above 120 dB; that is, a pressure of 200 dynes/cm^2. Several things can happen to raise the threshold of audibility: a blocked Eustachian tube as described above, damage caused by certain illnesses, or continued exposure to high-level sounds. Even short exposure to high-level sound causes a

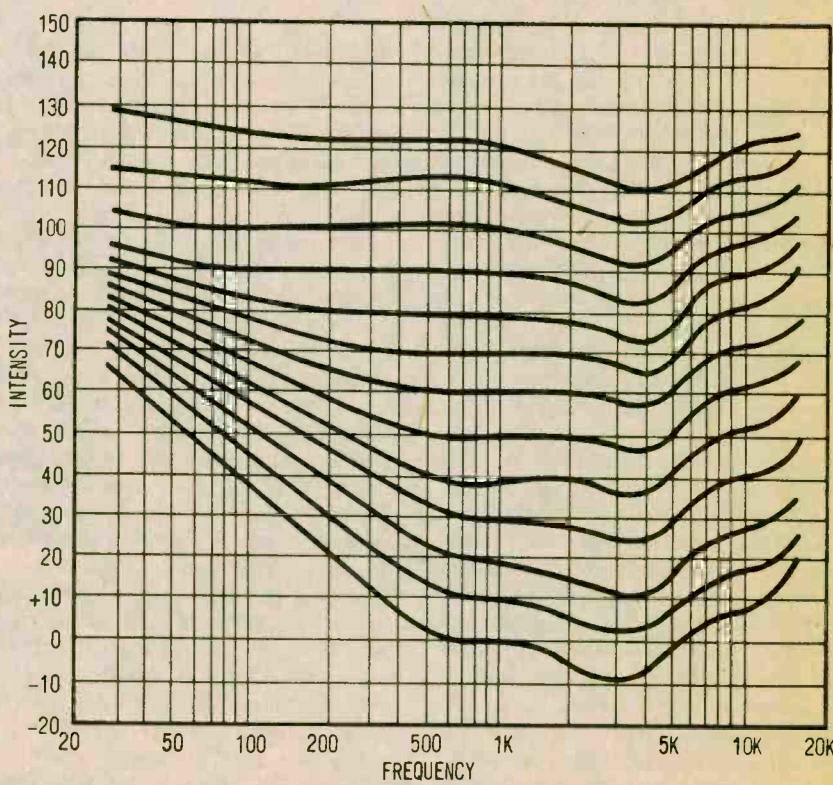


The human ear can distinguish between hundreds of thousands of sounds. And although it has no mechanical means of isolating itself from the outside world, it hears largely what the brain wants it to.

shift in the audibility threshold but this is usually temporary. Continued exposure can cause permanent hearing loss and this is the justification for the new OSHA regulations regarding permissible noise-levels in factories. By now, it is well established that rock musicians regularly suffer hearing loss, much of it permanent.

To achieve this fantastic dynamic range, the ear employs a technique similar to that used in radio broadcasting—compression. We do not react to loudness in a linear manner. That is, if you double the sound power, the result in your brain is *not* a doubling of loudness. Although what it takes to produce double loudness depends on the frequency, over much of the range a 10-dB increase in power (ten times as much) is required to double loudness. Thus, the tremendous 120-dB range over which we are capable of hearing, translates to something like a 12-to-1 loudness range. Before you cry "tilt" and "unfair," remember that this is the way your brain has always worked. It's no different in a concert hall than in your living room. Your brain is used to this compression; it's the only thing it has ever worked with. Thus there is no "distortion," psychoacoustically speaking.

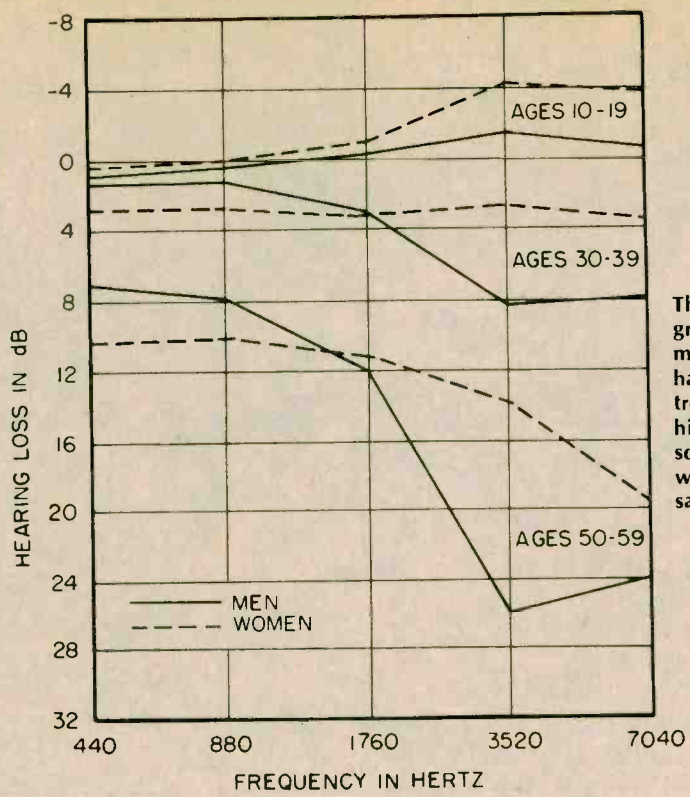
Although the ear "compresses" the 120-dB power range into something like



The famous Fletcher-Munson curves, first published in 1933, are mainly concerned with loudness and show how the "average" ear responds to sounds of various frequencies at various dB levels.

a 12-to-1 loudness range, it can hear many graduations of loudness. The minimum change in sound level which we can detect depends both on the frequency of the sound and its level. It also depends on how close together in time the two levels are presented. (The "computer" has a very good memory for classification but not such a good one for absolute levels.) Over much of the range, under laboratory conditions, a level shift of from 0.25 dB to 1 dB is just detectable. That's pretty good resolution over a 120-dB range!

Distortion? Measurements were made on a cat's cochlea to determine the harmonic and intermodulation products generated by the application of a simple two-sinusoid signal (700 Hz and 1200 Hz). Sixty-six products were generated. They ranged in amplitude from 0.1% to 18%. Eighteen percent IM, you say. Hardly high fidelity. But if somehow we removed the products, would the cat's brain have known what it was listening to? The cat never heard it any other way! There would be no match in the memory banks. Is this "distortion," or wouldn't the removal of those cross-products be the *real* distortion?



The hearing-loss graph shows that men, as they age, have more trouble hearing high-frequency sounds than women of the same age.

The ear is subject to another kind of "distortion" too, a sort of level-sensitive pitch change. It has been determined experimentally that if the strength of a 100-Hz tone is raised from 40 dB to 100 dB, the apparent pitch decreases about 10%. The effect is less severe at 500 Hz, resulting in a 2% apparent pitch change for the same 60-dB shift in intensity. Again we must ask ourselves: Is this really distortion? If it didn't occur, the pattern the brain is searching for wouldn't match.

Age, Sex & Hearing. Unfortunately, our hearing degenerates with age, more so for men than for women. This was determined by tests at the 1939 World's Fair. The results are shown in the figure. Up until age 40, the loss is slight and confined to the upper frequencies. By age 60, most men have a substantial high-frequency hearing loss. Unfortunate, but I'd like to see the high-fidelity component that can operate 24 hours a day for 40 years with such a slight reduction in performance!

The Fletcher-Munson Curves. It has been known for years that the "frequency response" of human hearing is not flat. Fletcher and Munson of Bell Laboratories established that it takes more energy at the very low frequencies and at the very high ones to produce the same loudness sensation as can be achieved in the mid-range. Actually we are most sensitive to signals around 2000 Hz. Other investigators found similar if not identical results. Again, this doesn't really matter since "we hear as we hear." That's what our brain expects.

However, there is another phenomenon, found by Fletcher and Munson, which *does* matter to the audiophile. Not only is our hearing "not flat," but the *degree* of "non-flatness," if you will, depends upon the sound level. As the sound level is decreased, it takes *more* boost at the frequency extremes *relative to* midband to produce equal loudness than it did at higher levels. Thus, although it makes no difference that our hearing is not flat when listening to a concert in the hall, it *does* make a difference if we listen at home at a *different average level* than existed in the hall. If we play back at the *same* level, we hear the tonal balance properly. It's when we reproduce at a different sound level that we have a problem.

Hence the "loudness control" or "contour" on many high-fidelity amplifiers. In a properly designed loudness control, the bass and, to some lesser extent, the treble, is boosted as you adjust to lower volumes, to compensate for the psychoacoustic unbalance which would occur otherwise. Unfortunately, few of these controls function properly. There should be *no* loudness compensation when you are listening at concert-hall level, say around 90-dB to 100-dB sound-pressure level. The compensation should come in only at lower levels. This means you should have *both* a loudness control *and* a volume control. Then you can set the loudness control at maximum (no compensation) and adjust the volume control for "concert-hall level." When you would rather listen at lower levels, you would turn down the loudness control, automatically putting in the correct amount of compensation. Used this way, the volume control acts like a calibration control, adjusting the gain of the amplifier to match the sensitivity of the signal source and that of the loudspeaker so that concert-hall-level sound is produced in your living room at maximum loudness setting. The early loudness controls were built that way; few of the modern ones are.

Well, what say you? Is the ear a Rube Goldberg device designed by a demented engineer? Or is it a most fantastically complex, delicate and adaptable organism? I'll say this for sure—I wouldn't want the job of designing an improved model! ■

SUB-BASEMENT RADIO

by Charles Green W6FFQ

EXPERIMENTER'S DELUXE FET/IC VLF RECEIVER

JUST AS MANY of the "cliff dwellers" in modern multi-story apartment buildings have little-known basements and sub-basements, the radio spectrum has a "basement" LF (low frequency) band and a mysterious "sub-basement" VLF (very low frequency) band, little known to many electronics hobbyists and experimenters. The LF band goes from 300 kHz down to 30 kHz, and the VLF band from 30 kHz down to 3 kHz.

The lower portion of the LF band, from about 60 kHz to the upper portion of the VLF band (about 18 kHz), is used by the National Bureau of Standards to transmit coded, standard-frequency signals (similar to WWV). Special receivers are used for proper reception of these signals, which automatically adjust electronic laboratory generators to coincide with the standard frequencies. The U.S. Navy has found that the VLF band signals will penetrate into salt water and has established giant high powered transmitting stations that communicate with submerged submarines anywhere in the world.

Other nations maintain transmitting stations in the LF/VLF region for scientific and navigational purposes. These stations are subject to changes in frequency, power, and time of broadcast since there is still considerable experimentation. The stations usually transmit their call signs in CW at periodic intervals for identification.

Receivers for the LF/VLF "basement" transmissions are usually quite complex, but you can sample the activity in this portion of the rf spectrum with our simplified receiver project which covers the most popular portion of the bands from 20 to 50 kHz. This frequency coverage can be changed by using different values of inductances than specified in our plans. Plans are also included for a VLF-style loop antenna to be used with the receiver instead of the usual outdoor dipole antenna used in the higher frequencies. Inasmuch as VLF wavelengths are many miles long, a half wave antenna dipole is impractical at these frequencies.

The receiver uses two ICs and three FETs in a simplified regen detector circuit with a two-stage rf amplifier. Good audio volume is provided for earphone reception, and the receiver is housed in a compact metal utility box. Perf board style construction is used for ease in building the receiver.

The Circuit. Very low frequency signals picked up by the loop antenna are fed through coax cable to the input of IC1, the rf amplifier stage. The amplified signals are fed through C3 to the coil L1 and the second rf amplifier stage, IC2. L1 and the input capacity of IC2 act as a broadly tuned circuit for VLF signals: R2 controls the rf amplification.

Capacitor C6 couples the amplified rf signals to the oscillating detector stage of FET Q1. These signals are tuned by L2 and the S1 switch-selected capacitors of C8 to C18. Variable capacitor C7A/B acts as a fine tuning control for the VLF signals, and R5 controls the oscillation point and, therefore, the sensitivity of the detector stage.

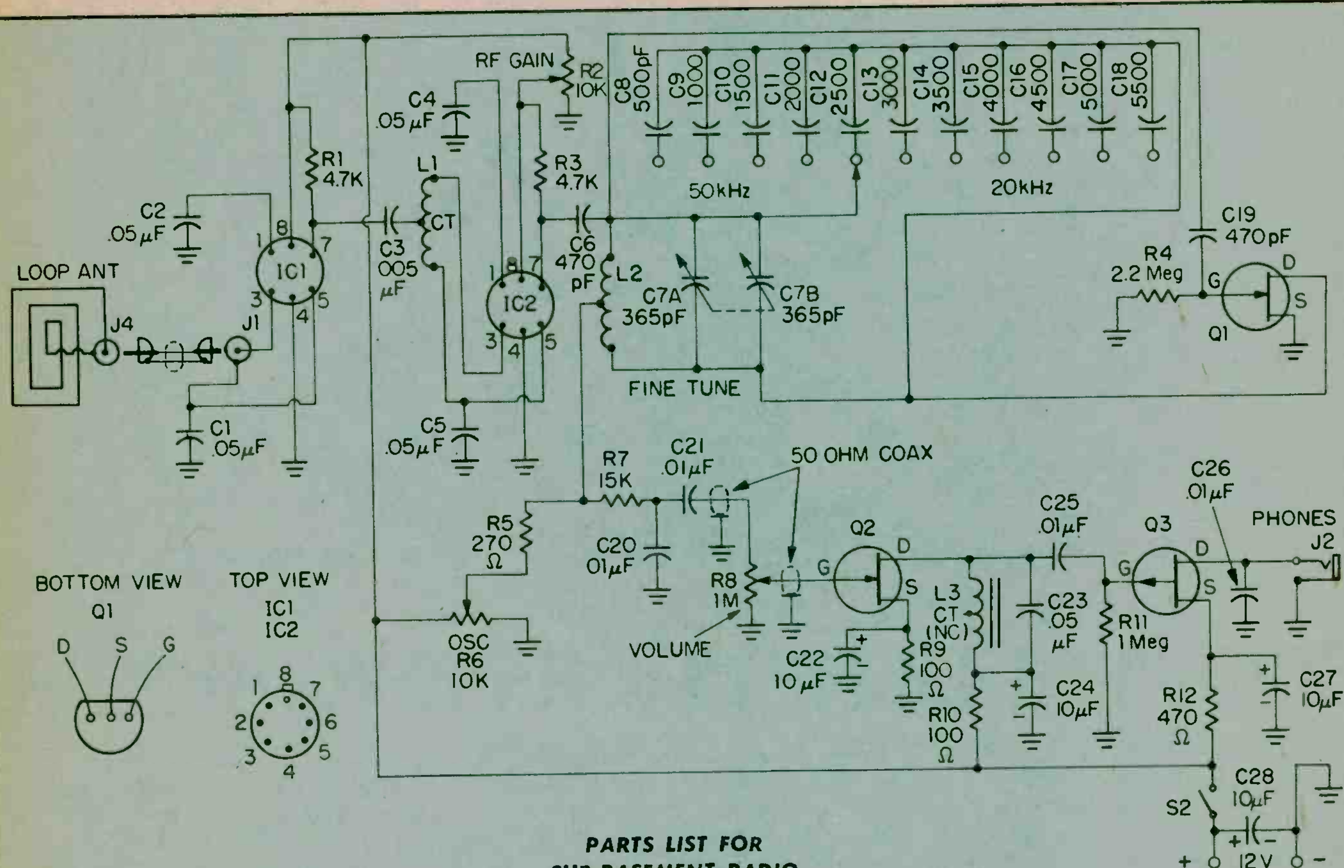
The detected audio signals are fed through the low pass filter R7/C20 and coupling capacitor C21, to the audio gain control R8 and audio amplifier stage Q2. The amplified audio signals are coupled via the L3/C23 peak filter to the second audio amplifier stage of FET Q3. The peak filter is tuned to approximately 800 Hz to provide better receiver selectivity of the

e/e SUB-BASEMENT RADIO

VLF signals. The amplified signals are fed from the drain circuit of Q3 to J2 and can drive high impedance earphones (2000-ohm type).

Field effect transistors Q2 and Q3 form the audio amplifier stages. Q3 is a P-channel FET and therefore requires a relatively negative potential on its "drain" terminal. This is accomplished by grounding the drain through the earphone and returning the "source" to the positive power supply terminal.

Construction. Coils L1 and L2 are made from miniature transistor audio transformers by removing the laminated iron core. We used 10,000-ohm to 2,000-ohm center-tapped transformers for the coils in our receiver. The connections are made to the 2,000-ohm center-tapped winding only; the leads to the 10,000-ohm winding should be cut off close to the coil form. Coil L3 is a 1,000-ohm CT to 8-ohm miniature output transformer and is used *with* its iron core intact. The 1,000-ohm winding is used (no connection is made to the center tap), and the 8-ohm and cen-



PARTS LIST FOR SUB-BASEMENT RADIO

C1, C2, C4, C5, C23—0.05 uF capacitor, 12 VDC or better (Radio Shack 272-1068 or equiv.)
C3—0.005 uF capacitor, 12 VDC or better (Radio Shack 272-130 or equiv.)
C6, C19—470 pF capacitor (Radio Shack 272-125 or equiv.)
C7A/B—dual-gang 365 pF variable capacitor (TRW 273 or equiv.)
Note—A dual-gang 365 pF variable capacitor may be difficult to obtain. You can go the same route as pioneer radio builders by using two single-gang 365 pF variable capacitors (such as Radio Shack 272-1344 or equiv.) and operate them in tandem (turn each knob the same amount).
C8—500 pF (see text for all capacitors, C8 to C18)
C9—1000 pF
C10—1500 pF
C11—2000 pF
C12—2500 pF
C13—3000 pF
C14—3500 pF
C15—4000 pF
C16—4500 pF
C17—5000 pF
C18—5500 pF
C20, C21, C25, C26—0.01 uF capacitor (Radio Shack 272-1065 or equiv.)
C22, C24, C27, C28—10 uF electrolytic capacitor, 16 VDC (Radio Shack 272-1002 or equiv.)
IC1, IC2—703-type integrated circuit (Radio Shack 276-008 or equiv.)
J1, J3—insulated phono jack, RCA type (see text)
J2—two-conductor phone jack (Radio Shack 274-252 or equiv.)
L1, L2—inductors made from small 10k to 2k audio driver transformers such as Radio Shack 273-1378 (see text)
L3—inductor made from small 1k to 8-ohm audio output transformer such as Radio Shack 273-1380 (see text)
Q1—N-channel FET, HEP-802 (Motorola)
Q2—N-channel FET (one of Radio Shack 276-112 package, see text)
Q3—P-channel FET (one of Radio Shack 276-112 package, see text)
R1, R3—4700-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R2, R6—10,000-ohm potentiometer, linear taper (Radio Shack 271-1715 or equiv.)
R4—2.2 meg, ½-watt resistor (Radio Shack 271-000 or equiv.)
R5—270-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R7—15,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R8—1 meg potentiometer, audio taper
R9, R10—100-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R11—1 meg, ½-watt resistor (Radio Shack 271-000 or equiv.)
R12—4700-ohm, ½-watt resistor (Radio Shack 271-00 or equiv.)
S1—single pole, 11 position rotary switch (Calectro E2-161 or equiv.)
Misc.—aluminum cabinet 8-in. x 6-in. x 4½-in. (Author used LMB 146), perf board, push-in clips, 50-ohm coaxial cable, knobs, hook-up wire, No. 28 enameled wire (Radio Shack 278-006 or equiv.), plastic tape, solder, etc.

ter tap leads should be cut off close to the coil form.

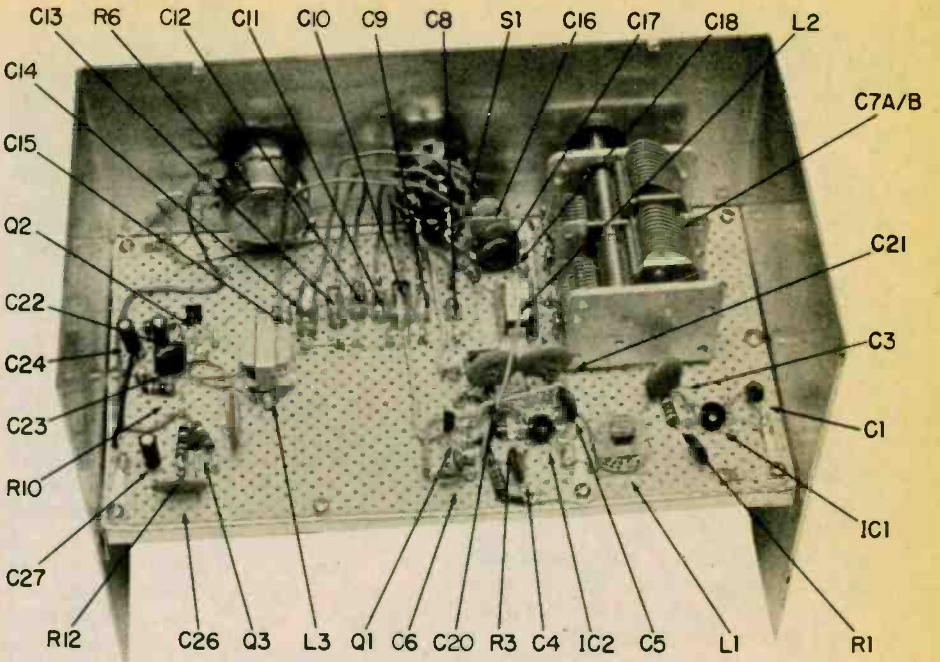
The receiver operation is at low rf frequencies, but the wiring of the receiver should still be carefully done. For best results, follow our component layout as shown in the photos. Your best way to start construction is to cut a 4¼ x 7⅞-in. section of perf board and install it approximately halfway up the LMB-146 aluminum box. We used two 4¼-in. lengths of sheet aluminum bent into brackets with sides approximately ¼ x ½-in. (½-in. side mounted to the box wall, and the ¼-in. side mounted to the perf board). Additional lengths of ¼-in. wide sheet metal stiffeners were added to the side of the perf board to increase the rigidity of the board. This may not be necessary in your unit.

More Mechanics. Locate C7A/B on the front panel as shown in the photos, and then cut a ½-in. or larger hole for the shaft. This will allow the frame of C7A/B to be mounted to the perf board and allow the shaft to protrude through the front panel without touching the metal panel. Note that the shaft *must be* insulated from the panel, or it will short the B+ at the detector circuit. If necessary, you can use an insulated coupling for the shaft. Make sure that you use a plastic tuning knob to minimize the possibility of short circuits.

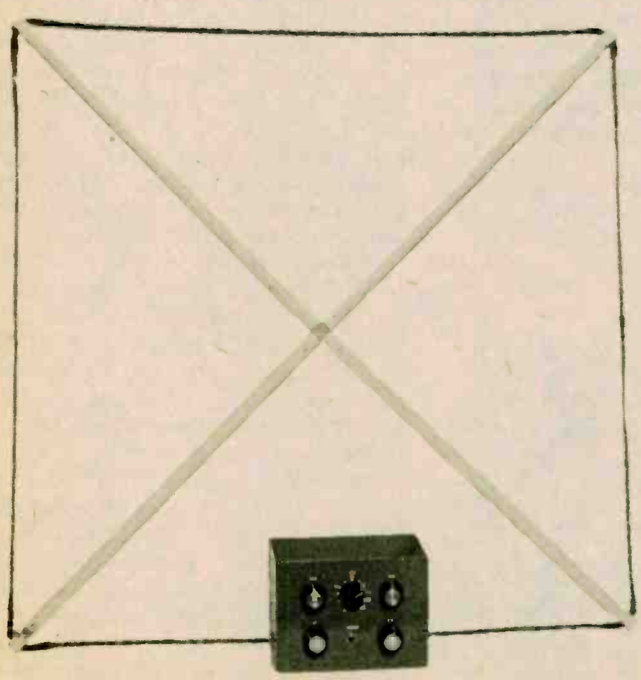
Locate and install the remainder of the front and side panel controls and components as shown in the photos. Make sure that you install serrated washers between the control bushings and the inside of the panels to prevent accidental disturbance of the position of the controls. Also, use insulating washers for J1 to keep the jack body from electrical contact with the box panel and electrical ground.

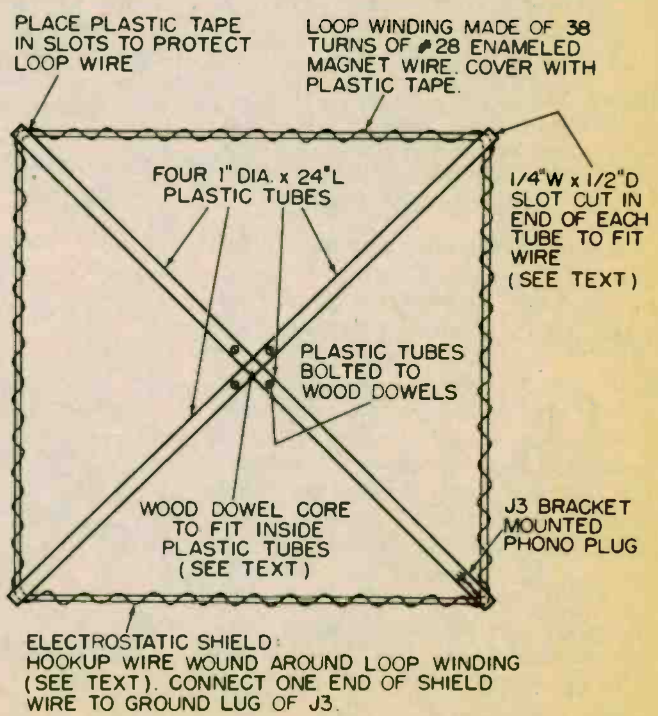
Most of the components on the perf board are connected to push-in clips. Keep the component leads as short as possible and group them around their particular IC or FET as shown in the photos. Wire the components as indicated in the schematic drawing and position the leads as shown in the board photo.

Coil forms L1 and L2 can be either cemented to the top of the perf board, or (as in our unit) held with an application of hot plastic glue from an electric glue gun. Use short lengths of coax or shielded wire to connect R8 to the perf board components as shown in the



These are the major parts locations for the perf board. Note dual-gang cap C7A/B.

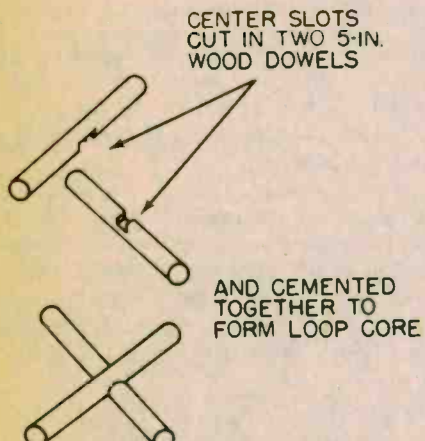




Reinforced PVC tubes available from building supply outlets are lighter and easier to work with than dowel sticks when building an open air antenna support frame. The RCA-type phono connector makes a convenient way to use standard audio cable.

photo. Connect ground lugs at the board corners and on the C7A/B mounting screws for the necessary electrical circuit connections.

Capacitors C8 to C18 should have as accurate a capacity value as possible (select them on a capacitor bridge if possible), and they can be either ceramic or polystyrene types. Mount them with short leads around S1 and connect them with straight direct leads to the S1 lugs. If necessary, you can parallel capacitors to make up the required capacity values. Connect the remainder of the front and side panel controls and jacks to the board circuits, and position the leads as shown in the photos.



Dowel sticks for this assembly are available from lumber yards, hardware store and hobby shops. Notch with a wood chisel or a keyhole saw or whittle with a pocket knife.

The Loop Antenna. As shown in the drawing, the loop antenna is composed of four 1-in. diameter x 24-in. long plastic tubes. We used polyvinyl chloride (PVC) tubes that can be obtained from a building supply store. Or any type of plastic tube can be used as well. The plastic tubes are fitted over a wood-dowel center core as shown in the drawing, and the loop antenna wires are wound over the slots in the tube ends.

Begin construction of the loop antenna by cutting center slots in two 5-in. long wood dowels (of a diameter to fit snugly into the plastic tubes), and cement them together as shown in the drawing. Wood screws can be used in place of cement, or hot glue from an electric glue gun can be used as we did in our model.

Cut the plastic tubes to size and then

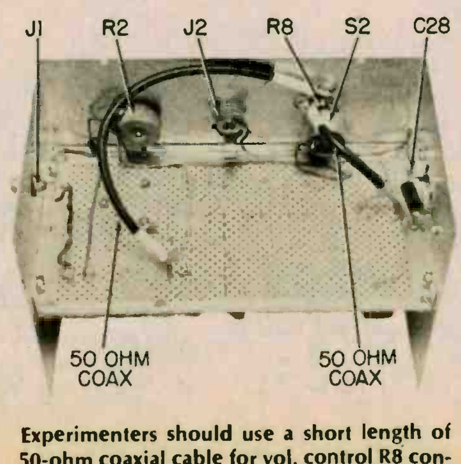
The front panel control knob "osc" sets the regenerative feedback point of the detector FET Q1 (it sets the audible "plop" point!). That "tune" knob is actually a fine-tune of the bandswitch-like "kHz" (course) control.

cut a ¼-in. x ½-in. deep slot on one end of each tube. Then mount the tubes to the wood dowel core with the slotted ends outward and parallel to allow the loop antenna wires to be wound around the ends as shown in the drawing.

Place plastic tape in the tube slots to prevent the wire from being abraded, and wind the loop with 38 turns of #28 enameled magnet wire, and cover the wires with a layer of plastic tape. Connect the loop leads to a phono jack (J4) mounted on the end of one of the plastic tubes.

To minimize noise pickup, wind an electrostatic shield composed of a spiral winding of hookup wire around the antenna loop. Leave about 1-in. spacing between the electrostatic shield wire turns, and connect one end of the wire to the "low" side (shell) of J4. The other end of the electrostatic shield wire should be taped so that it will not cause any accidental short circuits.

A length of good quality phono or coax can be used to connect the loop antenna to the receiver. Make sure that the "low" sides of P4 and J1 are connected together (the outside shells of the jacks).



Experimenters should use a short length of 50-ohm coaxial cable for vol. control R8 connections (mini-type RG-174U or RG-58 U).

Range and Panel Markings. We used rub-on decals for the panel markings for our receiver model, but neatly drawn pen and ink markings on white tape can be used as well.

The receiver does not require any calibration for exploratory operation on the VLF band, and you can designate the approximate frequency of the S1 kHz switch as follows: 20 kHz (C18=5500 pF), 25 kHz (C15=4000 pF), 30 kHz (C13=3000 pF), 35 kHz (C10=1500 pF), 40 kHz (C9=1000 pF), 45 kHz (C8=500 pF).

For more accurate calibration with the transformers you used for L1 and L2, connect an audio oscillator to J1 through an isolating audio transformer.

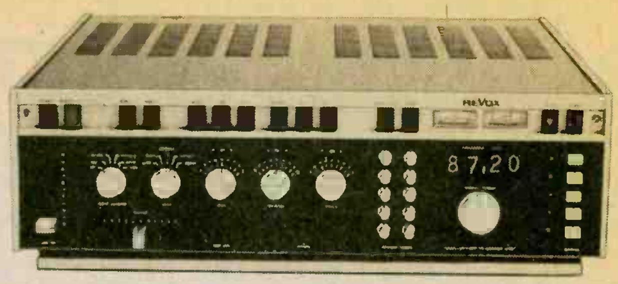
Testing and Operation. The loop antenna can be suspended with a length of cord from one of the plastic tubes for easy rotation and operation indoors. Or the loop can be placed on a wooden chair for temporary operation. Note, however, that the loop should be away from AC appliances for best performance.

Set all controls to the extreme counter-clockwise position, and connect the receiver to a 12 volt DC power supply or battery. Connect the loop antenna to J1 with either coax or a length of good quality phono cable, and plug in a set of high impedance earphones at J2.

Adjust the *audio gain* (R8), *rf gain* (R2) and *fine tune* (C7A/B) controls to mid-range. Adjust the *osc* control (R5) clockwise until the detector circuit (Q1) is oscillating. There will be a "click" or "plopping" sound in your earphones when the detector stage first falls into an oscillating condition. Keep adjusting the *osc* control (R5) near this point for best sensitivity when tuning for signals. Adjust R8 and R2 for best reception of signals.

Adjust the *fine tuning* control (C7A/B) for each setting of S1 as you listen in on the VLF band from 20 kHz to 50 kHz. Reposition the loop antenna as necessary for best reception of signals. Practice is required to obtain the proper "feel" for operating the receiver controls. You can also try different loop antenna assemblies with different turns of wire for best results in VLF reception over different portions of the band. You can experiment with the tuning range by changing the values of L1 and L2.

Remember, this is an experimenter's project exploring the little-known, little-tuned very low frequencies. It's a good first-step project into VLF; why not "kick in" right now! ■



e/e turns on with...

REVOX A720
DIGITAL FM TUNER/PREAMPLIFIER

REVOX, a respected name in high-fidelity tape recorders, has made a bold move into the high-fidelity component field with their model A720 Digital FM Tuner/Preamplifier. The A720 is so dramatically different in features and performance from the average tuner and preamplifier that it might well become the tuner to which all others are compared.

Basically, the A720 consists of a digital FM stereo tuner and a preamplifier housed in a single cabinet and sharing a common power supply. While the preamplifier, in performance, is typical of any other high quality preamp, the digital tuner goes well beyond what is usually seen or expected.

For example, just rotating the tuning knob told us something new and different was at hand. Instead of flywheeling when the knob was turned it "stepped" to the next position and stopped. Even a slight push on the knob caused it to follow through and step to the next position, almost as if it had a mind of its own. (Actually, the steps are a magnetic trick used to instill confidence in the user. We'll explain its operation later.)

Another big difference is the five-place digital readout. Most digital displays on FM tuners have four places. On the A720 the frequency steps are 50 kHz to accommodate the European 50 kHz station spacing as well as the "even" spacing (98.2, 98.4, 98.6, etc.) of the proposed FM cable transmission. If the cable FM is approved the A720 is ready.

The Revox A720 Digital FM Tuner/Preamplifier is available at many audio component dealers. Price is $1395. For manufacturer's specification sheet, circle Number 75 on Reader Service Page.

Electronic Tuning. Looking deeper into the digital FM tuner we find circuits more common to industrial, commercial, and military equipment than they are to hi-fi. Firstly, there's the frequency synthesizer electronic tuning. Unlike some hi-fi "digital" tuners which have *conventionally tuned* front-ends and a digital frequency readout (equal to the local oscillator less the IF), the A720's digital readout comes from a crystal-controlled frequency synthesizer which also tunes the front-end electronically.

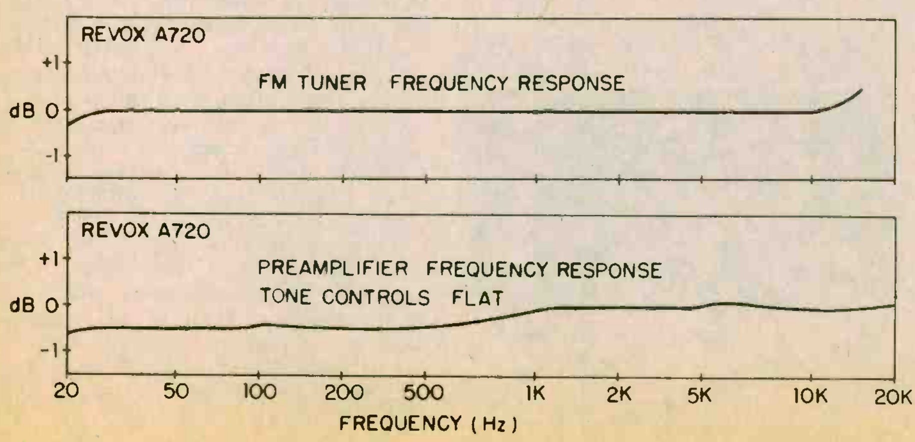
Here's how it works. A "free-running" local oscillator is coupled to the front-end and a down-counter. The *Manual Tuning* control programs the down-counter for the desired frequency. The output of the down-counter is fed to a phase comparator (phase locked detector) which is also receiving a fixed output from the down-counted crystal oscillator. A phase and frequency difference between the two phase detector inputs develops an instantaneous corrector voltage that electronically tunes the local oscillator to the desired frequency. Since the phase detector is locked to a reference crystal, the local oscillator is also locked electronically to the crystal, and the tuning accuracy is that of the crystal, 0.005%. This is the exact same frequency control system as used in the most modern FM transmitters. The corrector voltage that is used to tune the local oscillator is also used to tune the front-end's tuning circuits, hence, the entire front-end is tuned electronically.

Another interesting circuit is the FM detector, which converts the FM signal into a train of digital pulses. The average DC value of the pulses represents the modulation, and this becomes the "detector" output.

The Revox A720 rear panel looks very much like most preamplifier rear panels, but it serves both for an FM tuner and preamplifier. Thus your inter-system array of audio cables are reduced, making life simpler.

There's More. Moving along to the stereo (MPX) demodulator we once again find a phase-locked detector. A receiver's stereo separation is highly dependent on the phase relationship between the 19 kHz pilot transmitted by the station and the 38 kHz "carrier" developed in the receiver; they must be in precise phase relationship to attain optimum stereo separation. Unfortunately, an LC tuned oscillator is not the easiest of circuits to sync into zero-error phase coherence, and the LC tuned circuit has been the common MPX oscillator for too many years. The phase-locked detector, however, provides precise sync (phase coherence) between the pilot and carrier, and we found the A720 had a phenomenal midband separation of 50 dB. You can really appreciate the A720's stereo performance when you listen to a station and the record it's playing has the same deep separation it would have if you played the record on your own turntable.

The IF amplifier has an eight-pole LC filter driving six stages of wideband amplification. Giving you selectivity and limiting characteristics would produce meaningless numbers. Actual listening tests produced *adjacent* channel signal reception (not the usual *alternate* channel), and we heard signals from FM stations we



We'd call them curves but they're flat as boards. Upper graph shows straight line response from 30 to 10,000 Hertz for tuner section. Entire curve varies only +0.5, —0.4 dB. Lower graph gives frequency response of preamplifier section of +0.1, —0.6—a total swing of only 0.7 dB. The Revox A720 frequency response is as flat as its panels.

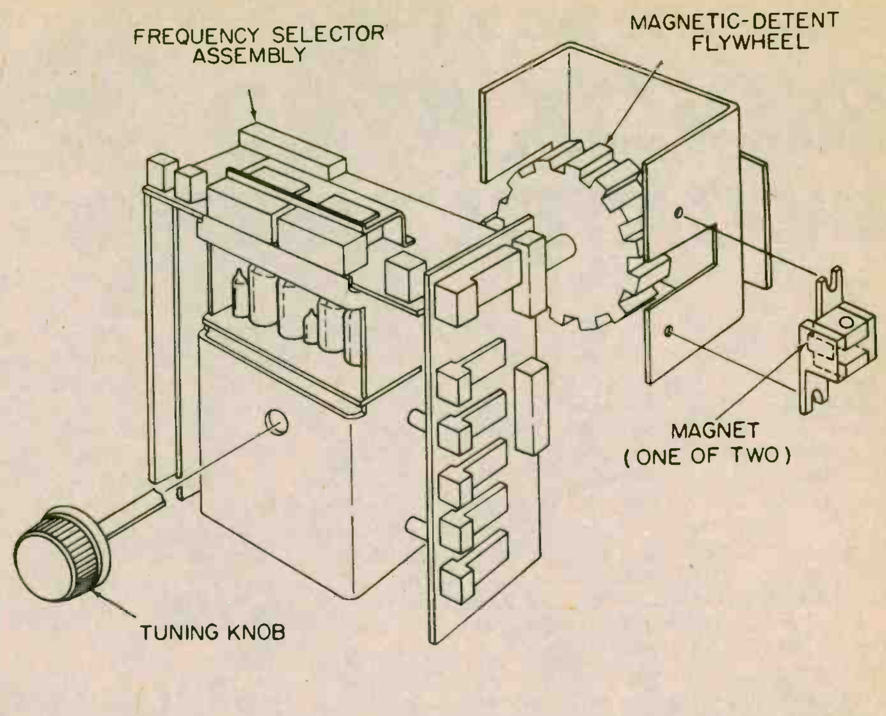
never knew existed as they were always *covered* when tuned on other receivers. The limiting was so effective we attained noise-free stereo reception from stations that barely got above the noise level on other FM tuners.

Before we get into the rest of the receiver let's take time out to look at the magnetic detented tuning, as that's the first thing you'll be impressed with the first time you try an A720.

The *Manual Tuning* control actually is a switch. The switch contacts are printed on a PC board and the wiper rides over the contacts as the tuning knob is turned. There are no mechanical switch detents. Rather, as shown in the drawing, a magnetic-detent flywheel provides the "step" action. The flywheel has teeth milled into the outer rim and resembles an ordinary gear. A magnet is positioned on either side of the "gear" in such a manner that they automatically center the teeth opposite the magnets. When the tuning knob is disturbed, the teeth produce an unbalanced magnetic field, which pulls the flywheel until the magnetic field is again balanced. The balanced condition of each tooth corresponds to the switch positions of the frequency selector, hence, each step provides a tuning change of 50 kHz, providing complete up or down the FM band coverage.

The Whole Package. In addition to the *Manual Tuning* control, there are two rows of five miniature *Memory Tuning* controls and an associated *Station* switch for each pair of controls, as shown in the photo. The switches provide up to five preset station frequencies. When a *Station* switch is depressed, the tuning is shifted from the *Manual Tuning* knob to whatever station has been preset by the associated controls. One control of each pair sets the frequency in MHz, such as 96, 98, or 101. The second *Memory Tuning* control sets the frequency in kHz, such as 96.10, 96.30, 98.50, etc. The preset frequency is instantly indicated by the digital readout, so there's no guesswork.

The preamplifier controls include an input selector, ganged bass, ganged midrange, and ganged treble tone controls, volume and balance controls, and a selector for various mono and stereo modes. Switches are provided for power, remote control (a future accessory), tape monitor 1, tape monitor 2, loudness compensation, low filter, high filter, binaural headphone effect, output 1 on-off, output 2 on-off, MPX filter, FM mute, and manual or preset tuning.



The stepped effect of the tuning knob is attained by using magnets (one shown) and a gear-shaped flywheel. The magnetic fields always center each tooth (magnetic-detent), which corresponds to a setting of the frequency selector switch housed in the frequency selector assembly.

There are inputs for two magnetic phono, auxiliary, and two tape. Outputs for two line, two tape, and two headphones. A tape output is also provided on the front panel. Individual left and right level controls are provided on the rear apron for phono, auxiliary, and one tape input.

This unit is also designed for use with a matching power amplifier and outputs are provided carrying a special remote control voltage for applying power to the amplifier.

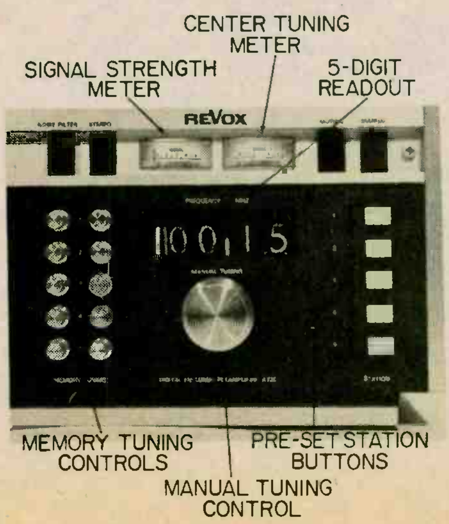
The FM antenna input accommodates 300 ohm twinline, or 75 ohm coaxial cable through a coaxial jack. The overall size is 19⅛-in. wide x 6-in. high x 12⅛-in. deep.

What the Meters Say. Performance is a winner all the way. The sensitivity measured 1.4 uV IHF with full limiting at 2.5 uV. The high fidelity sensitivity (60 dB quieting) measured 7 uV. Full mute release was attained with 11uV. At standard test level the frequency response measured +0.5/−0.4 dB from 20 to 15,000 Hz; distortion was 0.04% THD; signal to noise ratio was 70 dB; stereo separation was 50 dB (midband).

The preamplifier output could reach 6 volts before clipping, well above the normally used output level of 1 volt or less. At the normal output level of 1 volt the frequency response measured +0.2/−0.6 dB from 20 to 20,000 Hz at a distortion no higher than the 0.02% THD residual of the test equipment at any frequency.

The tone control range measured +11/−12 dB at 50 Hz; ±8 dB at 3000 Hz (the midband center frequency); and +10/−19 dB at 10,000 Hz. The magnetic input hum and noise was 62 dB; separation was 56.5 dB.

As impressive as these performance measurements are, they cannot truly reflect the outstanding performance and sound quality of both the FM tuner and the preamplifier. The Revox A720 is priced at $1395. For additional information circle No. 75 on the reader service coupon on page 17. ■

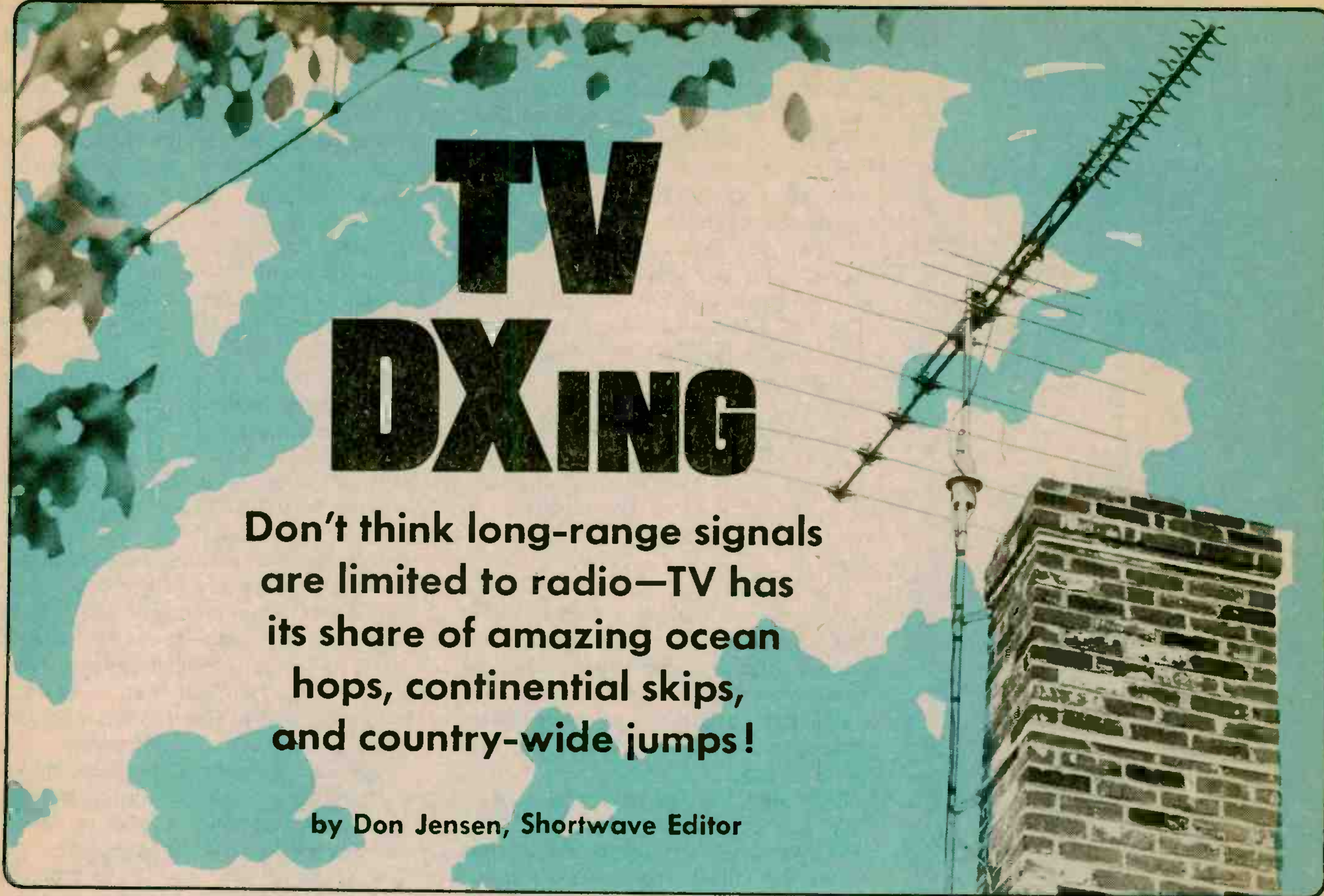


If you can read numbers, you can tune with .005% accuracy like an FM station engineer with the Revox A720. Manual Tuning control employs magnetic detenting. Buttons on right switch in preset FM stations. Knobs on right tune in preset stations you enjoy.

TV DXing

Don't think long-range signals are limited to radio—TV has its share of amazing ocean hops, continential skips, and country-wide jumps!

by Don Jensen, Shortwave Editor



TELEVISION DXing! It's a subject you seldom read about, but it certainly has its share of devoted followers. One reason you may never have considered TV DXing is because, at first blush, the idea of long-distance reception of television signals seems to fly in the face of everything you've ever heard about these VHF and UHF signals.

Nearly everyone has a TV set these days. For years you've probably relied on TV to bring you news and entertainment, but have never given it a second thought as a DX machine. TV, after all, is essentially a short-range type of communications. TV channels 2 through 6 use frequencies between about 55 to 88 MHz, channels 7 through 13, frequencies from about 175 to 215 MHz, all in the VHF range. Channels 14-83, the UHFers, operate on frequencies from 471 through 889 MHz. And, generally, very and ultra high frequency signals are limited to what is called electrical line-of-sight and ground wave ranges.

In the larger cities, you may be able to receive powerful local stations with little more than built-in rabbit-ears antennas. In the suburbs, you probably have roof-mounted antennas to pull in a good picture from your area TV stations. Out in the boonies, up to 100 or more miles away from the nearest stations, you may subscribe to a cable-TV service or have an elaborate stacked antenna set-up mounted on a tower at least 40 feet high. Perhaps you've never seen on your TV set a station from outside your regular viewing area. But TV DXers have, plenty of stations in some cases.

TV reception normally is a short-range affair, that's a rule of thumb. But like many rules there are exceptions. And, in the case of TV DX, these exceptions are of great interest. For under certain natural conditions, which are far more common than you might suppose, it is possible to receive TV signals from hundreds and even thousands of miles away. There are TV DXers who have logged both the audio and video portions of signals from across the country and, in some cases, from foreign countries.

Your Shortwave Editor at DX Central has viewed and heard TV signals from well over 30 states, six Canadian provinces, and Mexico. And this isn't an especially good record, compared to the really top-notch TV DXers, some of whom have logs listing receptions of hundreds of different stations. Some have received TV outlets in the Caribbean, Central and South America, Hawaii, and elsewhere.

And, to cite what is considered the world's record TV reception, in 1957, an Australian received a video signal from the British Broadcasting Corporation's London TV station. The distance? 10,400 miles! While this is the record, it is perfectly possible for an inexperienced TV DXer, with only ordinary equipment, to receive television stations a thousand, fifteen hundred or more miles away.

And, in passing, I should mention that just as it is possible to receive TV DX stations, one also can DX the FM broadcasters as well. There is a hardy band of FM DXers in this country that get their kicks from hunting the stations that inhabit the regular FM band, 88 to 108 MHz. And most of the things I'll be saying about TV DXing will apply to FM listening as well.

How can TV DX be? Why, if VHF/UHF reception is usually short-haul stuff, is it possible to receive these distant stations? To understand that, you have to know something about signal propagation, the phenomena that bring these signals from the transmitter to your antenna system.

Propagation and Such. Radio signals—and that means television too, of course—travel in straight lines from the

Tall towers, such as this 1000-foot-plus giant in Columbus, Georgia, spread TV signals for a hundred miles in all directions —a terrific source for skip signals!

transmitting towers. But the earth's surface is not straight, we live on a ball-shaped planet, remember. The result being that as the signals travel outward from the antenna, before they've traveled too far, the earth's surface curves away from them. In effect, the radio signals shoot off into space at the horizon. But, up there in the ionosphere, the region above our atmosphere, there are several layers of ionized gases. The effects of solar radiation and other factors cause these layers to change their electrical densities and act as a mirror, reflecting the outward bound signals back toward Mother Earth. This phenomenon is responsible for all reception of radio signals, be they on medium, short, VHF or UHF wavelengths, beyond the immediate area of the transmitter.

The frequency of the radio signal and the varying conditions within the ionized layers affect what ultimately happens to these radio waves. In the medium and shortwave ranges, most signals are reflected back to earth at some time during the 24-hour period we call a day.

The ionized layers have been labeled by physicists as "D," "E" and "F." The "D" layer tends to absorb, rather than reflect, the longer wavelengths, medium wave, and the lower frequency short waves. But when darkness falls the "D" layer disappears, allowing these signals to continue upward until they reach the "E" or "F" layers for reflection back to the earth. Hence, distant MW and low frequency SW reception is largely a nighttime thing.

The VHF TV signals, with short wavelengths, pass through the "D" layer without difficulty. Unfortunately, they normally also pass through the "E" layer; they aren't reflected back; and this is why TV is usually thought of as being limited to short range reception.

TV DX is therefore limited to those occasions when, for one reason or another, the signal is returned to earth by reflection (actually it is called refraction, but it is a bit easier to understand if you think of it in terms of a mirror-like reflection) at points beyond the normal transmitter range.

One of these special conditions is called sporadic E skip. The skip designation should be self-evident. The radio signals skip off an especially dense portion of the "E" layer in the same way a rubber ball thrown toward the ceiling of a room in front of you will bounce back toward the floor some distance ahead. As I've said, at VHF frequencies the usual case would be as though the ceiling was not there at all. The ball would keep on sailing out of your roofless house to be lost. But when the ionospheric "ceiling" is present, *voilà!* the signal "ball" comes skipping back to the earth "floor" some distance away.

Sporadic? That means that this ionized layer won't always act like a mirror for VHF signals. This mirror-like layer is not uniform. Some parts are more reflective than others; they are patchy. Also, there's no way of predicting when these extra-reflective patches will occur. These mirror portions, when located midway between the transmitter site and your home will then, on occasions, make distant reception possible. A sporadic E patch located "downrange" from your receiving location at a distance of, say, 600 miles, will bring a TV signal originating 1,200 miles away to your antenna.

Because of a more-or-less fixed height above the ground, a single-hop reception—that is, one-bounce off the E layer and back to earth—of up to around 1,500 miles is possible. Signals from about 500 to 1,400 miles are most common via E-skip. Greater distances are possible on those rare occasions when a series of sporadic E patches happen to line up the proper distance away from your location and present double and even triple signal skips.

Sporadic E skip signals are typically strong, sometimes overriding local stations on the same channel, but are subject to deep fades. One minute you may get very strong reception, the next, nothing. This sort of DX reception may last for minutes or many hours.

E-skip reception, TV DXers find, is most common in late spring and early summer. The further south you live, the earlier in the year you should notice these conditions. But from late May through mid-July you should find many "openings." There is a secondary E-skip DX season from mid-December to mid-January. Sporadic E skip reception can occur almost anytime during the day, but more often from around 9 a.m. to around 2 p.m., and again from about 6 p.m. to 11 p.m., local time.

Similar in many ways to sporadic E skip is F-2 layer skip. The "F" layer of the ionosphere is located at a higher altitude above the earth than is the "E" layer. It is extremely rare that the degree of ionization required to reflect U.S. television frequencies occurs in the "F" layer. It is called the F-2 layer because at certain times of the day, the "F" layer separates into two bands, the F-1 and the F2. F-2 skip usually occurs only during the peak portion of the sunspot cycle, still a few years off. F-2 layer reception, rare as it is, can bring in signals from stations more than 1,700 miles away and—with multiple hops—up to the 10,000-plus record distance and perhaps more.

Three other forms of "skip" reception are of interest to TV DXers, though they are, in fact, far less productive of DX signals than is E-layer skip. The Aurora Borealis—the northern lights—can cause VHF TV signals to skip back to earth far distant from their transmission point. Aurora signals usually are subject to severe flutter-type fading, garbling picture and sound and making identification of the distant received station very difficult.

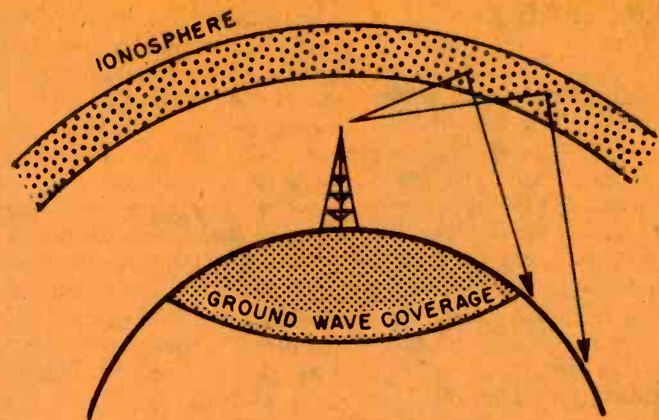
Meteors, as they enter the earth's atmosphere, can leave a narrow ionized trail behind them. This trail can act as the required signal mirror to bounce the TV signals back to you, the distant viewer. The ionized trails are short-lived, however, and you're apt to receive only a quick burst or several quick bursts of reception, usually not long enough to adequately identify the station observed. About the only time meteor burst reception is useful to the TV DXer is when the station affected is screening a test pattern which includes its call letters.

A recently identified propagation mode is known as lightning scatter reception. The whys and wherefores of this type of phenomenon aren't very well known, but it is presumed that lightning flashes in a thunderstorm result in short-term signal reflections similar to that caused by meteor showers. Most "skip" type distant TV reception occurs as a result of sporadic E layer reflection.

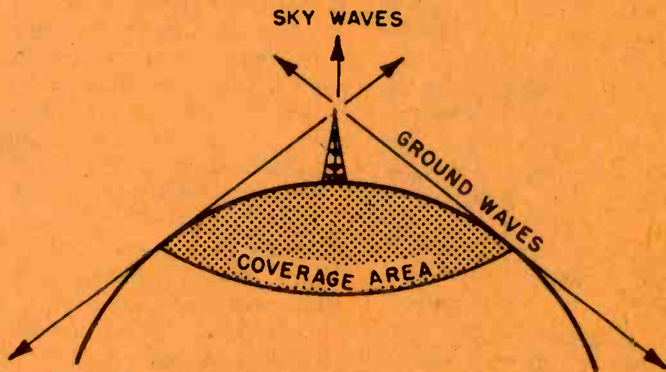
Tropospheric Topics. If, as noted, distant TV station signals can skip or bounce back to earth a long distance from their transmission point, they also can be bent or ducted back as well. This type of TV DX reception is called tropospheric bending or, in the DXer's jargon, Tropo. Tropo is a weather phenomenon occurring in our atmosphere, not in the ionosphere, as is the case with E-skip.

Tropospheric bending of a TV signal requires the meeting of barometric low and high pressure areas and a resulting temperature inversion. In these cases warmer air overrides a colder air mass. In the troposphere a layer develops which bends the outgoing signals and forces them to follow the earth's curvature. In some cases several such layers cause what amounts to a duct or pipeline for the TV signals, bringing reception far beyond the particular station's normal viewing range.

In terms of channels involved you may notice the effect of tropospheric bending on all the VHF frequencies, from channel 2 to 13, and even on UHF.



Electromagnetic energy radiating into space from medium and shortwave transmitting antennas can, as illustrated above, be reflected by the ionosphere andreturned to earth for reception by radio sets far beyond the normal ground wave coverage area. The short wavelengths of a television transmission depend on a different method of propagation. High frequencies radiate a ground wave and a sky wave. Both of these waves travel in essentially straight lines. To receive a sky wave, the receiving antenna must be within line-of-sight of the transmitting antenna—except when conditions are just right for skip.



Signals from a hundred to well over a thousand miles away can be received thanks to Tropo.

Tropospheric effects can be noticed at any time during the year, though the warmer months and, in particular, autums seem best. Dawn and dusk, when temperature changes are most rapid, seem the optimum times. Unlike the deep rapid fades and often brief local-like reception periods of E-skip signals, tropospheric reception can be recognized by the steadiness of the distant signals and the slow fade rate.

Between the two major TV DX propagation modes, sporadic E-skip and tropospheric bending, you can see that scanning the snowbands for distant signals can well be a year-round activity.

Well, you may wonder, if there's all this TV DX around, why haven't I ever seen any of it on my TV set? Maybe you have! Have you ever been watching a favorite program on, say, channel 2, and suddenly reception is ruined by a series of dark bars running horizontally across the picture. Your picture loses "sync" and begins to roll. For a period of time, perhaps a few minutes or an hour or more, regular television viewing on that channel was shot down. Maybe you never did find out whether Rory Calhoun gunned down the guys in the black stetsons in the final reel of the Late Show. More than likely the interference that spoiled your movie was caused by a distant TV station muscling in on your local TV outlet via E-skip reception.

When sporadic E-skip occurs it is first noted on channels 2 and 3. Frequently channel 4 is affected and, when these conditions are better than usual, on channels 5 and 6. And, FM DXers, when you note signs of skip on channel 6, that's the time to watch for similar skip signals on the FM band, located in the VHF range between the frequencies of channels 6 and 7. On rather rare occasions, maybe only once or twice a year, E-skip can be observed on channels 7 and maybe 8.

Under the above conditions, when the interfering black bars appear on the local low band stations—actually these bars are the video equivalent of the heterodyne interference you may be familiar wiht from your SWLing activities—a TV DXer would probably turn to his lowest clear channel.

Say you have locals on channels 2 and 4, but not on 3 and 5. You'd first check channel 3. If you're getting E-skip interference on 2, chances are you'll find a viewable signal from another TV outlet far away on channel 3. On 3, of course, with no local station present, the chances of identifying your TV DX station are greater.

Because of the location of a reflecting patch of the "E" layer, skip reception at any particular time tends to be from the same part of the country. During one "opening" you may be receiving stations from Texas to Louisiana; on another day, those from Bangor or Boston.

If the skip opening is of fairly long duration, you may actually observe that the super-ionized patch of the "E" layer is slowly drifting eastward. If you live on the east coast you may first be able to identify stations in Kansas and Oklahoma. Then these will fade, you'll note a hash as a number of distant station signals mix it up, and gradually signals from Missouri and Tennessee stations will become dominant and viewable.

And, there is such a condition as too much of a good thing. If an E-skip patch or "cloud" is relatively small, only a single station will bounce in at a time, making identification easier. If widespread, a number of stations will be received simultaneously on the same channel, with chaos resulting and none of them are identified.

After checking the local-free low channels, the avid DXer who has an antenna rotor will beam his antenna away from his local station and switch to that channel. If he can minimize the pick-up of his local station it may give the incoming skip signal a chance to overpower it and make an identification possible.

Remember, the skip signal, however distant, is coming virtually right down your throat. If you are 30 or more miles from the local station you may even be getting stronger signals from the skip station than from the local. For this reason, a highly effective antenna system isn't always an advantage and could be a disadvantage. It may even be worth your while to disconnect your roof or tower-mounted antenna and use the built-in rabbit ears to decrease the signal of the local station while still receiving the skip signal.

More Reception Tips. Reception of tropospheric signals is somewhat different from that of E-skip, but many of the techniques used to bring in the signals to a usable level are the same. The big difference is that you'll note Tropo reception on all the VHF TV channels and on UHF frequencies, not just on the lower channels as is the case with E-skip. Secondly, the signals will usually not be as strong, but they will be steadier, with less of the sharp, deep fades. Again you'll probably first detect the presence of Tropo DX signals by observing interference on your regularly viewed area stations.

The technique is the same. Check your "open" channels first, since interference will be minimal on these bands. Then try to get a viewable signal "through" the regular stations on the occupied bands. In the case of Tropo, signals will more often than not be weaker than the locals on the same channels. So, for this sort of TV DX, a highly efficient antenna and a rotor which will allow you to aim your antenna away from the direction of your local and toward the DX station will be a big help. But if you have a number of "open" channels, you can still get quite a bit of tropospheric DX without a rotatable antenna.

Identifying TV DX stations can be a real problem. With the deep fading of E-skip signals, your reception may consist of peek-a-boo programming; one moment you're getting a viewable, intelligible picture and sound, the next moment nothing. Co-channel interference often makes identification difficult.

There are clues, though, which you can look for to help you make the identification. You can check White's Radio Log in COMMUNICATIONS WORLD ($1.35 at your favorite newsstand) to see which stations are broadcasting on the particular channel to which you are tuned. If you're using an antenna rotor you'll have a rough idea, from the strength of the signal as you turn your antenna, from which direction the signal is arriving. If, for example, you live in St. Louis and you're getting optimum reception of a channel 2 skip station when your antenna is headed southeast, you can more or less eliminate the Denver outlet as your station.

Even if you don't get a positive identification of the station's call letters, sometime program content will help. Local news, sports and weather shows at suppertime and late evening may mention the locale—for example, "The high temperature in Boston today was 76 degrees." Keep an eye and ear peeled too for local commericals—"Car buyers! Blivet Ford in Albuquerque is overstocked with brand new . . ." is a dead giveaway.

TV DX QSLs? Once you've managed to identify your TV DX station, your thoughts will probably turn to the matter of verifying your reception. Just as SWLs seek QSL cards from those shortwave stations they hear to prove they actually received those stations, TV DXers also are interested in QSLs. And, fortunately, most television outlets will verify correct reception reports. Some, usually the stations operating on the low VHF channels which receive many reception reports, actually have printed QSL cards. But most will reply with a letter of confirmation if you request.

One thing to remember: most of the TV operators are commercial stations and are interested in reaching an audience in their own immediate area, people who may become customers of the advertisers who buy time on the stations. Your report of reception from afar is only a curiosity item to these stations and their verification replies are gestures of goodwill. Therefore, never demand, always be polite in your request, and enclose return postage with your report.

As with a shortwave reception report, you should tell the station how well it was received, something about your equipment if you wish, but the essentials are the date and time of reception and enough verifiable details of the programming received to enable the engineering or programming department to be sure it was their station.

Clearly this mean that details of a network program you viewed will not be enough. A number of different stations on the same channel will be carrying the same network program at the same time. Local commercials, details of local programs, a description of the station's identification-call letter "slide" should help to prove your reception.

Instant QSLs? One way is to photograph the DX station on your screen. Many TV DXers have scrapbooks filled with photos they've taken of their DX catches, test patterns and ID slides. Ex-

(Continued on page 93)

e/e counts on...

HEATHKIT IC-2100 ELECTRONIC SLIDE RULE

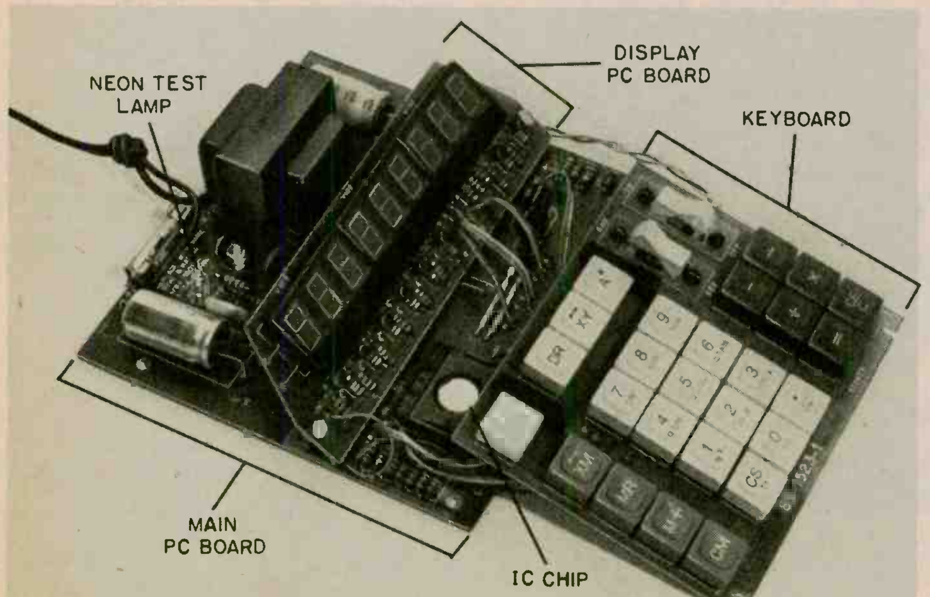
☐ You can walk into just about any department store and buy a *wired* calculator with the transcendental functions (sine, cosine, arc sine, etc.) for $50 to $120. Essentially the same functions are found in Heathkit's IC-2100 Electronic Slide Rule which sells for $119.95 *in kit form*.

Obviously, the Heathkit IC-2100 must have something going for it that is not apparent at first glance. Actually, there are two big pluses. First, the IC-2100 is an AC powered desk top model with large keys and a bright, large display almost ½-inch high. (The same display used in Heathkit's digital clocks.) You do not have to change to your reading glasses or tilt your bifocals to read the Heathkit calculator. Nor, because of its size, is it likely to grow feet and walk out (in someone's pocket). Second, the IC-2100 has an accumulation memory independent of the operating keys. You can clear a calculation and hold the memory, add to what is already in the memory, subtract from the memory, exchange the memory total with the working register to check intermediate solutions or look for an error in calculations, and even automatically solve for anti-log without using a scratch pad, for the memory can serve as an electronic scratch pad.

The Heathkit IC-2100 Electronic Slide Rule calculator is available mail order or from Heath stores. Price is $119.95 mail order plus postage. For catalog information circle No. 1 on R. S. Coupon on page 17.

It Functions. The calculator provides the four basic arithmetic functions of addition, subtraction, multiplication, and division, and all work in the chain mode; meaning, you don't have to press the = key after each operation. For example, you can add a string of numbers, subtract, go through a few steps of multiplication and division, back to addition, etc., and finally hit the = key for the solution.

The decimal is full "floating," automatically positioned to display the most significant digits.



The IC-2100 is assembled on three separate printed and drilled circuit boards. Multi-colored flat-wire cable between the keyboard and main board essentially eliminate the possibility of wiring error. Neon test lamp is used to check out high-voltage test circuit, a necessary step to protect the IC from damage.

Twelve keys serve for the numerals 0 through 9, the decimal and CS (change sign). These keys also serve for the transcendental functions: the value of *pi* (3.1415926), reciprocal (1/x) and square root if a key marked **F** for *function* is pressed. For example, the 7 key is also designated SIN (sine). To find the sine of 30° you would enter 30, press **F** to switch the key functions, press SIN (the 7 key) and the display would show *0.5*, the sine of 30°.

The transcendental functions provided by the double-duty numeral keys are: sine, cosine, tangent, arc sine, arc cosine, arc tangent, e^x, ln xn and log x (to base 10). Three additional keys provide for A^x—often termed x^y on other calculators—X-Y interchange and DR. DR is cute. Should you enter a number and then forget to press the F button before pressing the transcendental, pi, 1/x or square root keys you will enter an extra digit. The DR key clears this extra digit and allows you to key the F without need to clear everything out of the calculator.

A rocker switch provides for operation in degrees or radians. Four memory system keys provide for M+ (add into memory), memory read, memory clear and M-X interchange. The memory does not clear when the calculator is cleared, allowing you to hold a value in storage as you run through several problems. (The memory can also serve as a parenthesis.)

Constants are stored for the four arithmetic modes; they are the first or second entry depending on the mode.

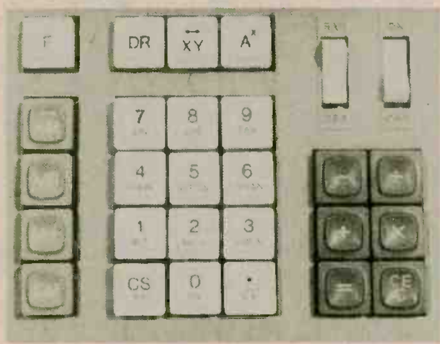
What You See. The display indicates up to eight digits; the ninth display is used to indicate the "—" sign, function key mode, and overrange (displayed as an upside down U). Though eight significant digits can be displayed, the calculator's working capacity is sixteen digits.

Log Thinking. Of interest, logarithm solutions involving values less than 1 are indicated directly such as −1.3336 rather than the mathematical notation of 9.3336−10. This is particularly handy when solving problems in dBs as the answer is direct reading. For example, assume the power output of a 4-watt amplifier is reduced to 2 watts. What is the difference in dBs? Rewriting the formula 10 log P2/P1 as log P2/P1 times 10 so the calculator can handle it directly without a scratch pad, we plug in the numbers and get log 2/4 times 10 or −3.0103 dB.

One feature you might find confusing, but which is common to almost all "scientific" and "slide rule" calculators is lack of automatic roundoff. If 2 is raised to the third power via the constant function, the answer shows as 8; but if it is raised to the third power via the A^x key it is shown as 7.999992. (2^3 through the constant is easy. Try 3^{12} without using A^x.) The reason for this insignificant error is because the calculator itself works internally through log *e* and logs have more than six digits, as do most other transcendental functions.

One Part, Many Functions. One integrated circuit provides all the calculator functions. All the other transistors are needed only to drive the display devices. The IC is programmed so only eight digits can be entered. As shown in the photograph the IC has many (40) leads—all delicate, so a socket is provided in the kit. (The IC is not soldered into the circuit.) It is also prone to static voltage damage, and there is a specific procedure for handling the IC detailed in the manual. Until you're ready to install the IC it should not be removed from its box, not even for a quick look.

Putting It Together. Construction takes about two long evenings. All components mount on three circuit boards. The largest board has the power supply and display device drivers (main board). A smaller board, which mounts over the driver board, is used for the three three-digit display devices. The third PC board is the keyboard, which is user assembled. Since the keys are oversize with relatively large terminals it is actually the easiest part of the assembly; so if you have had a bad experience with other keyboards in kits, fear not, you'll not have any problems at all with the IC-2100's keyboard.



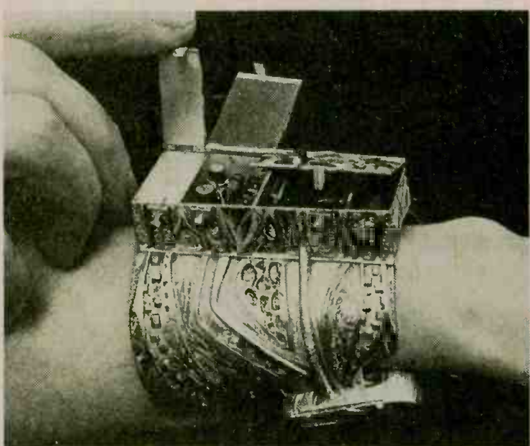
When the F (function) key is depressed, the numeral keys provide the functions indicated under the numerals. The memory bank (indicated by an M on the keys) is independent of the calculator clear (CE/C), and a value can be retained or used from the memory even when the calculator has been totally cleared for the next problem.

Typical of the more sophisticated Heathkits, the IC-2100 has a built-in test circuit. In addition to the 15 VDC power supply for the IC there is a ±200 VDC supply for the display circuits. If there is a wiring error in the high voltage circuit you can cause a lot of damage before you know about it, so Heathkit has provided a high voltage neon lamp indicator on the main circuit board which is used to check out the high voltage supply before installing the IC. This circuit consists of a neon lamp, a voltage dropping (current limiting) resistor and a push-in terminal. The user connects a wire to the terminal and then checks several high voltage test points. If the correct elements of the lamp glow for the associated test points the high voltage supply and its connections are correct and it's safe to install the IC. There are no other checks or adjustments.

Install the IC in its socket and the calculator is ready to go. The IC drops into the socket, and a locking cover secures the IC and forces its terminals into the socket contacts. But double-check that the IC is properly installed, as it can enter the socket two ways. There is a dot on the PC board which is supposed to line up with the dot painted on top of the IC. If you reverse

(Continued on page 91)

Hark, Hark...the Heart!



The girl going full speed ahead up a flight of stairs is about to be warned by her bracelet to slow down. Above, you see the sensoring device and the electronic works of this heart-saver exposed to sight, as well as a third compartment that holds medications.

□ "Hey, slow down!" is what this bracelet says, via an ingenious electronic mini-system, if its wearer overstresses her heart. This space-age bracelet was invented and made by Mary Ann Scherr of Akron, Ohio. Combining attractive design with practical use has long been the idea behind her work. She feels that something is more valuable if it fulfills a two-fold purpose: both to be of artistic merit and to be of practical, functional use. So Mary Ann designed a bracelet of silver which also monitors the wearer's heartbeat or pulse rate. The bracelet measures only 3 x 3 x 4 inches, and houses a sensor which monitors the pulse rate. A tiny bulb flashes with each beat of the wearer's heart, and is fitted to the top of the bracelet. Should the wearer stress the heart by running up a flight of stairs, for instance, or should the blood pressure change suddently due to a heart ailment then an alarm sounds from within the bracelet, alerting the wearer to take it easy or to seek medical aid. For people with known heart conditions there is a compartment fitted in the bracelet to hold whatever medication might be needed. It's good to know this "alarming" bracelet might save someone's life, thanks to the combination of esthetics and electronics. ■

E/E'S BEGINNER'S PROJECT

WINKY—THE LIGHT INFORMER

A flashy way of attracting attention, filling in photos, announcing danger or just having fun!

by Herb Friedman

HERE'S A PROJECT you can build that doesn't do much more more than wink and blink, but as an attention getter and fun project it's hard to beat. Capable of being powered by 6- or 12-volt dry cells, or the 12 volts from your car's cigarette lighter, *Winky* uses an electronic flashtube such as found in photographic strobe lights to provide a short, brilliant "strobe" burst of light at intervals of every four seconds or longer.

Uses for Winky are limited only by your imagination. For example, in a store window the bright flash is sure to be an attention-getter, as it would be for school displays. With red cellophane or plastic around the flashtube it becomes a warning beacon. For ultra-close macro photography it provides enough light for the picture (open shutter) without "frying" the object. (Note: Winky does not give enough light for general photography.)

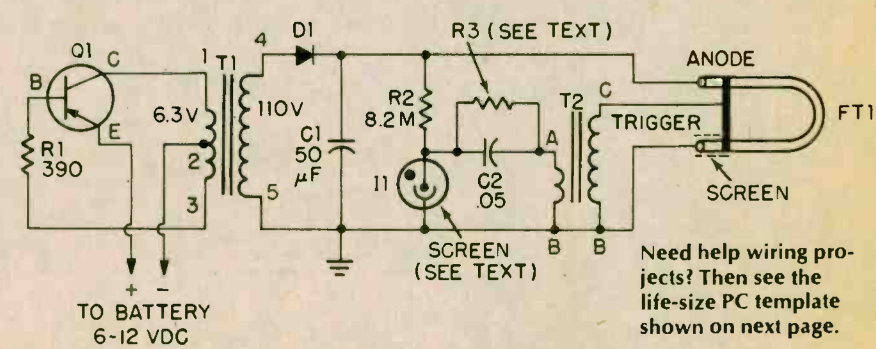
No Supply Problem. Parts are generally available in most electronic parts supply stores. The layout is absolutely non-critical, and you can use point-to-point or printed circuit wiring. For those of you who want a quick assembly so you can get right down to using Winky we show a PC layout that can be used in just about any cabinet, or even breadboard if you take safety precautions around the high voltage.

The model shown was used as an attention-getter for a community fund drive display in a store window with Winky mounted inside a standard plastic utility cabinet. A 1½-in. hole in the end of the cabinet with a celluloid "window" cut from a radio parts blister-pack allows the light to shine out. For a bright beam of light an inexpensive lens—such as sold in hobby shops—can be substituted for the celluloid.

How It Winks. Transistor Q1 and transformer T1 form a high-frequency oscillator. The current flowing in T1's primary winding induces a high voltage in T1's secondary. This voltage is rectified by D1 and filtered by C1: the resultant voltage being approximately 300 to 400 VDC. The flashtube, FT1, and the R2/I1 series circuit are connected across C1. As the voltage builds across C1, the voltage across neon bulb I1 similarly builds, charging C2 through the T2 path to ground. When the voltage across I1 is sufficient to cause neon in the bulb to conduct, the neon gas is ionized, providing a low resistance path to ground which causes C2 to discharge through I1 and back through T2's primary winding. The sudden flow of current through T2's primary induces a very high voltage in T2's secondary which triggers the flashtube. At the instant the flashtube triggers—caused by

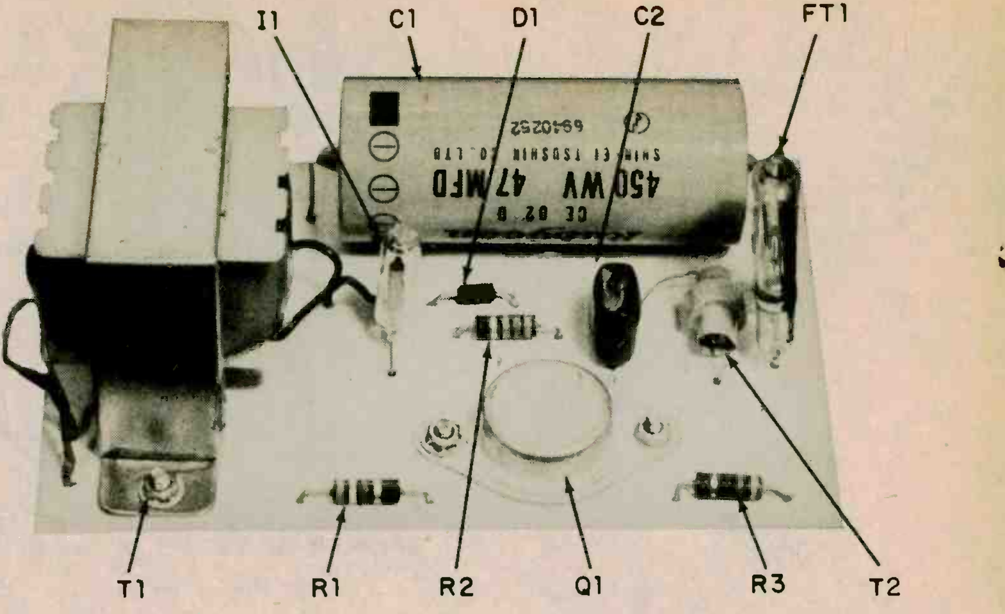
PARTS LIST FOR WINKY

- C1—47 or 50-uF, 450-VDC
- C2—.05-uF, 200-VDC disc capacitor (Radio Shack 272-1068 or equiv.)
- D1—silicon rectifier, 500 PIV, 500 mA (Radio Shack 276-1104 or 276-1139, or equiv.)
- FT-1—xenon flashtube (Radio Shack 272-1145 or equiv.) lamp
- I1—neon lamp (see text for description)
- Q1—2N155 pnp power transistor (Radio Shack 276-2006 or equiv.)
- R1—390-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
- R2—8,200,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
- R3—see text for value (Radio Shack 271-000 or equiv.)
- T1—filament transformer, 110-V prl. to 6.3-V center-tapped sec. at .5 A (Radio Shack 273-1510 or equiv.)
- T2—trigger transformer for matching to FT-1 xenon flashtube (Radio Shack 272-1146 or equiv.)
- Misc.—Printed circuit board materials and chemicals, cabinet 7¾ x 4⅜ x 2⅜-in., hardware, wire, solder, line cord, etc.



Need help wiring projects? Then see the life-size PC template shown on next page.

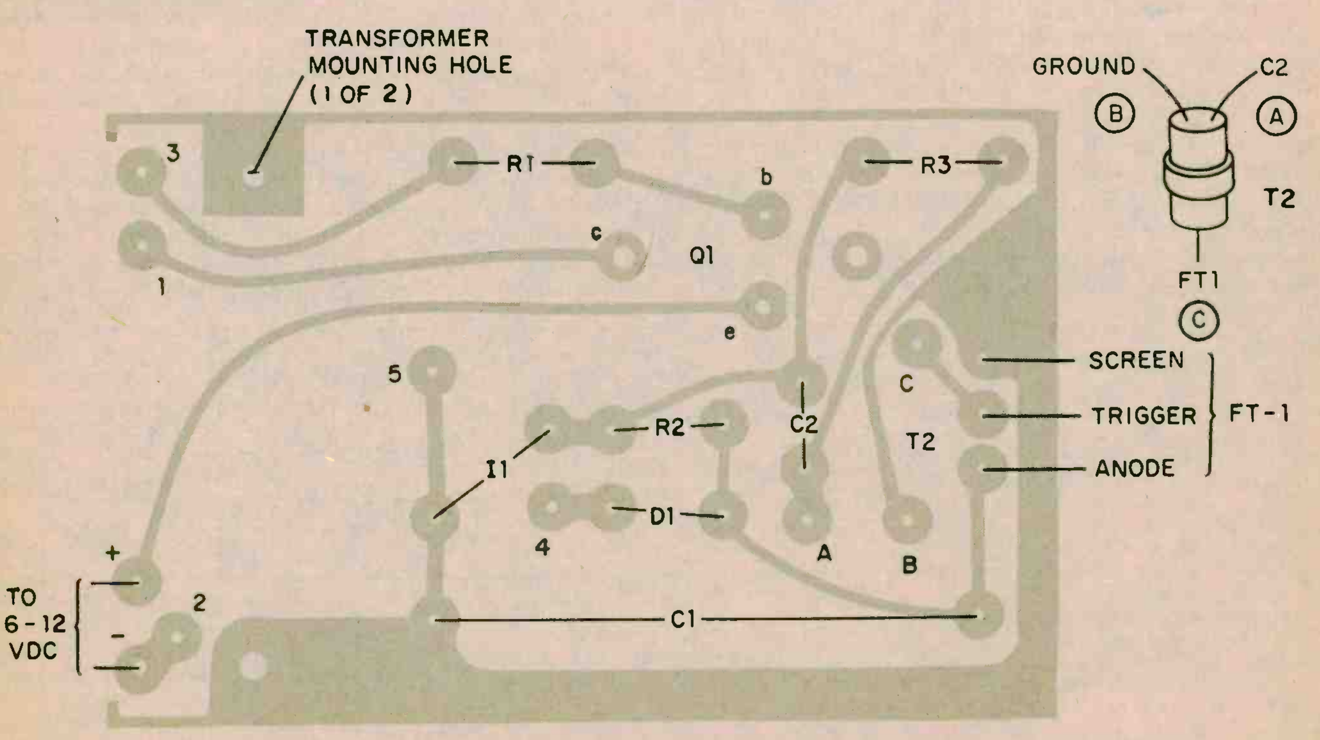
C2's discharge into the tube—the voltage across C1 starts to decay (very rapidly). When C1's voltage falls sufficiently low, below I1 deionizing voltage, I1 turns off and the cycle starts over. It takes about four seconds for the cycle to repeat. The cycle can be extended upwards from four seconds by connecting a resistance of 5 megohms or more across C2. Resistor R3 has provision for its use on the PC board template. An 8.2 megohm resistor for R3 will provide a flash repetition rate of approximately eight seconds.



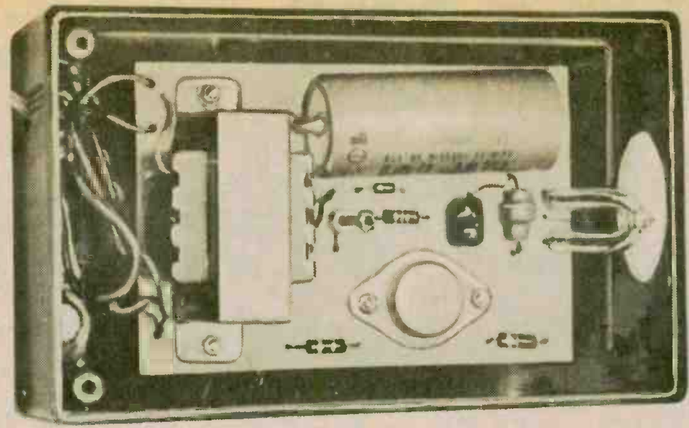
Here's what the homemade printed circuit board looks like after all the parts are mounted. Template dimensions and parts location are not critical—any practical and clean layout will produce a working Winky.

Construction. The PC board can be any type of copper-clad material 3 in. x 4¾ in. First, scrub the copper foil with a strong household cleanser such as *Ajax*, and then rinse and dry. Slip the board under the template and using a sharp pointed tool, such as an ice pick or scribe, punch through the template into the copper at each indicated component mounting hole. Remove the board and, using a resist ink pen, freehand the connections between the indents in the copper. Then build with resist a circle approximately 3/16 in. around each indent. It might look sloppy but it will work—there's lots of room on the board—and it's a lot faster than making a precise carbon-transfer of the template.

Immerse the board, copper side down, under about ¼ in. of etchant, or float the board copper side down on the etchant if you can get it to float. After about 30 minutes of intermittent agitation check to see if all the excess copper is removed. When all the excess copper is gone rinse the board under running water and remove the resist with resist solvent or by scrubbing with steel wool. (All printed circuit board supplies are available from Radio



The template shows the foil side of the printed circuit board. Simple enough to build, you can even use flea clips on a perf board. Do not make board until the transformer is obtained—its mounting holes may differ.



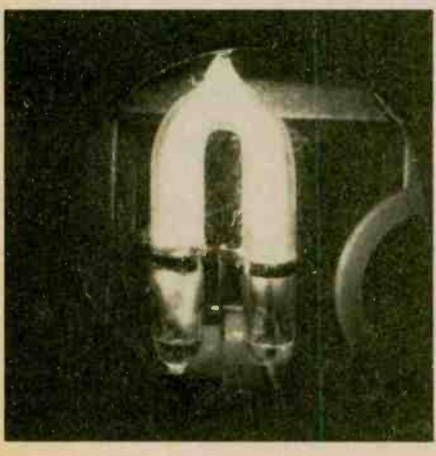
Cemented in place, the printed circuit board rests neatly in a plastic cabinet. Transformer size determines cabinet size. Look for a small transformer. Power output is secondary to size.

Shack.)

Drill the mounting holes for transistor Q1 first; use at least a #21 bit for a #4 or #6 screw. Use the same bit for T1's mounting screws. Use a #55 or #56 bit for all other component holes. Then enlarge the holes for the battery connecting cables (indicated "+" and "−"), flashtube FT-1, and the *E* and *B* leads of Q1 with a #45 drill bit.

Install the components on the PC board starting with T1 and ending with FT1. Transformer T1 can be any center-tapped 6.3 VAC filament transformer rated 500 mA for a power source up to 6 volts, and 1 ampere for a power source from 6 to 12 volts. Silicon rectifier SR1 should be rated at least 500 PIV at 500 mA.

Neon lamp I1 must be the "imported" type that appears to have a round cylinder inside the glass. The project will not work with the NE-2 or NE-53 type of neon lamp, the type with two metal wires inside the glass. Unfortunately, *hobby type* neon lamps can be either design; make certain you get the cylinder type. The I1 lead that connects to the cylinder (the other lead runs through the cylinder) is the *ground* lead.



Don't look, but this is what the photoflash looks like as it is fired. Note the U-shaped tube is centered in the hole cut in the plastic cabinet.

Two types of trigger transformers (T2) are available to hobbyists. The sleeve type has two leads on one end—connect it as shown.

The four-terminal coil type or trigger transformer has one terminal color-coded *red*; the red terminal connects to the flashtube. Short any two adjacent terminals and use them for the ground connection. If the coil-type is supplied with instructions follow the instructions as to connections.

Phototube FT1 is U-shaped, with a terminal at each end and one in the center (usually a trigger strap). Note that one end of the tube has a miniature metal *screen;* this is the ground terminal end.

Checkout. Connect Winky to a 6-volt battery (such as a small lantern battery). You should hear a whine from T1, and a voltmeter connected across C1 should start to build towards 300 VDC. If you don't get operation reverse T1's outer-winding connections.

If the power supply is okay and the voltage builds but the flashtube doesn't fire at approximately 300 volts check that T2 is installed correctly and FT-1's screen connection is the one connected to ground.

Installation. There are no mounting holes in the PC board because they are not necessary if Winky is mounted in a plastic cabinet, which it should be. Don't use a metal cabinet—it's too much unnecessary trouble. Simply put a few large gobs of RTV silicon rubber adhesive such as G.E. Window Sealer or Bathtub Caulk on the bottom of the PC board and press the board down firmly into the cabinet. Let the adhesive dry overnight and you'll have a shock-resistant mounting. ■

SECURITY IN A PLASTIC KEY

Gone are the metal key and lock, replaced by a plastic card! Above, you see the plastic receiver unit. Push the card in and the door opens.

☐ After centuries of use, and relatively little change since its invention, the metal key may be on the way out—replaced by plastic cards as part of an electronically operated card-lock system. The trouble with a key-type lock is that no matter how complex its internal works are, it is always possible for a professional lock-picker to open it. The new "Cardguard" system, however, is supposed to be 100% foolproof. The system uses a small plastic card—like a credit card—as the key to the lock. The cards have a series of holes punched in them which correspond in formation to the internal pickup of the lock on the door. Only the card with the correctly-positioned holes can activate the lock and open the door. The designers of the card keys use a computer-like electronic logic system to select the lock combinations of holes. This makes it possible to have 2,500,000 different hole positions before all the combinations are exhausted for that size card. The Cardguard system is already in use in several American hotels, and someday even you and I may be using a plastic card to open our front door. ■

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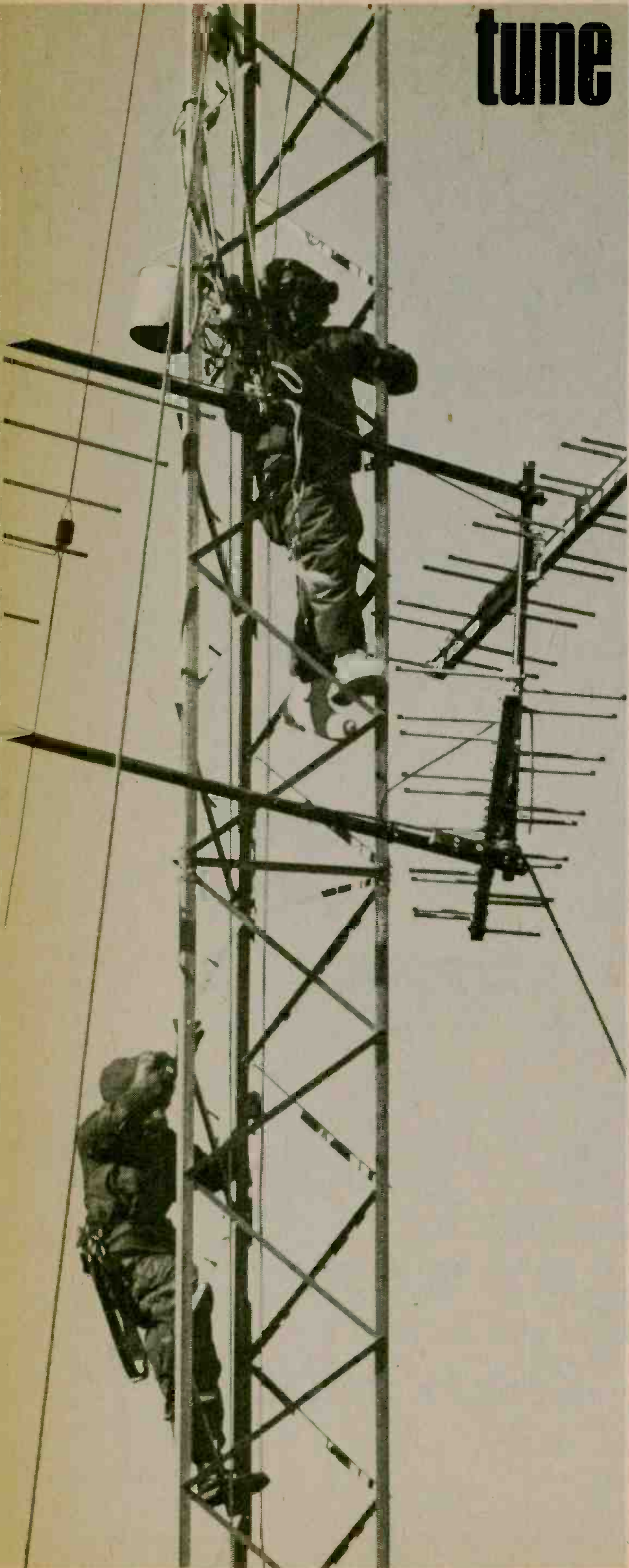


tune in AFAN McMURDO

The world's southernmost DX Station

by Don Jensen, Shortwave Editor

☐ "This is AFAN McMurdo, the southernmost station in the world . . . American Forces Antarctic Network."

That announcement, first heard last summer by "down under" SWLs in Australia and New Zealand, really set the DXing fraternity on its ear! The news was totally unexpected. As far as shortwave broadcast DXers were concerned there were only six continents on the globe: There had been no inkling, no advance hint that suddenly the SW world would have a seventh continent—Antarctica.

True, Antarctica was not without its radio voices. There were various military communications and amateur radio signals which could be logged, on occasion, Stateside. And though the rest of the world was beyond its range, a medium wave station—more recently an FM outlet—provided local broadcasts for military personnel at McMurdo base.

But this was different. AFAN McMurdo's new outlet was a *real shortwave broadcasting station* with real programs, news, entertainment, pop music, deejays and all, a realistic target for SWBC DXers.

Global Action. Across the world, interest in the new station mounted. In the U.S., SWLs began setting their alarm clocks for ungodly predawn hours, the best time, theoretically, to hear the station. At 3 a.m., 4 a.m., 5 a.m., countless shortwave receivers were switched on and tuned to 6,012 kHz, AFAN McMurdo's frequency.

Several months went by and no solid loggings. Part of the problem was the annoying interference from an all-night Costa Rican shortwave outlet on an adjoining frequency. Even the most persistent listeners managed only a nasty heterodyne "howl" and, now and then, a few fragments of music programming.

Fall came to North America. Finally, as it happens in DXing, reception conditions changed. The months of frustration came to an end. Early one October morning, a handful of DXers in Massachusetts, New Jersey, Michigan, Illinois and Wisconsin simultaneously received intelligible signals from the world's most southerly SW station. About the same time a California SWL also picked up the signals.

Other loggings followed. At first just a few, then dozens of receptions were reported across the continent. Later the first QSLs were received, purple-ink duplicated verification letters signed by J. T. Adams, public affairs officer for the Navy's Operation Deepfreeze.

What's Down There? Antarctica is about as remote a spot as one can find on the globe. On many world maps it doesn't show up at all, except perhaps for just a jutting peninsula or two at the bottom of the chart.

Antarctica is a place of extremes. The world's coldest temperature was recorded here. Its interior is without life—plant or animal. Millions of square miles are totally untouched by man. Until 1838, man only suspected the existence of *terra incognita australis,* the unknown southern land. And it wasn't until 1911 that polar explorers Scott and Amundsen reached the earth's southern axis, an adventure that cost Scott his life.

Admiral Richard E. Byrd mounted Antarctic expeditions in 1928, 1933, 1939, and 1946. But the first permanent exploration stations were not constructed until the International Geophysical Year, 1957-58.

McMurdo base, Antarctica (top) isn't the pleasantest-looking of terrains, but it is home to several hundred American scientists and military personnel during the "warm" summer months. AFAN McMurdo is about their only source of entertainment—and a great DX catch for you! Hallett station (above), shown here in the grip of a "deep freeze," is one of the remote U.S. bases, along with Byrd and South Pole stations, served by AFAN McMurdo's SW voice. This is about as far south as you can go (left): the geographic South Pole.

Today, the main United States base is at McMurdo on the tip of Ross Island, off the Antarctic coast, some 800 miles from the South Pole. Russia, New Zealand, and several other nations maintain a handful of bases on the continent as well.

Our bases are operated by the U.S. Navy, part of Operation Deepfreeze. During the "warm" months, roughly October through February, something like 900 American scientists and military support personnel probe the continent's frozen secrets.

During the rest of the year, the long, long winter when the sun's rays don't peek over the icy horizon for months on end, the Navy stations a "winter-over" crew of around 200 at the Antarctic bases.

Why SW Radio? Morale is always a potential problem. So the U.S. Navy, in cooperation with AFRTS, the American Forces Radio and TV Service, established a local radio station to provide entertainment for the men of McMurdo. More recently, the low powered medium wave broadcaster was replaced by an FM station transmitting on 100 MHz. But as most DXers know, FM signals have only a very short range.

In late 1973, television came to Antarctica. A volunteer crew of electronics technicians, led by then chief of Navy broadcasting, J. E. Rizer, installed a three-channel TV network at McMurdo.

On November 9, the first telecasts were seen by viewers

"We began experimenting on shortwave in March '74," Carter explains. "After many hours of trial and error, we perfected it, and shortwave transmissions began."

Seven days a week, from 6 a.m. to 1 a.m. local time (1800 to 1300 GMT), Navy deejays broadcast pop music and patter live from the AFAN studios in what they call "Downtown McMurdo." The remaining five hours of the at McMurdo, nearby Williams Field, and New Zealand's Scott Base. But, like the FM station, AFAN-TV had a very limited range. Programs could not reach the more distant Antarctic outposts, Hallet, Byrd, and South Pole.

Only a month before the TV station became operational, Radioman 1st Class William R. Carter arrived "on the ice." For Bill Carter, newly assigned as AFAN station manager and leading officer for the McMurdo communications department, it looked like a long one-year tour away from his wife and ten-year-old daughter back in Middletown, Ohio.

One thing there is no shortage of in Antarctica during the winter is *time*, time to think. And one of the things Carter thought about was how to provide all of the isolated Antarctic bases with continuous radio entertainment. He talked it over with another radio technician and with his communications counterpart at the South Pole outpost. Collectively, they had a brainstorm.

Why not rebroadcast the short range FM programs of AFAN McMurdo via shortwave?

(Continued from page 92)

A NEW FACE FOR CB...?

by the Elementary Electronics

IF the FCC's own proposal for restructuring of the citizens band goes through—which appears likely—in a few short years class D CB will be just another form of "business band" or commercial two-way radio, with all the expected restrictions on operation, equipment type approval or acceptance, and of course, high costs. The hobbying, endless chit-chat and "technical conferences" that take up most of today's channel space and time—not to forget interference caused to legitimate users—will be a thing of the past. (Anyone who wants to hobby or "communicate" will have even better opportunities—see Kathi's column in this issue.)

On the surface, however, the FCC's Citizens Band proposal appears to expand Class D service. We've selected some of the highlights of the proposal to give you a better idea of the features that will most directly affect *you.*

The CB frequencies will be extended up to 27.540 MHz, providing room—at the beginning—for 47 additional frequencies. Starting at 27.310 MHz there will be 40 additional channels to be used only for A3J emission, which is upper sideband/suppressed carrier (SSB). The reason for the upper-sideband limitation is that the channels will be spaced only 5 kHz apart, leaving just enough room for a modulation bandwidth of 54 kHz plus 1 kHz guard between adjacent channels. (If lower-sideband were also allowed, the modulation could spill into an upper-sideband signal on the *lower* adjacent channel.) In this manner we squeeze 40 channels into the space that could hold only 20 double-sideband AM channels.

Between 27.255 MHz (channel 23) and 27.310 MHz, seven new "standard" channels will be added, providing a total of 30 channels which could be used for either AM, upper, or lower sideband. Five years after the effective date of the new proposal, these 30 channels, with the exception of channels 9 and 11, will also be restructured for upper-sideband only; and with 5 kHz spacing between channels—instead of the present 10 kHz—there will be 59 channels plus the original 40 upper-sideband for a grand total of 99 CB channels.

Channel 9 will remain the emergency channel, while channel 11 becomes a national calling channel. Stations would establish contact on channel 11, then move to another channel for their communications.

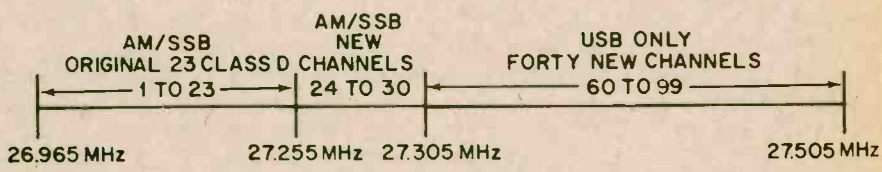
Another Reg. Channel use will be restricted on adoption of the proposal. Channels 1 through 30 could be used for communications between units of the same or different stations (later to be channels 1 through 59). Channels 60 through 99 could be used only between units of the same station.

On channels 9 and 11, only type A3H emission could be used (upper-sideband with full carrier—an AM compatible signal). Transceivers with capacity for four or more channels will be required to be equipped for operation on channels 9 and 11, with the transceiver's channel selector so connected that the correct type of emission is automatically determined by the channel selector.

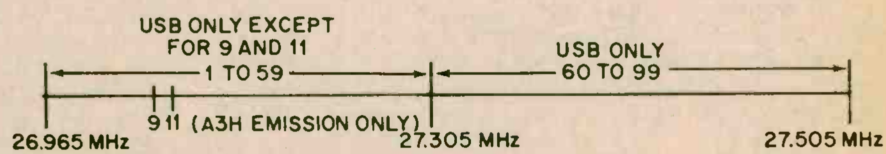
A logical question is: "Why a different emission for channels 9 and 11; doesn't it complicate the transceiver's design?" Yes, it does complicate things, but it provides for the interim change-over to SSB operation. Equipment can be used for up to five years after adoption of the proposal; but after the first year, transceivers cannot be manufactured which are anything other than upper-sideband (except for channels 9 and 11).

Now suppose you had an all-sideband transceiver and you sent out a distress call on channel 9. How would you be heard by most other transceivers in use, which are AM? The answer is simple. A sideband signal with full carrier can be received on any AM receiver, so dur-

Today dealer shelves bulge with CB sets of every description in a wide price range. If you buy equipment today, will it become obsolete tomorrow? Read our answer.



Initial proposed class D expansion would add seven AM/SSB channels, number 24 to 30, and forty upper sideband only channels, 60 to 99. Only channels 1 to 30 are to be used for communication with other licensees.



Final expansion of citizens band channels under the Federal Communications Commission's new proposed rules would convert channels 1 to 30 exclusively to upper sideband suppressed carrier; Channels 9 and 11 are excepted.

It may never be the same again if the FCC passes its own rules changes. Every CBer should know what may be in store!

editorial staff.

ing the five year changeover period, the A3H emission of the newer units will allow a channel 9 or 11 signal to be picked up by any CB station. Since the shift to A3H on channels 9 and 11 must be automatic, there's no problem for the user: he simply flips the channel selec- to 9 and 11, and the correct emission is broadcast.

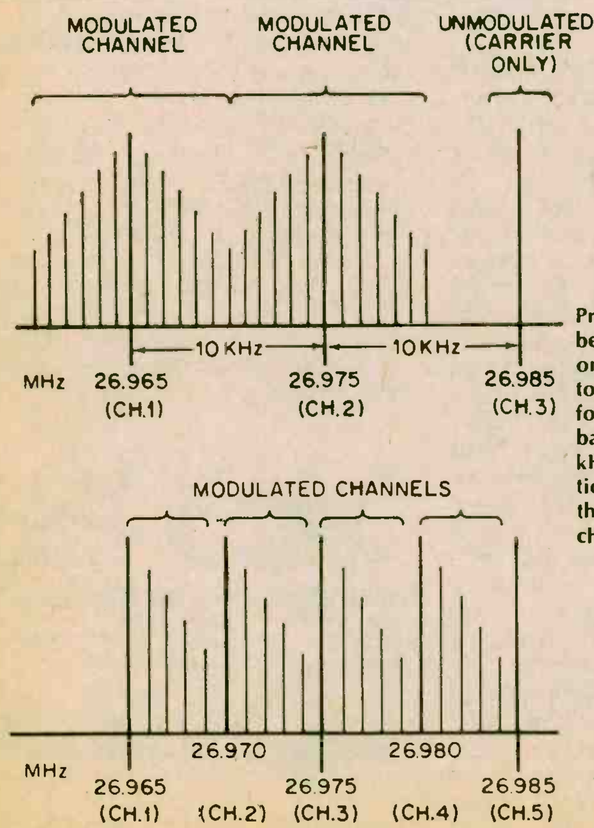
For the commercial user with no need for the extra expense of automatic A3H emission, he need simply purchase a transceiver with less than four channel capability.

No More Afterburners. CB was intended as, and remains, a short range communications medium. One of the problems that has plagued CB almost from its inception is the high-power booster tucked away under the desk or in the trunk. Combine a power amplifier with a highly directional antenna and the signal range moves out two or three counties, well beyond the FCC's intended range, causing interference to users who should be getting interference-free communications. It is one thing to outlaw power amplifiers, it is quite another thing to enforce the rule (as the FCC has discovered). Power amplifiers will be eliminated by the simple act of requiring type acceptance of all CB antennas; the FCC has proposed some hard and fast rules for acceptable antennas, and any antenna installed one year after the effective date of the new proposals must meet the rules (in fact, it will be illegal to market a CB antenna that doesn't conform). Antennas in use prior to the effective date can continue to be used as long as they are used at the same location by the same licensee. If you move, or give up your license, the antenna is no longer legal.

These are the highlights of the proposed antenna rules. First, antennas would have a maximum power handling capacity 10 dB (10X) greater than the permitted power. As example, if the FCC specifies a maximum power output of 4 watts (AM for illustration), the antenna could handle no more than 40 watts. A high power (illegal) ampiifier would simply *Zap!* the antenna. Second, the antenna gain could not be greater than 8 dB compared to a reference dipole antenna (in terms of radiated signal). Thirdly, the front-to-back ratio compared to the major horizontal lobe could not exceed 30 dB. On the face this doesn't appear to mean much to the average CBer; what it does is prevent antenna manufacturers from pulling tricks by using major lobes *other* than forward to exceed the 8 dB reference limitation.

Beyond Sixty. Of course, these proposed antenna limitations are in addition to the new antenna rules which allow an antenna height up to 60 feet providing the antenna has an omnidirectional pattern and no gain. Antennas no higher than 20 feet can be directional (have gain over a reference dipole). The antenna "problem" has existed for almost the entire history of CB, and there's nothing to say the antenna proposals won't be modified five times over before the rules are finalized. The key to what's expected is the FCC's avowed pur-

(Continued on page 92)



Present class D channels will be split to create a new SSB-only band. Final conversion of todays channels provides space for 4 kHz worth of upper sideband modulation space and 1 kHz for channel-guard separation. This puts two channels in the space originally used by 1 channel thus doubling channels.

Will public service organizations such as volunteer fire departments be the only ones left holding a CB microphone? Will all-SSB be too expensive for today's CBer?

ROCK BOTTOM COST HIGH BAND MONITOR

by Herb Friedman

Getting bored by the temp-humidity index? Slide an inexpensive weather monitor up or down for some exciting signal hunting!

BECAUSE they're priced so low, generally from $10 to $20, the "weather monitor" has been a hot gift item for the electronics experimenter, so you probably have one. Tuning the weather station frequencies of 162.40 and/or 162.55 MHz, these small, inexpensive radios are supposed to keep you up to date on the latest weather conditions. But as you've probably discovered yourself, unless you're a boat owner with need for tide and sea conditions, you get a more up-to-date report from your local news station—AM or FM.

Also, reception is probably not all that great. The recommended receiver sensitivity for weather station reception is 0.6 uV for a 50-mile range, and these inexpensive weather receivers can't get anywhere near this kind of sensitivity.

But there's no need to let an unused weather receiver sit on the shelf. Fortunately, very few models use crystal control tuning, and they are easily converted to a police or fire monitor, or even a sound channel receiver for the higher VHF TV stations. But remember, there won't be any super-sensitivity. TV stations might be received some 30 or 40 miles from the transmitter, but you'll have to be within 2 miles or so of the average police or fire transmitter to pick them up. If you live near an airport you might get coverage of the aircraft frequencies above 108 MHz, but with sharply reduced sensitivity.

The weather monitors are generally similar in electronic design, though the packaging might be anything from a cube to a desk-top pen holder. The circuits are bare-minimum superhet receivers with a local oscillator tuned over a limited range by a panel control. Generally, there are two panel controls, one for *volume* and one for *fine tuning*. The fine tuning knob might have calibrations for *both* weather frequencies, or no calibration at all. It doesn't make any difference as long as the local oscillator is tunable.

To change the weather monitor tuning range, all you need do is connect a small external trimmer capacitor across the oscillator tuning capacitor—the fine tuning control. The value of capacitor will determine which frequencies are tuned. Keep in mind that as you tune lower in frequency the sensitivity is sharply reduced, particularly below about 160 MHz. A capacitor with a maximum value of 7 pF will get you down to the police/fire frequencies. A 60 pF maximum trimmer will get you about to the top of the FM band, but tuning will be extremely critical and sensitivity will be very low.

A 60 pF trimmer will also get you some of the TV sound carriers above 162 MHz. How can you receive signals above 162 MHz if the tuning range is lowered? Simple. The harmonics of the local oscillator are used to receive the TV stations. For example, if you lower the monitor's oscillator to, say, 100 MHz, the oscillator's harmonic output is also 200 MHz, and a very weak 300 MHz. (The monitor's front end appears to pass the frequencies above the design-range, 162 MHz, with greater sensitivity than lower frequencies.)

Tear It Down. To experiment you must first get the circuit out of its cabinet. Keep in mind these weather monitors are inexpensive and designed to be assembled quickly by unskilled workers. Don't go looking for tricky or difficult assembly sub-systems. Generally, one or two screws are all that's holding the cabinet together. If necessary, unsolder the speaker wires, battery wires and on-off switch wires, and remove the circuit board from the cabinet. Locate the trimmer capacitor used for the fine tuning and its two solder terminals. Solder a 3-in. length of solid, insulated wire to each terminal.

Check how the board fits the cabinet and mark the outside of the cabinet nearest the fine tuning. Drill two small holes at the mark and then install a trimmer capacitor on the cabinet near the holes. Or, you don't have to secure the trimmer if you feel you will experiment with different capacitor values, but it will be difficult to tune the stations with a "floating" trimmer. You can't hand-hold the trimmer because the capacitance from your hand will affect the tuning adjustments.

Slip the wires from the fine tuning control through the holes you've drilled in the cabinet and seat the circuit board. Then reassemble the monitor.

Connect the wires protruding through the cabinet to the trimmer capacitor using the shortest possible leads (cut off the excess).

That's the whole bit. Use an insulated alignment-type screwdriver to adjust the trimmer. You'll probably be able to tune a few TV stations immediately. Tuning police/fire calls or anything else will be more difficult because transmissions in these services are short and fast. You can preset the tuning by using a signal generator or a well calibrated grid dip oscillator.

Remember, this is a fun project. Don't hope for more than acceptable reception. But then who knows, you might be able to tune your favorite TV channel and keep track of the program while working in your shop. ■

Install a small trimmer on the cabinet at a point just outside the internal trimmer.

A DX CENTRAL PROJECT...

SWL's STATION FINDER

☐ ***Tune this stable wide-band oscillator to any SWL station you want to remember; come back the next day and "zero beat" your receiver to the very same spot.***

by Charles Green, W6FFQ

SHORTWAVE BROADCASTS have been a source of interest for many years with their exotic and different forms of programs from all over the world. Many shortwave listeners (SWLs) spend many hours tuning for elusive stations on the international shortwave broadcast bands.

But, once an interesting station is found, there may be a problem in locating it the following day, if the shortwave receiver has poor dial calibration or frequency stability. Also, many receivers used by SWLs have bandspread dials which are only calibrated for the amateur radio bands—not the international shortwave bands.

Our SWL station finder project will make it easier to relocate a desired SW station on a receiver the following day. This project has an rf oscillator which is "zero beat" with the SW station's frequency, will hold the calibration, and deliver a signal close enough to the station frequency to locate the station on the following day.

This SWL station finder covers a 5 to 18 MHz range to include the most popular international shortwave bands. Construction is simplified by using a commercially wound coil and solid-state oscillator circuitry.

Perf board and push-in, clip-type construction is used for easy building. The SWL station finder is built into a compact 6¼-in. long by 3¾-in. high by 2-in. deep plastic utility box, and it requires only two penlite cells for a power supply. No connection is required to your shortwave receiver; the station finder has only to be placed close enough to the receiver for its radiated rf to be picked up.

The Circuit. The SWL station finder is essentially an rf oscillator with a hartley (grounded drain) circuit and a FET (field effect transistor) used as the oscillator (Q1). The high input resistance and low heat generation of the FET together with the large value of capacitance in the tuning circuit (L1, C1) provide low drift performance. Also, there is no rf output connection as the circuit radiates the rf signal to the receiver, thus minimizing oscillator loading.

When S1 is depressed, electrical power from B1 flows through the Q1 circuit which oscillates at a frequency in the 5 to 18 MHz range determined by the setting of C1 (which tunes L1). Capacitor C2 and R1 act as the "gate leak" which biases Q1, and C3 is the bypass capacitor which grounds the rf in the Q1 drain circuit. The Q1 source is connected to the tap on L1 that supplies the rf feedback necessary to make the circuit oscillate.

Construction Facts. The SWL station finder is built in a 6¼-in. long by 3¾-in. high by 2-in. deep plastic utility box with a metal panel. Most of the parts are mounted on a 4-in. long by 2⅝-in. wide section of perf board with push in clips, and the board is installed behind the metal panel with three ⅜-in. long metal spacers. The parts placement is critical because of the high frequency operation of the circuit, and for best performance follow our component layout and wiring placement. All of the wiring must be made with short lengths of solid hookup wire for best frequency stability.

Begin construction by mounting the vernier dial on the panel in the approximate position shown in the photos. Cut the perf board section to size and mount C1 through holes cut in the perf board (in the position shown in the photo) using three machine screws in threaded holes in the front of C1. Install a ground lug on the lower mounting screw of C1 placed on top of the perf board.

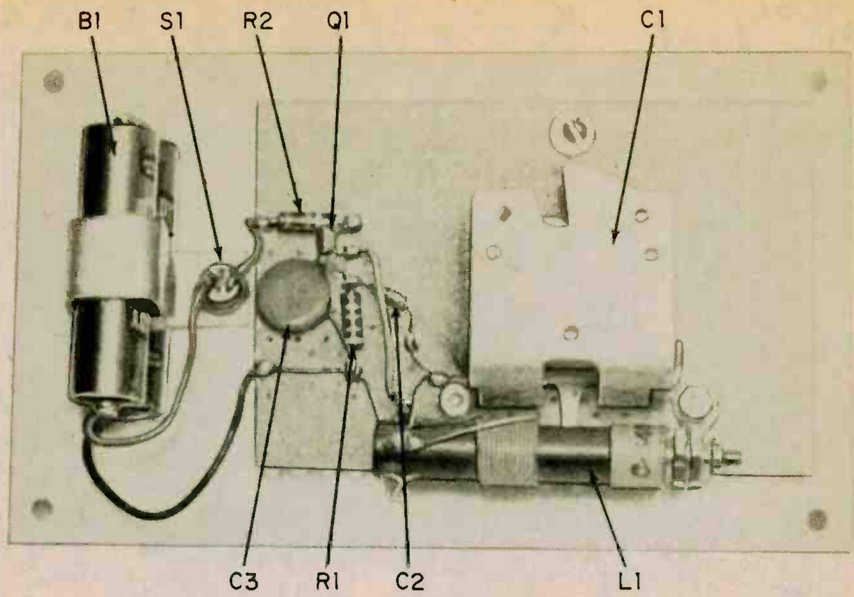
Temporarily position the shaft of C1

onto the vernier dial and locate the mounting holes for the ⅜-in. metal spacers. Remove the vernier dial and then cut the rotor shaft of C1 to the length required to fit when the ⅜-in. spacers are installed. On our model (for greater rigidity and a neater appearance) we used long machine screws for the vernier dial mounting that also fit through the ⅜-in. metal spacers and held the board. But, if this is believed too difficult, you can mount the perf board with ⅜-in. metal spacers at each corner of the board.

After the perf board is mounted, locate and cut a hole in the metal panel for S1 in the position shown in the photos. Cut a bracket from sheet aluminum to fit around the two penlite cells that are series connected to make up the 3-volt battery B1. Drill a hole in the end of the bracket to fit the mounting screw of S1. Then install S1 and the B1 bracket on the metal panel with the bracket positioned as shown in the photo.

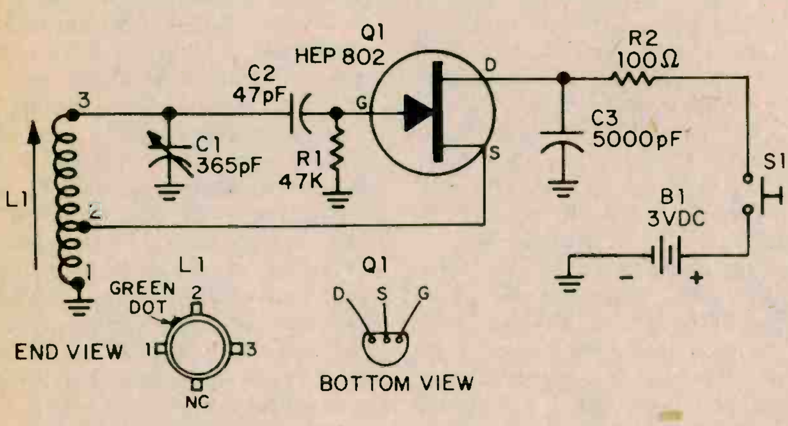
Mount L1 on the perf board parallel to the base of C1. A solder lug fitted on top of the coil with an extra nut and soldered to another solder lug mounted on the adjacent ⅜-inch spacer mounting screw keeps it in place. The other end of L1 is held by soldering pin 1 to a push-in clip on the board. Locate the L1 pin numbers by the position of the green dot on the coil form as shown in the schematic drawing.

Install Q1, R1, R2, C2 and C3 with push in clips on the perf board between S1 and C1 as shown in the photo. Position the components as in our model, and cut the leads short so that the components will remain in place without any movement for best frequency stability. Wire the rest of the circuit as shown in the schematic drawing keeping all leads as short and direct as possible.



Very simple wiring job gets you a variable frequency reference for SWLing.

Low drain circuit is powered by three AA cells. Holder can be made from scrap piece of aluminum or bought. Vernier dial has 8 to 1 turns ratio for precise adjustment.



PARTS LIST FOR STATION FINDER

B1—3-Volt Battery (two penlite cells in series, see text)
C1—10 pF to 365 pF variable capacitor (Radio Shack 272-1344 or equiv.)
C2—47 pF ceramic or mica capacitor (Radio Shack 272-121 or equiv.)
C3—.005 uF capacitor (Radio Shack 272-130 or equiv.)
L1—5 MHz to 18 MHz tapped oscillator coil (J. W. Miller C-5496-C)
Q1—field effect transistor, HEP 802 (Motorola)
R1—47,000-ohms, ½-watt resistor (Radio Shack 271-000 or equiv.)
R2—100-ohms, ½-watt resistor (Radio Shack 271-000 or equiv.)
S1—spst push-button switch, momentary contact, normally open (Radio Shack 275-1547 or equiv.)
Misc.—6¼ x 3¾ x 2-in. plastic utility box with metal cover plate (Radio Shack 270-627), 2-in. precision vernier dial (Radio Shack 274-615), perforated board and push in clips, ⅜-in. metal spacers, hardware, wire, solder, etc.

The J. W. Miller C-5496-C coil is available from Circuit Specialists, P.O. Box 3046, Scottsdale, AZ 85257, for $3.80 postpaid.

Testing And Calibration. Calibration of the station finder is not necessary, but for convenience in tuning, you can mark the ends of the vernier dial to indicate the high frequency end (18 MHz) with C1 at *minimum* (plates unmeshed) capacity and the low frequency end (5 MHz) with C1 at *maximum* (plates meshed) capacity. Rub-on decals can be used to mark the vernier dial ends and for marking the metal panel.

Preset L1 by adjusting the tuning slug all the way into the coil (for maximum inductance), and adjust C1 for maximum capacity. Place the station finder unit near your shortwave receiver, and tune the receiver to 5 MHz. Press S1 (to *on* position) and adjust the tuning slug of L1 for maximum received signal. Place the station finder metal panel into the plastic box and it's ready for use.

If your shortwave receiver does not have an S meter to indicate the unmodulated carrier of the station finder,

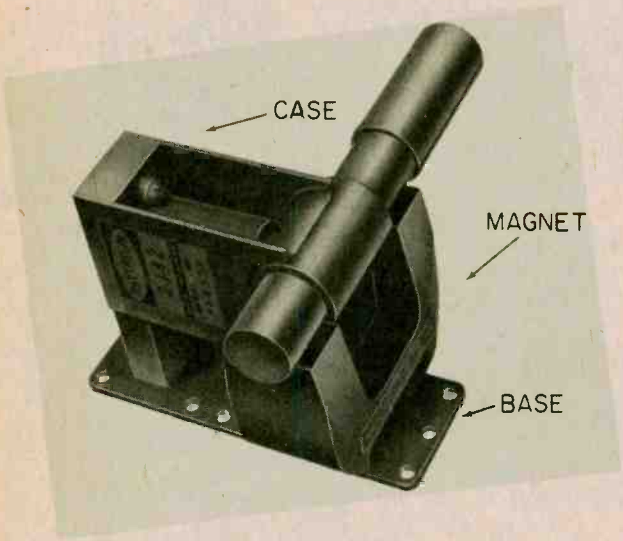
(Continued on page 91)

A passing technology...?

THE VANISHING VACUUM TUBE

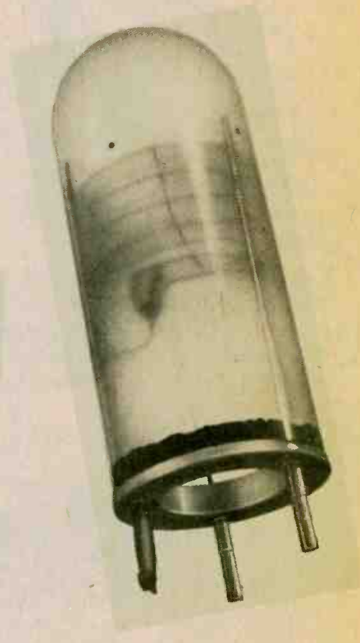
Profiles of some of technology's most famous and unusual creations!

by David R. Corbin



Magnetron type 2J24 is very common as a small-craft radar power oscillator "tube." This is one of the few tubes that has not really been threatened by solid-state technology . . . yet!

Typical small-craft magnetron modulator used to power pulse a magnetron in the 2 to 8 kW power region. Still common although it is slowly being replaced with SCR (solid-state) switches.



The 53GT high power flash tube has spiral Xenon gas flash tube inside. Outside glass sheath is protection for the actual flash tube inside. Flash tubes are still in their own class without solid-state challenges.

THE TIME is at hand when vacuum tubes will be retired to the museum shelves and become wonderments to the children of the solid-state age. More people than one might think have taken up collecting unusual vacuum tubes—not just the tubes of the pioneering radio days, but ones still in use today.

For example, take a look inside most of the small-craft radars operating today. Chances are you'll find at least three tubes in all but the last couple of years' models: the magnetron, which produces the actual transmitted RF energy, the modulator (such as the famous KU99 or the "triggertron" in its wine basket cover) that "hits" the magnetron with a huge DC pulse, and the local oscillator tube, which is a reflex klystron with its mechanical tuning strut up one side and long RF injection pin (probe) coming out the base (as with the 2K25).

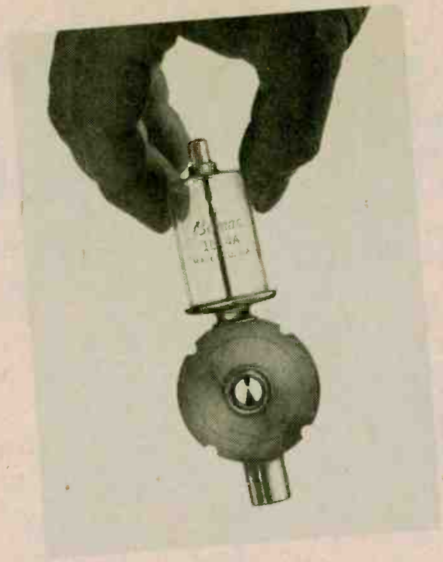
The typical small magnetron, similar to a 2J42, is almost entirely magnet and holder. The actual tube is very small, held between the jaws of the powerful magnet. There really hasn't been much challenge to the magnetron, but the klystron and modulator have been slowly replaced by step-recovery diode and high-voltage thyristors.

One other radar tube is the waveguide-mounted transmit-receive or anti-transmit-receive tube, called the TR or ATR for short. It is a spark gap in a sealed chamber, having no filament, but sometimes using a high bias voltage to help it ionize and "steer" the energy to where it belongs in the radar system.

One of the most recently threatened sanctuaries of vacuum tubes is the Action Band two-way radio transmitter. Until just this year, nearly every high-powered (over 25 watts RF output) mobile radio and base station in these services, whether in the 30-50 MHz or the 147-174 MHz band, used tubes long familiar to amateur radio opera-

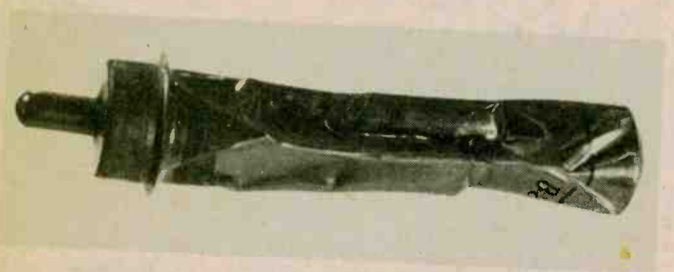
e/e VANISHING VACUUM TUBES

Invented in 1939 by the Varian brothers, the klystron is being replaced by step-recovery diodes as local oscillators in radar sets, although some, like this famous 2K25, are still used in police radar sets.

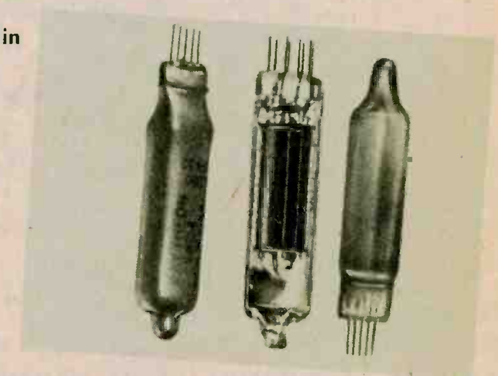


Critical part of radar is the transmit-receive switch, basically a spark gap in a vacuum. High power transmitter power arcs across spark gap on way to the antenna and effectively tunes out the receiver input in system of waveguide tuned stubs and cavities.

Unusual magnetron modulator used in small-craft radar has explosion-proof cover. Metal net is part of this English-made 24B1 Triggertron.



This common 1B85 geiger counter tube has a thin metal case which actually goes flat from fatigue. Atmospheric pressure on the thin metallic skin is the cause.



Aptly named pencil tubes were last major development before transistors became commonplace. These 1AD4s and 1AH4s are obsolete, victims of the VHF transistors, FET technology and power transmitter transistors.

tors. The old 829B is still in use in operating systems, though it hasn't been sold as part of new equipment for a number of years. The 100-watt-output VHF tube, 5894, is still used in a number of new models. And the 8298, 8552, and 6907 are still used in some VHF and UHF radios.

With the advent of high power VHF and UHF transistors, the tubes have changed to "second-best" status, but even then they hold their own in the ceramic, forced-air-cooled designs. The heavy 8560 with its massive copper plate connector can even be used with 120-watt output in the VHF band without forced air. The old familiar UHF tube, 2C39, is seldom seen sporting its model-airplane-type engine cooling fins these days, but the many-pinned 8072 is still common as a final amplifier in low, medium, and ultra-high frequency transmitters.

On the hopeful side for the preservation of vacuum tubes, some special applications haven't, as yet, been seriously threatened. The Geiger counter still uses high vacuum diodes to detect the presence of atomic particles. One peculiar type of radiation detector tube is the 1B85. Its life is limited by the fact that it literally goes "flat" with age. The tube is made of thin metal; eventually the metal fatigues, allowing the vacuum to pull the sides together, crunching the tube! The second special application is teamed with one of the very latest new technologies: laser communications. Some laser rods are stimulated by gas discharge tubes, which are similar to the flash tube in your electronic camera flash. One high-powered flash tube, the 53GT, is enclosed in a glass housing like a radio tube, but the bottom is open. The actual tube is a coil of about three inches diameter wound around inside the protective glass case.

The closest bet the tube ever had to challenging the transistor in the small signal field used to be presented in the pencil tubes, such as the 1AD4 or the 1AH4. Their last use was for VHF front ends in receivers, and for lower power finals in VHF transmitters that were considered "portables".

One of the best sources of odd-looking tubes is a two-way radio or marine electronics service shop. Used tubes are normally thrown away, unlike the high power broadcast valves which are rebuilt time and time again. Among tube collectors, the magnetron seems to be a prize trophy . . . especially if no one has stolen the magnets. Good hunting! ■

by Kathi Martin, KGK3916

Kathi's CB Carousel

☐ Others might claim the credit, but I am absolutely certain the proposed FCC "communicator license" is due almost entirely to the proved popularity and effectiveness of class D CB; and if the CB clubs—and individual CBers—don't louse things up with a big mouth, we CBers are going to wind up with the best deal since Don Stoner's magazine article "exposed" class D CB to the general public—creating a billion-dollar industry.

To understand what's going on we must consider two different FCC proposals which haven't appeared together in the same publication . . . until now, that is. And it's only when you compare them side by side that the big picture emerges.

First, there are the FCC proposals for restructuring class D CB, detailed elsewhere in this issue. I consider them a disaster for the typical CBer; they turn CB into just another high-priced commercial radio system with virtually all the restrictions of commercial two-way radio! The *very* few channels that will be available for inter-station communications can be easily terminated, almost at whim. But more important, a single installation of the proposed type-accepted equipment will run upwards of $500 (at today's prices) and a typical base-and-mobile setup would cost well over $1000. That's not Citizens Band priced—no way! (Though these proposals are generally supported by the EIA, we must keep in mind the EIA is a manufacturer's group whose purpose is to get the consumer to keep buying new equipment.)

So I foresee the end of class D CB as we know it within five years after the proposals go into effect (which, admittedly, might be tomorrow or never).

Secondly, the FCC has proposed changes in amateur radio licensing. Among their proposals is one for a "communicator license" which, if read *carefully*, is CB. The communicator's license will be code-test free. (Gee, for years we heard how the code test was an international requirement for hams—amazing how the rules change!) Reading the proposal further shows a simplified test for the communicator's license which appears to be not much more than a few basic questions on rules and procedure, much as for a restricted third class radiotelephone license for marine radio. In short, the communicator license will be yours almost for the asking.

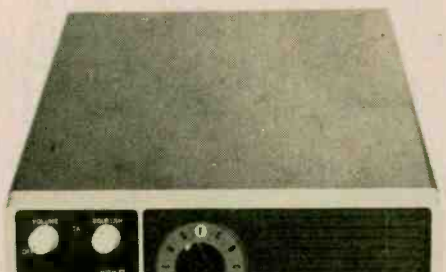
Now it should not be inferred that the "communicator license" means all amateur radio privileges. The proposed operation is limited to the VHF/UHF ham frequencies above 144 MHz (2-meters) using only FM modulation, but with a maximum power input limitation of 250 watts. This puts the 146 to 148 MHz amateur band segment into the communicator's operations, and it is 146 to 148 which is the key to the new Citizens Band—or "Communicator's Band" as it will probably be called.

Maximum Range. Sitting up on 2-meters, at approximately 146 MHz, is almost a national network of FM *repeaters,* receiver-transmitters installed on high buildings and towers by local clubs. These repeaters can pick up the flea's whisper signal of a 1-watt walkie-talkie at 20 miles and rebroadcast the signal for twenty or more miles in all directions. The *reliable* working range therefore exceeds anything we can presently accomplish on class D CB even with an expensive directional antenna array.

Because the modulation is narrowband FM, signals are received at essentially the same volume level regardless of the received signal strength; there is none of the blasting-volume effect common to AM and SSB transmitters. Also because of the FM mode, there is little noise—even in mobiles, and the *capture effect* of FM insures there will be no interference from signals weaker than the one being received.

The typical transceiver for 2-meter FM is very similar in size and appearance to a CB transceiver—only it's less expensive, quality for quality. There are many switch selected crystal controlled "channels" (user selected), a volume control, a squelch control, generally a power cut-back switch that provides either (approximately) 10 to 15 watts, or 1 watt output, and there might be a *priority* switch that instantly switches to your most desired frequency. Sensitivity and selectivity generally outclass what's available in CB gear. The Lafayette HA-146 2-meter transceiver shown in the photographs (one of the moderately priced models) has a 100 percent usable sensitivity of less than 0.5 μV and 60 dB selectivity at 25 kHz—more than is usually needed for 2-meter operation.

Also, should you need more power output (which is rare), a handfilling



Typical 2-meter FM transceiver by Lafayette for hams. You will find gear like this well within the class D price range for AM sets.

The rear of the 2-meter transceiver also resembles a standard CB transceiver except for the tone control input that allows a plug-in touch-tone keyboard to control repeaters, or turn on an automatic phone patch if the repeater is so equipped.

box costing about $50, known as a booster, will put about 50 watts into your antenna; these units are powered directly from the auto battery and can be mounted just about anyplace—even behind the dashboard.

I'm Ready to Go. As far as operations are concerned, what's happening on 2-meters puts CB to shame, though I hate to admit it. Since I am not an amateur radio operator I asked Big Herb of e/e's test lab to give me a demonstration of the repeaters. He set up a typical problem. We'd throw a dart at a map, note the street and town, and then take a running start for our cars (a Grand Prix racing start!). He'd use the 2-meter repeaters for directional assistance while I would use CB channel 9. Since both of us had no idea where the rendezvous was, other than the town, it was a typical "lost traveller" situation. The only handicap in this race was that neither of us could start until we had established our first contact: no driving around looking for familiar roads. To illustrate how effective the 2-meter amateurs were, Herb installed a 2-meter walkie-talkie in my car so I could monitor him.

Let me first describe what I heard on the walkie-talkie. Herb got in his car and simply gave his call letters—nothing else. Instantly someone came back. Herb gave the town and street, and a second station near the town he was looking for came back with routing directions—guiding the car from road to road. As Herb approached the town a third station, in the town, came on and brought Herb straight in to the rendezvous: a total of approximately 40 minutes driving time with Herb in contact with someone all the way for about 25 miles. (Those 2-meter repeater frequencies appear to be under full-time monitoring by a lot of people.)

Now My Adventures. It took about 10 minutes to raise someone on channel 9, who had no idea of where I was going, nor did she have a map available. Another 10 minutes later I broke in on some clowns hobbying on channel 10, and they got me started in the right direction. About five miles out their signals faded, and I could raise no one for another 20 minutes.

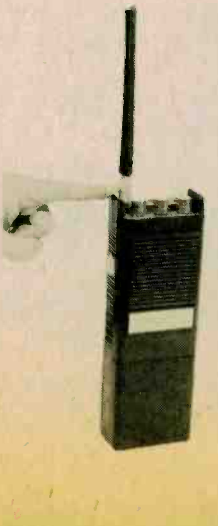
After four more fade in/fade out contacts, I finally arrived at the rendezvous—some fifty minutes *after* Herb, with a lot of trouble and frustration.

As I pulled alongside Herb's car he reached in for the walkie-talkie, called back to thank the first station he worked—who turned out to be some twenty miles away (through the repeater); the station answered immediately. It's a first rate example of what the amateurs have accomplished in low-power/repeater operation.

As is typical of 2-meter walkie-talkies, this Regency can run for hours on one Ni-cad battery charge. The reason is a whopping Ni-cad battery which takes up the entire lower compartment. Unit can also be AC powered or operated directly from the car's cigarette lighter. An antenna jack on the bottom allows the rig to be used for base or mobile with enough power output to hit the local repeaters.

Looking back, I realize we CBers have accepted long waits on channel 9. Sure, I've used channel 9 to get assistance; but those ten-minute waits before a station was raised were overlooked in my happiness at just getting assistance. We've got a long way to go before channel 9 equals what the amateurs have on 2-meters.

I might be going out on a limb, but I feel the popularity and success of CB and the low-cost effectiveness of the VHF/UHF FM-operating amateurs are directly related to the FCC proposals for both CB and the "communicator license." I believe the FCC looked at CB and finally realized an awful lot of people just want to chit-chat, without the bother of becoming an electronics expert or a skilled telegrapher. The FCC then looked at the amateur FMers and realized (as I have from listening to them) that many are basically interested in CB-type operations. So why not combine the two groups? Make the VHF/UHF amateur frequencies available to those who just want to "communicate," thereby freeing the class D CB frequencies for commercial radio.

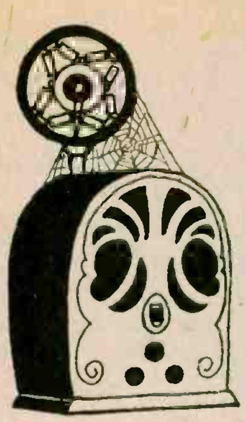


This Regency HRT-2 walkie-talkie for the Communicator Band puts out 1 or 2 watts RF and is similar in appearance but smaller than a CB walkie-talkie. Finger points to the "rubber ducky" replacement antenna for the telescopic whip. Most 2-meter walkie-talkies accept the rubber ducky, which can be wrapped in a circle, only to snap open undamaged.

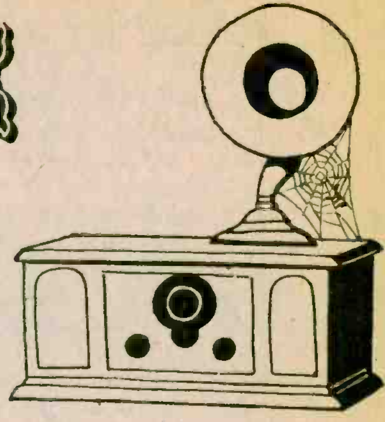
Of course, there are those on both sides of the fence who will have nothing to do with the other. CBers don't want to become amateurs and amateurs don't want the CBers. But we are talking of *communicators.* Is there really a difference between the CBer and the "licensed" CBer—the ham who communicates? And is there a difference between the non-practicing (technically) amateur and the CBer? Not really. The only real difference is the frequencies being used. They are both *communicators,* and communicating is what CB is really all about. I believe the FCC also recognized this similarity and came forth with two separate proposals to accomplish a single result: two proposals to avoid a conflict between *communicators* with the same interests.

Personally, I don't care whether I'm called a "CBer" or "communicator," and when the communicator's license is finally approved, this CBer expects to be the first on line to get one!

As We Go to Press. Just before this issue went to the printer's we got a hot rumor out of the New York Boat Show—and all the electronics crowd was at that show. According to "an informed source," class E CB has been ordered by the OTP (Office of Telecommunications Policy). Class E will be up around 220 MHz with the 1¼ meter amateur band. The modulation will be NBFM with allowed mobile power to 50 watts, and base and repeater power to 400 watts. That's right, *repeaters.* (There are presently amateur repeaters up at 220 MHz, the same as for 146 MHz.) Basically, what we have is the Communicator's Band as I envisioned for 2-meters. From what I can put together from the little information available at press time, the amateurs screamed bloody murder at having communicators on 2-meters, while the electronics industry was desperate for the $2-billion market a communicator's band would create. (Our economy is also desperate for a *new* multi-billion-dollar market.) Since the technology already exists for 220 MHz equipment—it's essentially ham gear—the easiest thing to do was accommodate everyone's desires with a class E band essentially equal to what the VHF FM hams have on 146 and 220 MHz. Another rumor out of the show says CB license fees will drop to $4 on March 1. With Motorola ready to unveil a frequency synthesizer IC for consumer use the class E CB gear might be even less expensive than a budget class D AM transceiver. Things are happening so fast in CB we just can't keep up with the action. We will keep you informed. ■



ANTIQUE RADIO CORNER



by James A. Fred

Hello out there in Radioland! I want to welcome all of you to the Antique Radio Corner. We have lots of news about radio collectors clubs being formed in all parts of the United States. The first is the California Historical Radio Society being formed in, where else, California. There is also a club being formed in the Dallas, Texas area. The latest club I've heard about is one near Winston-Salem, North Carolina. If you live near any of these prospective clubs try and join one. If anyone out there in Radioland has any further word about these clubs please let me know.

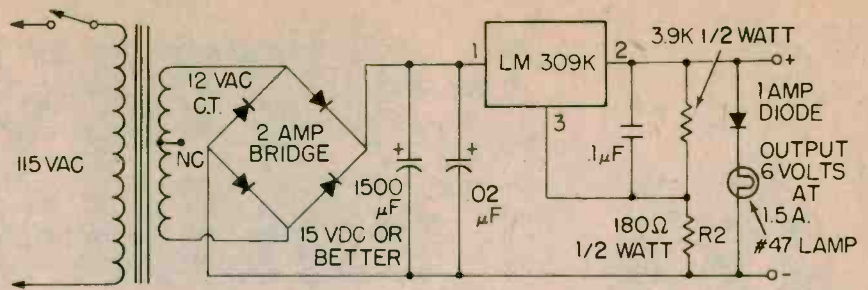
I am pleased with the response to my plea for information about Norman Baker and W. K. Henderson. From time to time I will be asking readers for help in locating information about other men who were early pioneers in the radio broadcast industry. In the March-April 1975 issue of ELEMENTARY ELECTRONICS I told you a little about Norman Baker so this time I will give you some information about William K. Henderson.

The following is a condensed version of information sent me by several readers, notably: Karl Marquardt of Minneapolis, Minn., and J. C. Parker of Durham, North Carolina. Apparently William K. Henderson started broadcasting in Iowa, then moved to Shreveport, Louisiana. He always greeted his listeners with, "Hello world, doggone your buttons." then proceeded to lambast the chain stores (Piggley-Wiggley being the first), politicians, and especially President Herbert Hoover. He published a nationwide directory of radio stations with the name W. K. Henderson Iron Works and Supply Company on it. Because of his attacks on chain stores and his use of profanity on the airwaves the FCC, or its predecessor, refused to renew his license. He then moved his transmitter to Laredo, Mexico where he covered practically the whole North American continent with his super-powered station.

The Need for Schematic Diagrams seems to be the subject of most of the letters I receive from my readers. In the early 1930s John Rider started to publish the Rider's Perpetual Trouble Shooters Manuals. These manuals ran from two to five inches thick and contained as many as 2500 schematic drawings in one volume. The contents of each book depended upon the cooperation he received from the radio receiver manufacturers. In many cases Rider merely copied the literature supplied by the set maker. Consequently the larger, better-financed set builders are well documented in the Rider's Manuals while the smaller companies may have only one schematic or no mention at

This Western Electric model 360W microphone with a 4A horn is in the collection of Lloyd Williams of Frankfort, Indiana. The microphone was originally used by telephone installers of the Western Electric and Bell Telephone companies.

This Atwater Kent breadboard is one of the very first sets competely assembled at the factory. At first, kits of parts were sold by Atwater Kent to experimenters so that they could build the sets in their homes.



Electronically-regulated "A" battery eliminator for a 1- to 6-tube set using 01A's (see text for more detail). The IC voltage regulator device used is a National LM309K or Motorola MLM309K with heat sink such as Radio Shack 276-1360.

all. Nearly every week I hear from a reader whose set isn't listed at all. For instance, a friend of mine has a "Tigerdyne" battery radio, and a "Little Giant" AC radio that isn't listed in the Rider's Manual index. Nevertheless, Rider's Manuals are still the best source of information for sets made before 1950.

The next best source of information for the older radio receivers are circuit diagram books published by Supreme Publications. These books are titled "Most Often Needed Radio Diagrams" and were edited by Morris Beitman. Because of space limitations these books only cover the most popular radios manufactured. Usually the books have less than 300 pages. However, you will find them very useful.

Another source of information are the Mallory-Yaxley Service Encyclopedias that were published prior to 1942 by The Distributor Products Division of P.R. Mallory and Company, Inc. This information is compressed into volumes of facts with fragmented circuit diagrams covering a particular part of a radio circuit, i.e., volume control, filter capacitor, vibrator, etc.

Now comes the $64.00 question. "Where do I get a circuit diagram for my own radio? I don't want to buy a set of Rider's Manuals that weighs up to 200 pounds and take up to eight foot of bookshelf room. Maybe if I buy a set of Supreme Circuit Books my set won't be there." I have the answer for you.

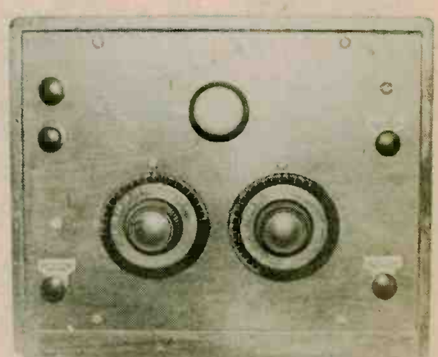
M. N. Beitman, 1760 Balsam Road, Highland Park, IL 60035 offers to sell any service information for a particular radio for $2.00 and up. Simply send him the name and model number of your radio and he will do the rest. Another source is the Antique Radio Press, P.O. Box 42, Rossville, IN 46065. Their rates are somewhat less for copies of pages from Rider's Manuals printed before 1950. If you send $1.00 and a long, self-addressed stamped envelope along with the name and model number of the radio you desire information on you will receive the schematic and other information not to exceed two pages. If you want all the information in the book (which might run to 10 pages) write for a quotation.

Power Supplies are another popular subject for readers letters. They want to know where they can get a circuit for a power supply that will operate their old restored radios. In this column we will present the circuit diagram of an "A" power supply, and in two months we will show a "B" power supply. These two power supplies were designed and built by our good friend E. E. Taylor of Indianapolis, who owns his own antique radio museum. He is happy to let us present these plans through Antique Radio Corner so that other collectors may be able to play their old battery radios. The "A" supply is intended for use only with radios using 201A's, 200A's, 112A's, and 71A's. Later in 1975 we will have plans for an all-in-one power supply that will furnish "A, B, and C" power in one unit. The supply is in the design stage and should be built and photographed within three months.

The one bugaboo for operating antique radios has always been the "A" battery. To use a 6-volt storage battery, as our ancestors did, is messy with acid, water, chargers, etc., and most collectors do not want the fumes and danger of spilled electrolyte in their homes.

Since the early Atwater Kent breadboard radios are so hard to find, many collectors are ready to settle for a replica such as the one shown here.

This fine example of a one-tube homemade radio is part of the author's collection.



The old-style "A" battery eliminators were very cumbersome with large wet or dry capacitors, and rectifiers, plus heavy transformers and chokes which even then did not completely filter out the AC hum.

The circuit shown here is that of a compact, solid state, 6-volt "A" battery eliminator that features electronic regulation and filtering. There are no adjustments to be made since the correct voltage is present on a 1- to 6-tube receiver that uses the previously mentioned 01A, etc. tubes. The heart of the power supply is a monolithic silicon integrated circuit voltage regulator which contains the equivalent of 23 transistors and diodes. The voltage regulator should be mounted on a heat sink to enable it to safely pass 1.5 amperes.

The #47 pilot lamp serves three functions: it indicates that the eliminator is turned on, if there is a short in the receiver the bulb will dim or go out, and the bulb will discharge the filter capacitor when the unit is turned off. A diode connected in series with the bulb lowers the lamp voltage and adds to its life.

This "A" battery eliminator is well worth the few hours labor needed to build it, plus the parts cost of about $20.00. Normal parts substitution can be made if you have a well-stocked junk box. It will give you many happy hours of listening to your antique battery radios. Detailed plans for a box or cabinet aren't shown so that each collector can build the type housing that will please him.

The Balkite Battery Charger was the subject of a letter I recently received from William Hoy of Charleston, West Virginia. He gave some additional information on how the charger shown in the November-December issue of ELEMENTARY ELECTRONICS should operate. This charger was supposed to have an electrolyte of sulphuric acid with a specific gravity of about 1.200. The tantalum wire electrode was subject to arcing and erosion at the point where it contacted the surface of the electrolyte. To prevent this erosion a glass sleeve was provided to enclose the tantalum wire. The space between the sleeve and the tantalum was filled with a pitch-like material. The glass sleeve was long enough to have its end about ½-inch under the normal electrolyte.

New Fronts for Old Sets. New front panels are now available for most models of old radios. Many times the front panel of a very old radio may be broken or otherwise unusable. I know that I have a Freshman Masterpiece that is in good condition except that someone cut an inch-square piece out of the upper right corner of the panel. Now there is a man who can fabricate a new front panel, engrave it to exactly match your damaged panel, fill the engraved letters with white coloring and make your set look like new again. He can match the original holes, lettering, and logotype that were on your radio panel. You can write him for a quotation on a replacement panel for your radio. His address is: Norman A. Parsons, 22 Forest Street, Branford. CT 06405.

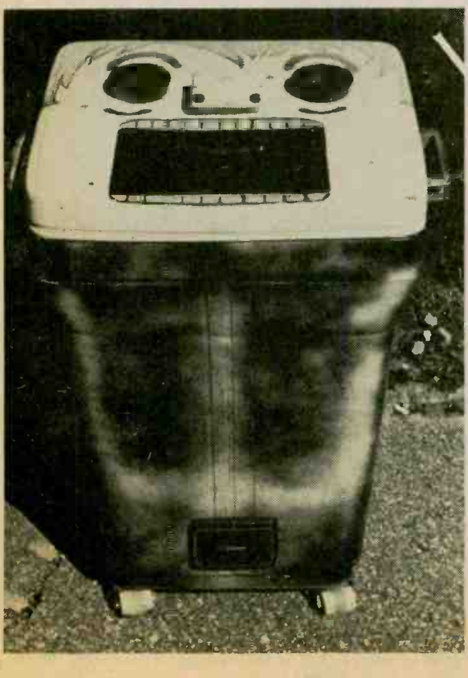
New Atwater Kent Booklets. "Restoring an Atwater Kent Model 40 Radio" is the title of a booklet to be

(Continued on page 91)

NEW 1975 FACT SHEET

☐ Collectors of antique radio and wireless equipment can get an updated Fact Sheet from ELEMENTARY ELECTRONICS which includes information on antique radio publications and clubs, and a listing of public and private radio and wireless museums. To get your copy send a long stamped self-addressed envelope to Antique Radio Corner, ELEMENTARY ELECTRONICS, 229 Park Avenue South, New York, NY 10003. ■

ARTHUR THE TALKING TRASHCAN



☐ A trashcan is just a trashcan. It just sits there. And whether you throw your candy wrapper into it or not doesn't seem too important to a lot of people. But a *talking* trashcan is something else! At C. W. Post College on Long Island, NY, a trashcan has been fitted with a continuous-loop cassette tape machine which is activated whenever something is thrown through the trashcan's "mouth." This isn't a joke—rather it is part of an experiment in behavioral psychology. The people who gave "Arthur" a voice—as well as a name—were trying to find out how to draw attention to the trashcans on campus. Too often, they found, students would just throw their trash anywhere except in the right place—the trashcan. They tried several systems, but when they finally hit upon the idea of having a trashcan say "Thank you!" they succeeded. The tape recorder can be fitted to any trashcan in a matter of minutes, so students never know when they are going to meet up with Arthur. Since Arthur was born the campus has been pleasantly cleaner. After all, wouldn't you go a little out of your way to throw your empty soda can into a trashcan that said, "Hmm, that was delicious!" in its most polite pre-recorded tone of voice? ■

A cassette tape recorder is fitted in the lid of a trashcan (center). The message is on a continuous loop of tape that is activated for a short time when a piece of trash is thrown in.

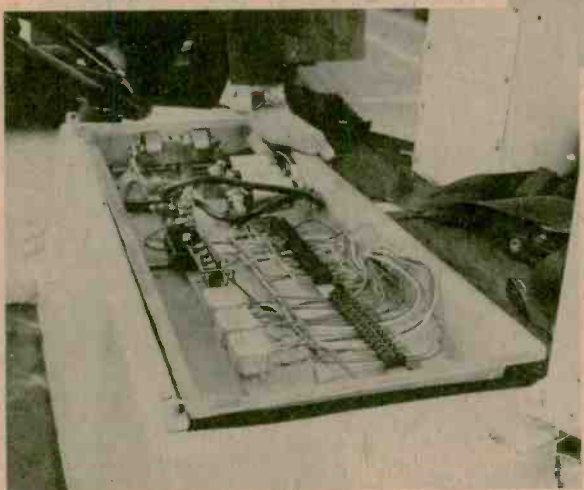
Electric Rent-A-Car A Real Credit Buy

Three-wheeled two-seater keeps the ecology clean: credit card is ignition key to carefree city driving!

by Joe Gronk

☐ Traffic is the ruination of cities the world over. Cars, buses, taxis and trucks are literally shaking cities to pieces. The time is fast approaching when in many countries drastic action will have to be taken to prevent road traffic from not only destroying the cities but also the life of the cities' inhabitants. Without much fuss a citizen's transportation system has been introduced to Amsterdam, and so far it seems to be working without any major faults.

The Witkar is the brainchild of a 38-year-old Dutchman, Luud Schimmelpennink, who has always voiced the view that transportation should be for all the people equally, and that cars



Look out Avis, here comes Witkar! Dutch rent-a-car idea may set the world's wheels into electric motion. Three Witkars (the rentables) are stacked up in a charging bay (upper left) waiting for credit card holders. Driver inserts credit card for automatic time billing and hits the road (lower left). Inside the car are seats for two passengers (upper right) and room for shopping parcels. The guts (lower right) show a nickle-cadmium battery with rapid charging characteristics. The battery is rated at 55 ampere-hours at 24 volts DC; because of its weight and center location the three-wheeled car is very stable.

should be kept away from city centers altogether. In 1965, Luud (the Editors prefer to use his first name) put forward a scheme for the Amsterdam City Council to buy 20,000 bicycles, paint them white, and leave them all over the city for anyone to use. The idea worked well for a time, but the city withdrew its financial backing and the idea was dropped. Over the following years Luud put together plans for the Witkar.

The city provides the Witkar oraganization with a number of stations where the electric vehicles are parked, ready for use. While in their parking bays the vehicles' batteries are rapidly and automatically recharged. For a fee, anyone can obtain a credit card. With this card a driver enters a Witkar station, places the card into the slot of a two-seat electric car, the car is activated, and the driver hums off. The rental is automatically recorded against the credit card holder, and for every minute of use a ten-cent charge adds up. The Witkar user simply drives to any of the other stations where the insertion of the card and parking of the car cancels the hire.

It doesn't take much of a electronic brain to regulate the battery charge for the vehicle. While in the parking bay an overhead trolley connects to an external power source and the charge is taken on immediately when parked.

The system is working so well that city planners all over the world are hurrying to Amsterdam to study the world's first transportation system designed to keep the traffic *out* of city centers. Since the introduction of the Witkar, the Amsterdam traffic department has started to close roads to all traffic other than Witkars, buses, and, naturally, bicycles. In time Amsterdam may well become the first city in the world to ban all motor traffic other than electric vehicles. Now you will understand why the Dutch are apt to blow their fuses during the going-home rush hour. ■

BUILD IT FAST...

AUDIO FUN-DAMENTALS WITH THE 741

TELEPHONE VOICE

☐ The "telephone voice" effect is usually created by passing a voice signal from a high quality microphone through a bandpass amplifier—a device that attenuates the frequencies on both sides of a selected frequency. Bandpass amplifiers are also effective at providing mid frequency boost—presence, as it's called in hi-fi terms.

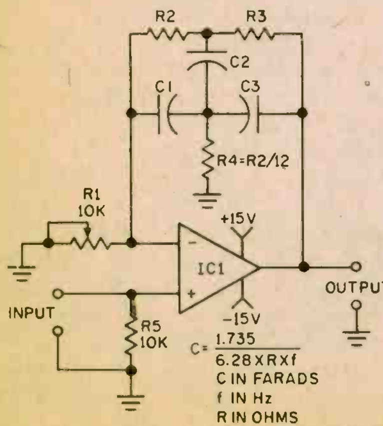
The center frequency of this bandpass amplifier is determined by the values of C1, C2, C3, R2, R3, and R4. The exact frequency can be determined from the formula shown. To start, assign a value of 100,000 ohms to R2 and R3 (use ½-watt resistors). To avoid hum pickup, the unit should be assembled in a metal cabinet. Potentiometer R1 serves as the Q-control; it determines the degree of boost at the center frequency.

R5 connects to the non-inverting (+) input of the IC, R1 between ground and the inverting (−) input. No pin connections are given because the IC is available in many different configurations.

Of course, you could find a carbon microphone "button" and matching transformer to create the effect naturally, but that's not how it's done in the big city, bub! ■

PARTS LIST FOR TELEPHONE VOICE

C1, C2, C3—(C1 equals C2 equals C3, see formula)
IC1—Type 741 opamp (Radio Shack 276-010 or equiv.)
R1—10,000-ohm pot (Radio Shack 271-1721 or equiv.)
R2, R3—(R2 equals R3, see text)
R4—R4=R2/12
R5—10,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)



MAG TAPE AMP

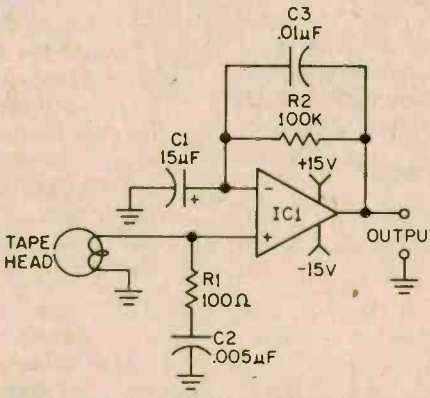
☐ From time to time surplus dealers offer complete tape or cassette mechanisms—everything ready-to-go except for the electronics, and at rock-bottom prices of $10, $15 or $20. Often, all the mechanism needs is this equalized tape head preamplifier.

Though the power supply is rated at ±15 VDC, almost optimum results will be obtained with supply voltages as low as ±7 VDC. Two ordinary 9-volt transistor radio batteries will power the preamp for many hours.

As with all these projects, the 741IC is internally compensated and no special wiring practices are needed; the preamp can be built in just about any enclosure. ■

PARTS LIST FOR MAG TAPE AMP

C1—22-uF electrolytic capacitor, 25 VDC or better (Radio Shack 272-1014 or equiv.)
C2—0.005 uF disc capacitor, 25 VDC or better (Radio Shack 272-130 or equiv.)
C3—0.01 uF capacitor, 25 VDC or better (Radio Shack 272-1065 or equiv.)
IC1—Type 741 opamp (Radio Shack 276-010 or equiv.)
R1—100-ohms, ½ watt resistor (Radio Shack 271-000 or equiv.)
R2—100,000-ohms, ½ watt resistor (Radio Shack 271-000 or equiv.)



RC FILTER OSC

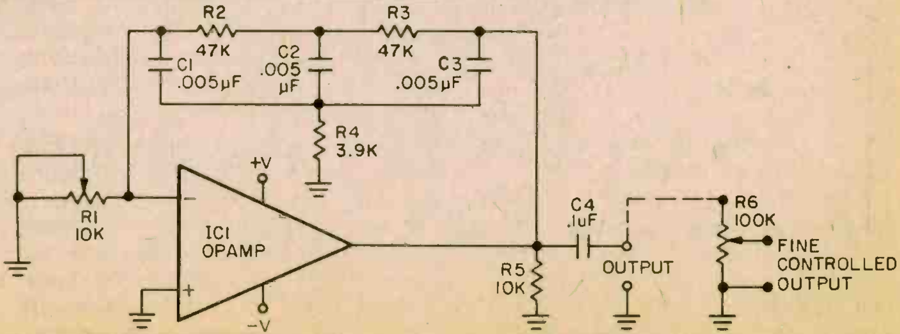
☐ An experimenter has many uses for a basic 1000-Hz oscillator. If you're an experimenter you know how many and can make up more. Even audio buffs find an increasing interest in test signals for speaker balance and phasing. In this circuit, a resistor/capacitor filter tuned to 1000 Hz is connected between input and output of IC1 to sustain selective (1000 Hz) feedback. It's suitable for testing audio equipment, signal tracing or tape recorder bias adjustments.

The 1-kHz "notch filter" from the amplifier output to the inverting or negative (−) input determines the output frequency. Non-inverting or positive (+) input is grounded. The power supply is bi-polar; use any voltage up to ±15 VDC. While resistor R5 is not needed, in many instances its use insures your project's success.

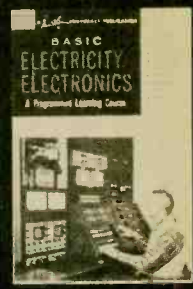
If fine output control is desired, add potentiometer R6. When your oscillator is connected to a DC circuit, connect a DC blocking capacitor in series with R6's wiper arm. If the oscillator is to drive circuits of less than 10 k-ohm impedance, substitute a 1 uF non-polarized capacitor for C4, rated to the power supply's voltage. ■

PARTS LIST FOR RC FILTER OSCILLATOR

C1, C2, C3—0.005 uF, 75 VDC (Radio Shack 272-130 or equiv.)
C4—0.1 uF (see text)
IC1—741-type operational amplifier (Radio Shack 276-010 or equiv.)
R1—10,000 ohms pot (Radio Shack 271-1721 or equiv.)
R2, R3—47,000-ohms, ½-watt (Radio Shack 271-000 or equiv.)
R4—3,900-ohms, ½-watt (Radio Shack 271-000 or equiv.)
R5—10,000-ohms, ½-watt (see text)
R6—Potentiometer, 100,000-ohms, audio taper (see text) (Radio Shack 271-1722 or equiv.)



e/e BASIC COURSE IN ELECTRICITY & ELECTRONICS



This series is based on BASIC ELECTRICITY/ELECTRONICS, Vol. 1, published by HOWARD W. SAMS & CO., INC.

UNDERSTANDING SEMICONDUCTORS

What You Will Learn. In this part you will learn about how transistors are biased for use as amplifiers and why different polarity voltages are required for PNP and NPN transistors. You learned what a hole was in Part 1, now you will see where hole flow is found in transistors. How a transistor amplifies is discussed, and a look at the three basic types of transistor amplifiers shows you why each has special uses. You will also be introduced to transistor specification sheets.

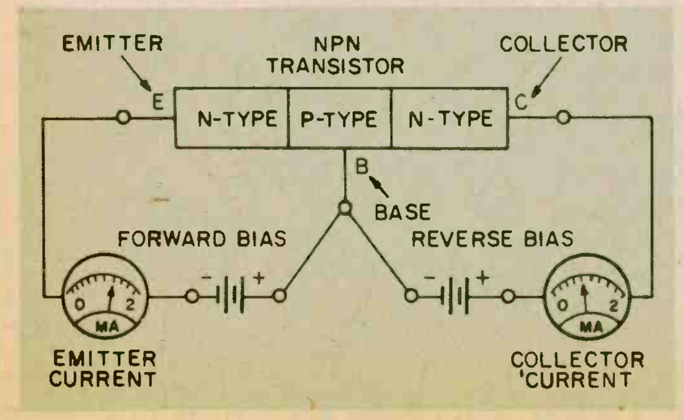
TRANSISTOR OPERATION

Several questions have probably come to mind by now if you have read and digested Part 1. How can a solid-state material amplify? Is there a difference between a junction and point-contact transistor or between a PNP and an NPN transistor? One of these questions can be answered immediately. Junction and point-contact transistors are almost identical in operation for our purposes. Therefore, all discussion will be directed to junction transistors, but it is understood that it applies to both types.

Biasing

In the junction transistor, two PN junctions are established. If these PN junctions are properly biased, the transistor can be made to operate as an amplifier.

Bias For NPN Transistor Amplifier



The proper method for biasing an NPN transistor is discussed next.

The figure shows an NPN transistor biased properly to operate as an amplifier.

QUESTIONS

Q1. A transistor is a single semiconductor crystal with - - - PN junctions.

Q2. A transistor can perform the same function as a ------ ---- ------. (From part 1)

Q3. P-type semiconductor material sandwiched between two pieces of N-type material forms an - - - transistor.

ANSWERS

A1. A transistor is a single semiconductor crystal with **two** PN junctions.

A2. A transistor may perform the same function as a **vacuum-tube triode.**

A3. P-type semiconductor material sandwiched between two pieces of N-type material forms an **NPN** transistor.

In the arrangement shown, a forward bias is applied between the base and the emitter. This results in emitter current. A reverse bias is applied between the collector and the base. This results in a flow of collector current that is nearly equal to the emitter current. The reason for this seeming contradiction, as we will see, is that the base is very thin—less than one-thousandth of an inch.

Before continuing, it is time to learn a few more short-hand notations used when referring to transistors:

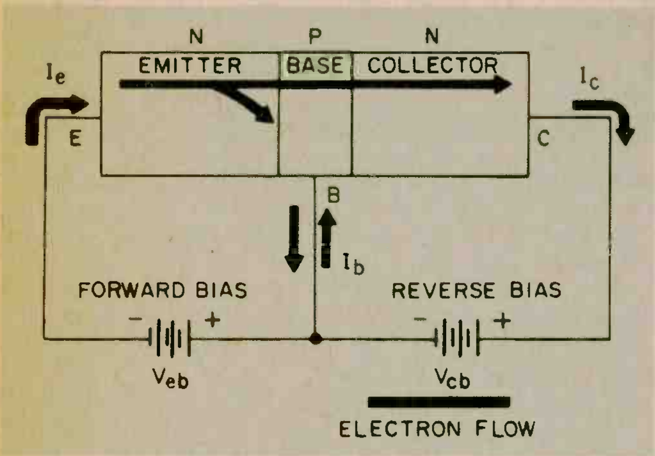
B—Base
E—Emitter
C—Collector
I_B—Base current (All average values.)
I_E—Emitter current
I_C—Collector current
V_{EB}—Voltage from emitter to base
V_{CB}—Voltage from collector to base

Current Flow in a Biased Transistor

The figure shows the electron flow in a biased NPN transistor. With the emitter-base junction forward biased, electrons in the emitter drift into the base to combine with the holes in the base. Each time an electron enters the emitter from V_{EB}, an electron leaves the base and returns to V_{EB}. Thus there is electron flow from emitter to base.

Since the base-collector junction is reverse-biased, very little current should flow through it. This current is produced by leakage due to V_{CB}.

Current In A Biased NPN Transistor



Why is Ic almost equal to I_E? Since the base is very thin, there is not a sufficient barrier in the base region to stop the large number of electrons coming from the emitter. These excess electrons pass through the base and on to the collector due to the presence of V_{CB}. The reason why these electrons are not stopped by the collector-base barrier is that there is a strong positive voltage attracting them. This voltage is due to the series combination of V_{EB} and V_{CB}. **The major portion of Ic is due to the electron flow from emitter to collector.** Notice that current flow in the base is due to both the forward and reverse bias voltages. Thus, there are current flows indicated in both directions. I_B is the difference between these two currents.

QUESTIONS

Q4. The emitter-base junction of a transistor amplifier must be - - - - - - - biased and the collector-base junction must be - - - - - - - biased.

Q5. Under these conditions collector current is (equal to, slightly less than, more than) emitter current.

Q6. This is explained by the fact that not a large enough electrical - - - - - - - exists in the base to stop all the - - - - - - - - - coming from the - - - - - - -.

Q7. Identify the following shorthand notations: I_B, Ic, I_E, V_{EB}, and V_{CB}.

ANSWERS

A4. The emitter-base junction must be **forward**-biased and the collector-base junction **reverse**-biased.

A5. Under these conditions collector current is **slightly less than** emitter current.

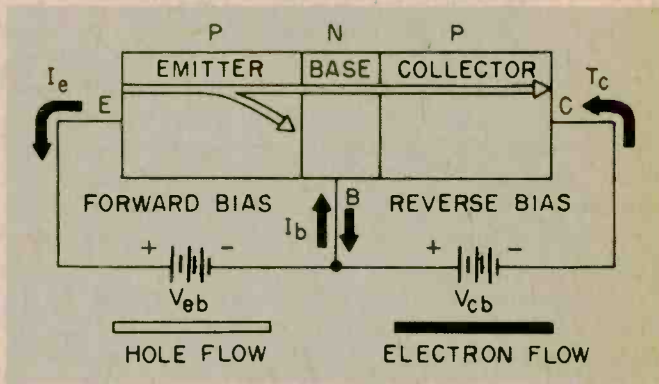
A6. This is explained by the fact that not a large enough electrical **barrier** exists in the base to stop all the **electrons** coming from the **emitter.**

A7. I_B—**Base current**
Ic—**Collector current**
I_E—**Emitter current**
V_{EB}—**Voltage from emitter to base**
V_{CB}—**Voltage from collector to base**
(All average values)

Biasing PNP Transistors

The difference in operation between PNP and NPN transistors is that the movement or flow of electricity in PNP transistors is accomplished not by electron flow but by hole flow. Also, proper bias for a PNP unit is achieved by using negative voltage polarities—just the opposite of those used for an NPN transistor. However, the bias between emitter and base is still forward bias and the bias between collector and base is still reverse bias. Since the emitter is P-type and the base is N-type germanium, a battery with its positive terminal connected to the emitter will forward-bias the emitter-base junction. In a similar fashion, a battery whose negative terminal is connected to the P-type collector will reverse-bias the collector-base junction.

Current In A Biased PNP Transistor



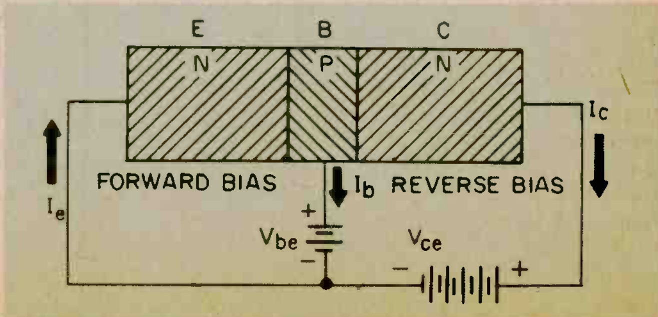
When so biased, the transistor conducts. The emitter, being a P-type semiconductor, passes a positive charge to the base. Whenever an electron from the emitter enters the positive terminal of the forward bias battery, it leaves what is called a hole. At the same time, an electron from the negative terminal of the battery enters the emitter via the base to fill a hole. This is the technique employed to describe the passage of electrons in P-type semiconductor material.

Because the base is thin, nearly all the holes from the emitter are drawn to the negative terminal of the battery connected to the collector. Of course, only electrons, and not holes, flow in the external circuit.

HOW A TRANSISTOR AMPLIFIES

Recall in basic theory how the control grid in a vacuum-tube triode has a great control over plate current. A transistor is capable of amplification because of a similar arrangement. The base in the transistor acts to control current through the transistor in much the same fashion as the grid controls current in the triode.

Grounded-Emitter Bias Circuit



Consider another arrangement of the transistor. This arrangement is similar to the one showing a properly biased NPN transistor. The only difference is that the reverse bias between collector and base is provided by V_{CE} in series with but opposing V_{BE} (V_{CE} is large compared to V_{BE}). This is called a **grounded-emitter** circuit.

QUESTIONS

Q8. Bias polarities for a PNP transistor are the - - - - - - - - of those for an NPN transistor.

Q9. The base in a transistor has an action similar to the - - - - in a triode.

ANSWERS

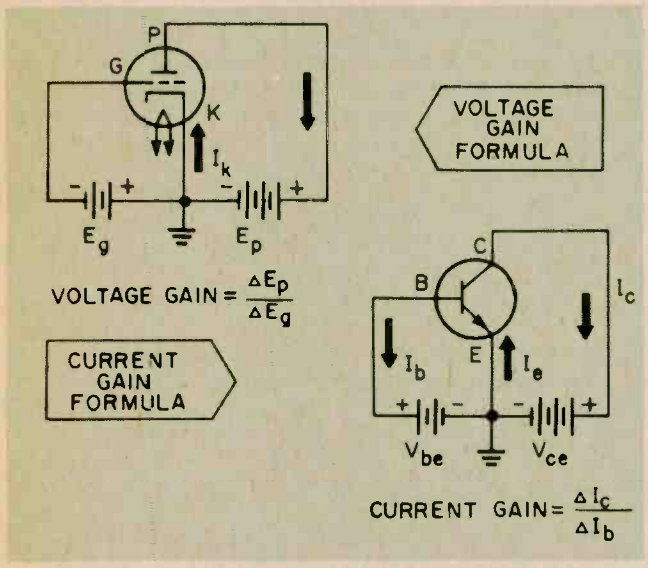
A8. Bias polarities for a PNP transistor are the **opposite** of those for an NPN transistor.

A9. The base in a transistor has an action similar to the **grid** in a triode.

Triode Amplifier Versus Transistor Amplifier

The grounded-emitter circuit mentioned is the most common arrangement for a transistor amplifier. Let's compare it with the most common triode circuit, the grounded-cathode amplifier. You can see from the figure where this amplifier gets its name.

Basic Tube And Transistor Amplifiers



Compare the two circuits shown in the figure. The triode is composed of a cathode (K) that emits electrons; a plate, or anode, (P) that collects the electrons; and a grid (G) that controls the flow of electrons to the plate. The transistor is composed of an emitter (E) that supplies electrons, a collector (C) that collects the electrons, and a base (B) that controls the flow of electrons. The transistor base is very thin, and the vacuum-tube grid has a fine-wire construction. Each of these elements, therefore, allows accelerated electrons to pass through. However, each has great control over the number of electrons that actually reach the collector of electrons (the plate or collector).

In the transistor, the forward bias (V_{BE}) serves the same function as the negative bias in the triode. Instead of a voltage gain, however, a current gain will be measured. The symbol for current gain is the Greek letter β. To obtain this current gain, I_C and I_B are recorded for a particular V_{BE}. V_{BE} is changed and the new I_C and I_B recorded (V_{CE} is held constant). Current gain is then calculated by dividing the change in I_C by the change in I_B. β is often called h_{FE}.

Another parameter of the transistor (beta is a parameter like mu in the triode tube) is alpha (α). Alpha is the ratio of the change in collector current to the corresponding change in emitter current, when the collector voltage is constant. Another symbol for α is h_{FB}. It has been shown that under most biasing methods the collector current is slightly less than the emitter current (due to the base drawing some of the current from the emitter). Therefore, the ratio of ΔI_C and ΔI_E must be less than one. For example, if the collector current changes 4.8 mA and the emitter current changes 5 mA, then the base current must change 0.2 mA. Calculate alpha as follows:

$$\alpha = \frac{\Delta I_C}{\Delta I_E} = \frac{4.8 \text{ mA}}{5.0 \text{ mA}} = 0.96$$

QUESTIONS

Q10. A - - - - - - - - - - - - - - - transistor configuration corresponds to a grounded-cathode triode amplifier.

Q11. The numerical value of alpha is - - - - - - - - - - -.

Q12. If I_B is 100 uA when I_C is 1.0 mA, and I_B is 50 uA when I_C is 0.5 mA, what is β?

ANSWERS

A10. A **grounded-emitter** transistor configuration corresponds to a grounded-cathode triode amplifier.

A11. The numerical value of alpha is **less than one.**

A12.

$$\beta = \frac{\Delta I_B}{\Delta I_C} = \frac{1.0 \text{ mA} - 0.5 \text{ mA}}{100uA - 50uA} = \frac{0.5 \text{ mA}}{50uA} = 10$$

Transistor Amplification

How can a current gain of less than one result in amplification? The answer is that a power gain is realized. The reason for this can be found in the values of the input and output impedances (resistances) of the transistor. The input resistance of the forward-biased, emitter-base junction is low. The output impedance of the reverse-biased, collector-base junction is very high. Consider the formula for power.

$$P = I^2R$$

If you compare the input and output circuits of the transistor in terms of their power consumption, you will see that there is a power gain. Consider a transistor with an emitter-base resistance of 100 ohms and a collector-base resistance of about 1 megohm. Since the collector and emitter currents are very nearly the same, the difference in the power produced by each will depend largely on the resistance. Thus, the power in the collector circuit will be much larger than that in the emitter circuit. The transistor is capable of matching low-resistance circuits to high-resistance circuits and of providing a power gain. It is this transfer of resistance that gives the transistor its name. Contracting **transfer** and res**istor** gives **transistor.**

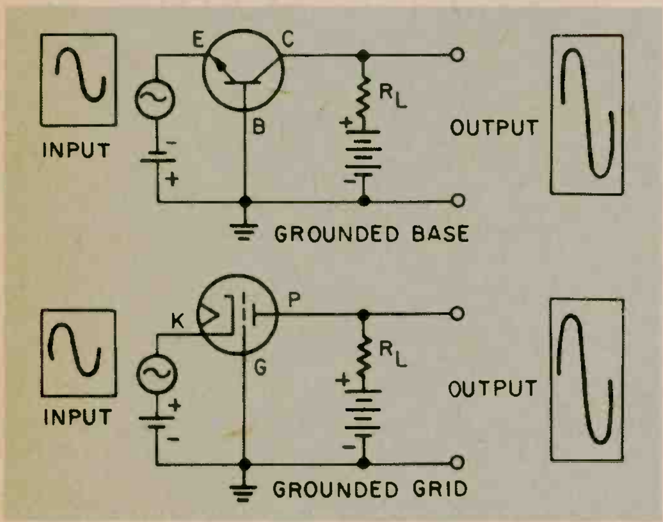
BASIC TRANSISTOR AMPLIFIERS

NPN or PNP transistors can also be used as grounded-collector and grounded-base amplifiers. The three basic transistor amplifiers can be compared with the three basic vacuum-tube amplifiers—the grounded-cathode, grounded-grid, and grounded-plate.

Common- or Grounded-Base Amplifier

Shown are an NPN common-base amplifier and its vacuum-tube equivalent, the grounded-grid amplifier. The base and grid are grounded. The input signal is applied to the emitter in the common-base circuit, and

Tube-Transistor Amplifier Comparison



to the cathode in the grounded-grid circuit. The output signal is taken from the collector and the plate. The input and output signals of these amplifiers have the same polarity; that is, they are in phase. The common-base circuit is used mostly as a voltage amplifier. It has these characteristics:

1. The input impedance is low, about 60 to 100 ohms.
2. The output impedance is high, about 0.5 to 1.0 megohm.
3. Current gain is less than one.
4. Voltage gain is medium, about 150.
5. Power gain is medium, about 450.
6. No phase reversal occurs.

QUESTIONS

Q13. Phase shift in a grounded-base amplifier is - - - -.
Q14. The voltage gain in a grounded-base amplifier is - - - - - -.
Q15. In a grounded-base amplifier, the input impedance is - - -, and the output impedance is - - - -.

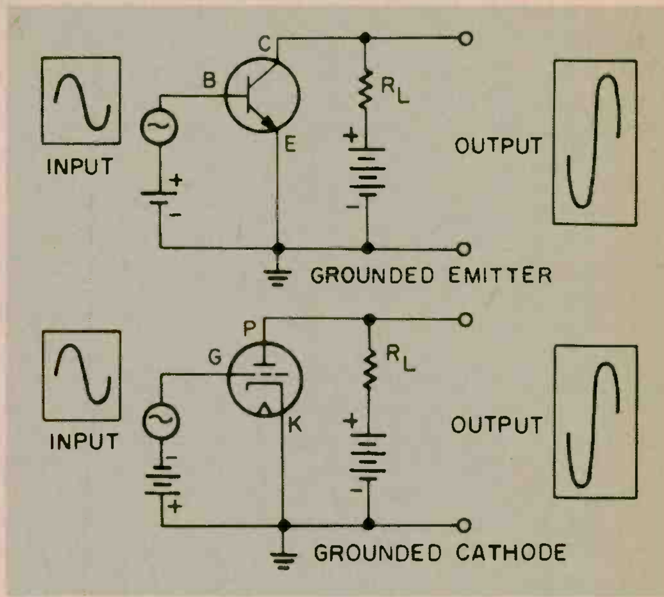
ANSWERS

A13. Phase shift in a grounded-base amplifier is **zero.**
A14. The voltage gain in a grounded-base amplifier is **medium.**
A15. In a grounded-base amplifier, the input impedance is **low,** and the output impedance is **high.**

Common- or Grounded-Emitter Amplifier

The figure shows a common-emitter amplifier and its vacuum-tube equivalent, the grounded-cathode amplifier. The emitter and cathode are grounded. The input signal is applied to the base and the grid, respectively,

Tube-Transistor Amplifier Comparison



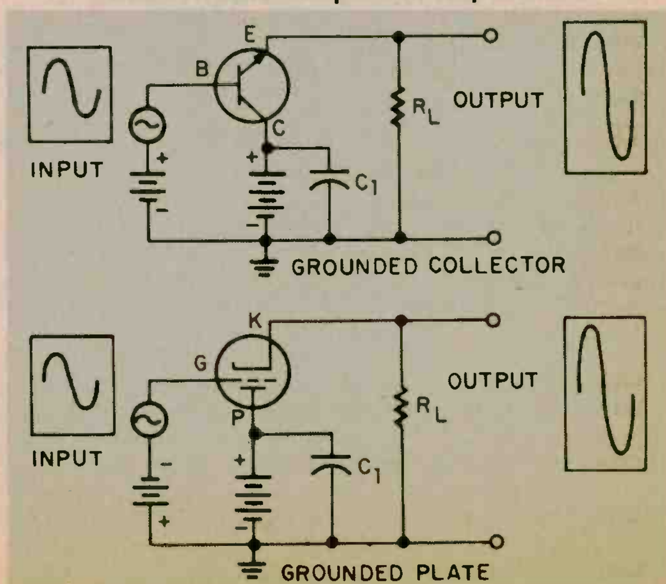
and the amplified output is taken from the collector and the plate, respectively. A phase reversal of 180° occurs between the input and the output. The common-emitter amplifier had these characteristics:

1. Input impedance is low, about 700 to 1,000 ohms.
2. Output impedance is high, about 50,000 ohms.
3. Current gain is about 50.
4. Voltage gain is high, about 500.
5. Power gain is very high, about 800.
6. Phase reversal occurs.

Common- or Grounded-Collector Amplifier

The figure shows a common-collector amplifier and its vacuum-tube equivalent, the grounded-plate ampli-

Tube-Transistor Amplifier Comparison



fier. Notice that the collector and plate are not at DC ground, but at AC ground, due to the large capacitor bypassing the battery. The input signal is applied to the base and grid, respectively.

The output signal is taken from the emitter and cathode, respectively. This circuit is also called an emitter follower, and its equivalent is called a cathode follower. The characteristics of the emitter-follower amplifier will follow.

QUESTIONS

Q16. A common-emitter amplifier produces a phase shift of ____.

Q17. The voltage gain of a common-emitter amplifier is - - - -.

ANSWERS

A16. A common-emitter amplifier produces a phase shift of **180°**.

A17. The voltage gain of a common-emitter amplifier is **high**.

Emitter-Follower Characteristics

The gain of an emitter-follower and a cathode-follower circuit is always less than one. These circuits are usually used to match impedances between two circuits. The common-collector amplifier has these characteristics:

1. Input impedance is very high, about 300,000-ohms to 600,000-ohms.
2. Output impedance is low, about 100-ohms.
3. Current gain is about 50.
4. Voltage gain is less than 1.
5. Power gain is low, about —250. (The negative sign means that power is consumed by RL.)
6. No phase reversal occurs.

TRANSISTOR CHARACTERISTICS

The performance of transistors, like solid-state diodes, is affected by temperature. A change in temperature varies the junction resistance. From the study of diodes you learned that the PN junction has a negative temperature coefficient. This changes the junction bias and the current flow across the junction and therefore affects transistor performance. For this reason, manufacturers list operating temperatures for their transistors.

TRANSISTOR CHARACTERISTIC CURVES

Do you remember how to obtain information from a family of curves associated with vacuum-tube amplifiers? Transistors have similar curves. The figure shows the family of curves for both a pentode amplifier and an NPN-type transistor connected as a common-emitter amplifier. Notice the correspondence between IP and Ic, EP and Vc, and EG and IB.

QUESTIONS

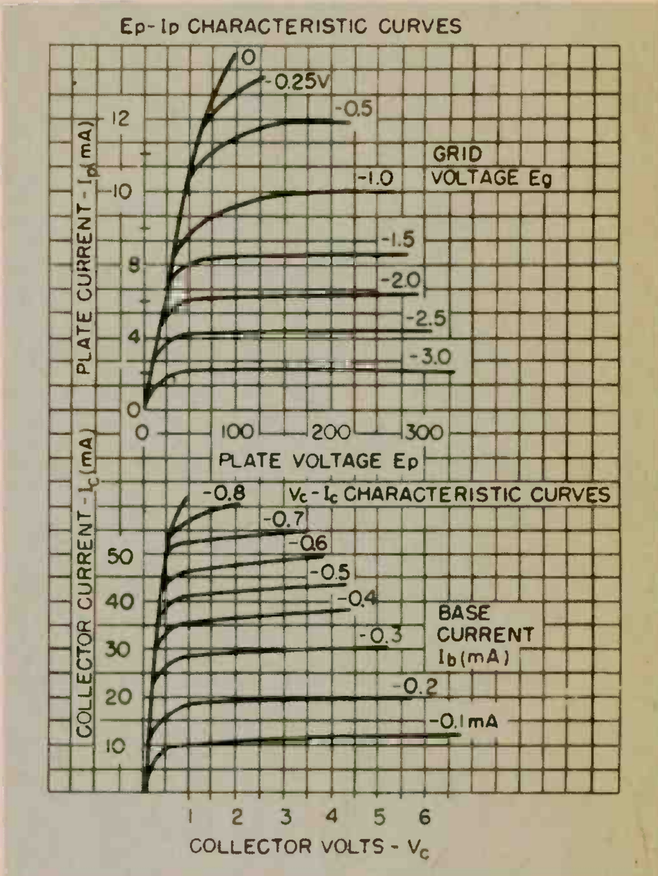
Q18. The emitter follower is best used for what purpose?

Q19. The common-base circuit is most used as a - - - - - - - - - - - - - - - -.

Q20. The - - - - - - - - - - - - circuit may best be used as a power amplifier.

Q21. Use the Vc Ic curves to obtain beta.

Tube-Transistor Characteristic Curves



ANSWERS

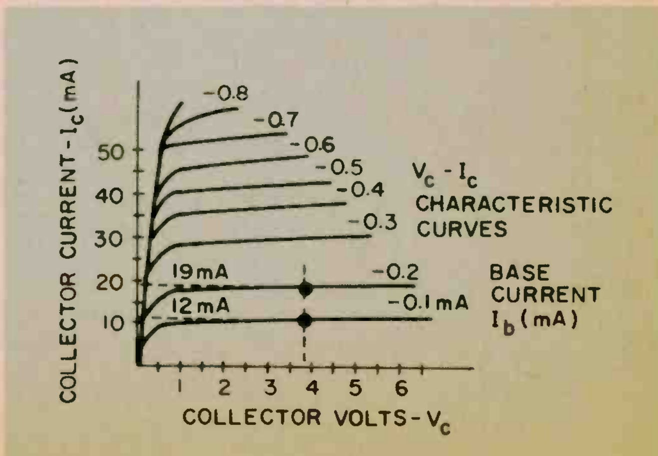
A18. The emitter follower is best used to **match high-impedance circuits to low-impedance circuits.**

A19. The common-base circuit is most used as a **voltage amplifier.**

A20. The **common-emitter** circuit may be used as a power amplifier.

A21.

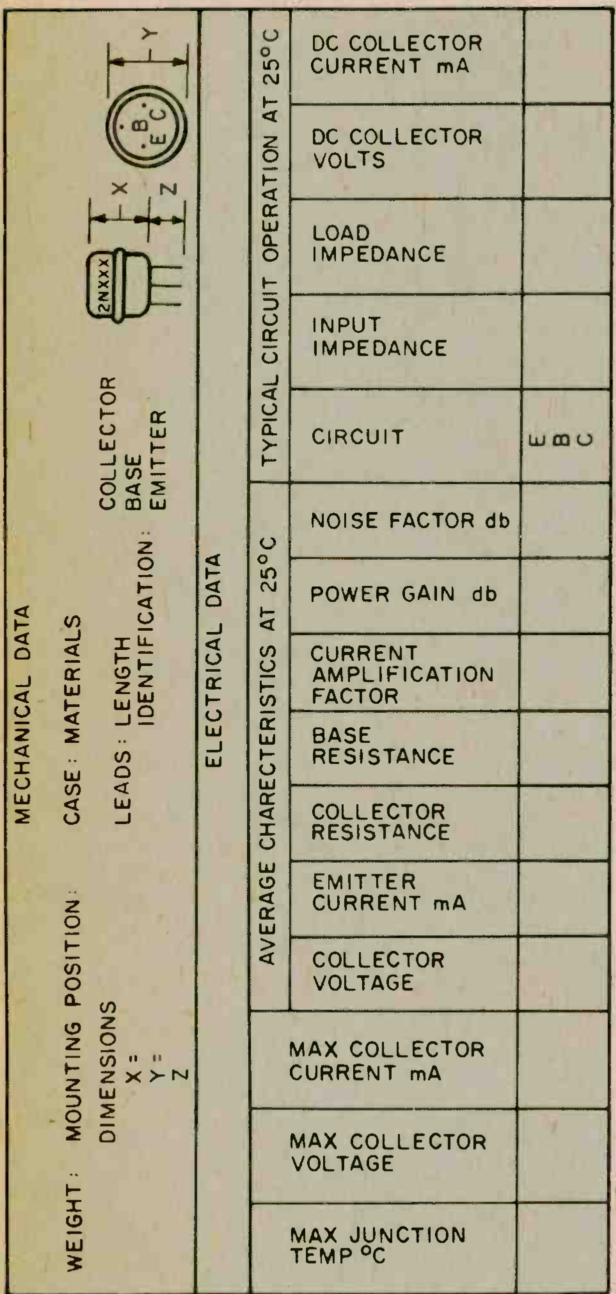
$$\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{19 - 12 \text{ mA}}{0.2 - 0.1 \text{ mA}} = \frac{7 \text{ mA}}{0.1 \text{ mA}} = 70$$



TRANSISTOR SPECIFICATION SHEETS

Most transistor manufacturers present transistor information on specification sheets. These sheets are the equivalent of a tube manual. The figure shows some of the typical data supplied.

Typical Transistor Data Sheet



Each manufacturer selects some of his own electrical specifications for presentation on these data sheets. However, many of them are alike for various manufacturers. Notice that the temperature at which these specifications were obtained is mentioned. Many of these specifications differ at other temperatures. The maximum values listed are limiting values. Above these values transistor life and performance are impaired.

QUESTION

Q22. Transistor data sheets give - - - - - - - - - - and - - - - - - - - - - specifications.

ANSWER

A22. Transistor data sheets give **electrical** and **mechanical** specifications.

WHAT YOU HAVE LEARNED

1. Semiconductors are materials that are neither good conductors nor acceptable insulators.

•

2. Transistors and solid-state diodes replace vacuum tubes because they are smaller, weigh less, are more rugged, use less power, and have a longer useful life.

•

3. Holes behave as though they were positively charged particles.

•

4. Current flows through a forward-biased PN junction but not through a reverse-biased PN junction.

•

5. Transistors function like valves to amplify signals,

•

6. The emitter, base, and collector of a transistor correspond to the cathode, grid, and plate of a triode tube.

•

7. The collector-base junction must be reverse-biased.

•

8. Transistor current gain (measured from collector to base) is called beta (β) and may be quite large. Another current gain (measured from emitter to collector) is called alpha (α) and is usually less than one.

•

9. The base of the transistor is very thin.

•

10. Holes in a PNP and electrons in an NPN transistor are drawn to the collector by the voltage connected to the collector terminal.

This series is based on material appearing in Vol. 1 of the 5-volume set, BASIC ELECTRICITY/ELECTRONICS, published by Howard W. Sams & Co., Inc. @ $22.50. For information on the complete set, write the publisher at 4300 West 62nd St., Indianapolis, Ind. 46268.

ELEMENTARY ELECTRONICS INDEX TO ADVERTISERS

SWL Station Finder

(Continued from page 74)

you can intermittently tap S1 to produce a series of CW "dashes" and then tune for the loudest "clicks" in the receiver. Or, if you have a beat frequency oscillator (BFO) on your receiver, you can adjust the BFO for a convenient audio note (as in CW code reception) and tune for best reception.

Do not place the station finder too close to the receiver, or it may overload the receiver, and result in broad tuning. Place the receiver far enough away for sharp tuning for best results. Tune the station finder from the high frequency end of the vernier dial (minimum capacity) downward and toward the lower frequency end to minimize the possibility of receiving image signals; tune for the strongest signals as heard in the receiver.

When you have found a shortwave station that you wish to listen to again, depress S1 and zero beat the station finder signal with the received station. Do not retune or disturb the station finder unit until the next day (at the correct time of reception). Tune your shortwave receiver until you hear the station finder (but first push and hold S1). You should then be able to find the desired shortwave station close to the frequency. You may have to fine tune the receiver slightly to compensate for warm-up drift of your receiver.

You can also use the station finder to transfer the tuning of a shortwave station from an uncalibrated bandspread dial to another position on the main tuning dial by zero beating the station with the station finder signal. ■

Antique Radio Corner

(Continued from page 81)

NEW 1975 FACT SHEET

☐ Collectors of antique radio and wireless equipment can get an updated Fact Sheet from ELEMENTARY ELECTRONICS which includes information on antique radio publications and clubs, and a listing of public and private radio and wireless museums. To get your copy send a long stamped self-addressed envelope to Antique Radio Corner, ELEMENTARY ELECTRONICS, 229 Park Avenue South, New York, NY 10003.

published soon. Complete with photographs, schematic drawings, and other valuable information, it will be available when you receive this magazine. There will be complete details on troubleshooting, restoring, replacing parts, repairing the power pack, replacing the audio transformers, and repairing the speaker of the model 40. There were so many similar AC-operated Atwater Kent radios that the information will be helpful when restoring any Atwater Kent radio of this type.

The price of the booklet will be $3.00 postpaid. To expedite mailings it will be available from three sources in the United States. It can be ordered from the author, Alan Douglas, Box 225, Pocasset, MA 02559. It can be ordered from the publisher, Antique Radio Press, P.O. Box 42, Rossville, IN 46065. And for those living on the West Coast it can be ordered from Midco Enterprises, Box 15370, Long Beach, CA 90815.

Old-Time Projects. Art Trauffer's old-time radio projects have become so popular with collectors and experimenters that a list of those published is now available. Many people have written to Art requesting a list or reprints of the many articles he has written describing how you can build his projects. He does not have reprints because the material is the property of the magazines he sold the material to. However he has compiled a list of the articles showing when they were published and in which magazine. In many cases you will be able either to find old copies of the magazine or you can write to the publisher.

The list will be available only from Antique Radio Press, address above, for $1.00 to cover the cost of printing, mailing, and postage. ■

Heathkit IC-2100

(Continued on page 60)

the IC it will be zapped the instant you turn on the power switch. You get only one chance to get it right.

You will no doubt note after checking the schematic diagram that the power switch disables only the 15 VDC to the IC; the main high voltage supply is on all the time even though it doesn't provide current when the IC is off (so there's essentially no power used). This is not an error. According to Heathkit the Sperry displays might require a warm-up if the calculator is kept in a cool or cold environment. By keeping the high voltage on the display the warm-up is eliminated and the calculator is ready for use as soon as the on-off switch is closed.

Performance. The calculator works as well as any other with the same features (anything different would give an erroneous answer). If anything, its independent memory system makes the IC-2100 more convenient than the average electronic slide rule pocket calculator. Also, the relatively large keys reduce the number of keying errors, while the large display is a delight when doing a substantial amount of calculations.

We gave the IC-2100 to several students to help with their math homework for a few weeks; their reaction was "first class all the way." And that's about the best recommendation it's possible to give a calculator. The IC-2100 kit sells for $119.95 mail order direct from Heath. See their advertisement in this issue. For additional information on the Heathkit IC-2100 circle No. 1 on the reader service coupon on page 17. ■

AFAN McMurdo

(Continued from page 69)

daily schedule are filled with "canned" AFRTS programs.

The signal is fed simultaneously to the "local" FM and shortwave transmitters. Those transmitters, a Gates 50-watt FMer and a 1,000-watt FRT-24 high frequency AM unit, are located atop Transmitter Hill, three miles south of McMurdo. The shortwave signals are radiated from an omni-directional antenna. The first scheduled SW programs went out over the air in July 1974.

"We were thrilled," says Carter, "when we began getting favorable reports from the isolated Antarctic bases. Then we started receiving letters from other countries whenever mail planes came to visit. They added tremendously to our already swelled heads!"

News From Home. Particularly exciting to the Navy broadcasters were the first reports of reception back home in the States. Before Bill Carter's tour of duty ended, letters were received from listeners in Canada, Australia, New Zealand, England, and West Germany.

At first, DXers' requests for QSLs caused a brief bit of consternation among the Operation Deepfreeze "brass." By agreement, the various countries engaged in Antarctic exploration and research have deferred the question of territorial claims to the seventh continent. Antarctica is considered "international territory."

Would the other nations consider the broadcasts by the U.S., which could be received outside Antarctica, a violation of the agreement? It wasn't long before the answer became apparent. There would be no international incident. And DXers got their QSLs.

Though Carter, now a Navy chief, has been reassigned to a communications installation in Greece, the shortwave broadcasts of AFAN McMurdo go on.

If you want to add this exotic DX station to your SWL logbook, try tuning 6,012 kHz between about 0900 and 1200 GMT. October and November seem to be particularly good months for Antarctic reception. Reports may be sent to the public affairs officer, Naval Support Force, Antarctica, FPO San Francisco, CA 96692.

The McMurdo shortwaver is not and probably never will be an easy SWL catch. But with a reasonably good receiver, DX-ability, plenty of patience, lots of lost hours of sack time, and more than a little luck, you may hear the southernmost—and coldest—DX station in the world, AFAN McMurdo. ■

A New Face for CB

(Continued from page 71)

pose of "spectrum management," which in plain terms means the FCC intends to keep Class D CB for short range.

While these are the basic highlights of the antenna proposals, it is clear from the FCC Notice Of Proposed Rule Making that they intend narrow technical parameters in terms of radiation pattern (both horizontal and vertical) and directivity—closely approaching, if not the equal of, parameters for other radio services.

Operating Procedures. The remainder of the FCC proposal concerns operating procedures such as waiting periods, maximum transmission time, what you can and cannot use CB for, etc. There's not too much of prime interest at this time.

It is obvious that just the transceiver and antenna proposals makes class D CB a whole new ball game. With the requirement of type acceptance for both the transceiver and antenna, class D is no longer different from any other commercial radio service, and its cost will certainly go up. No longer can a transceiver be offered which does not meet its advertising claims *vis-à-vis* FCC requirements. For example, though present CB transceivers are supposed to have 100 percent modulation limiting, few really do. You cannot get away with this when you certify type acceptance, for if the FCC withdraws acceptance, the unit cannot be sold. Similarly, fantastic, unrealized claims for antenna performance could not be made for type-accepted antennas; for again, failure to meet the acceptance certification will preclude further sales.

Since type acceptance even to minimum standards means a specific in-built level of performance and quality, CB equipment under the new proposals will, of necessity, reflect the pricing of top-of-the-line, and we are now talking of a substantial investment per CB station—possibly well in excess of $500 for a base installation.

Not Dead Yet. Even if the proposal should go into effect immediately, there is really no reason not to go CB if you need it. All equipment will be legal for five years *after* the effective date of the final rules. Whatever you purchase now will be usable for, at least, its normal life. (After five years, CB equipment owes you nothing.) Then again, the wheels of the FCC are known to grind exceedingly slow, if at all, and it might be one, three, or five years before there is an effective date. Quite possibly, the rules might never be substantially modified.

But as we've said, even under worse-case conditions you'll get at least five years of active CB operations from whatever CB gear you get now. At the worst, the new proposals might limit your inter-station contacts; for example, you might not be able to use channel 11 for any purpose other than calling—but that's a small loss. Then again, some channels presently used for inter-station communications might be changed to intra-station only, but that's just guesswork. Basically, CB will stay the same *for you* for at least five years, and that's a long time.

Wondering? You might wonder, as do others, what brought about this new proposal which completely restructures class D CB. Simple. CB has outgrown its childhood. There is a heavy demand for personal and small business radio systems. There are few frequencies *other* than 27 MHz where it can be done so inexpensively and without disruption to other radio services. The technology already exists, as evidenced by the modern SSB transceiver and most CB antennas, and there is no longer any reason to allow a handful of "hobbyists" to disrupt and retard the growth of a complete communications system. For each CB hobbyist there are possibly a hundred potential users of CB for business and pleasure, yet one single hobbyist can tie up a channel almost full time. This is not permitted in any other radio service; why, then, is it allowed for class D? Though the new proposals don't forbid hobby operations, they do make it inconvenient and expensive. For example, communications regarding the technical facilities being used are forbidden and, therefore, prima facie evidence of rule violation. The FCC need no longer struggle to make a case of "hobbying" stick. If they've got you on tape giving an S-report or talking about your antenna you've had it. As for expense, it's to be questioned whether it's worth in excess of $500 just to hobby when the FCC is considering a new class of amateur radio license for Communicators requiring no code test and a smattering of rules and regulations, with equipment costs for the "Communicator" possibly well under $200. But Kathi has more to say on that in her "CB Carousel" this issue. ■

TV DXing

(Continued from page 58)

perienced snowband DXers have a few tips to offer the newcomer to this phase of the hobby.

- Try a 1/30th of a second exposure if you have an inexpensive type camera. An f5.6 setting is a good place to start, but you may have to experiment.
- Use a fast film, such as Kodak's Tri-X.
- A close-up lens may help but, regardless, make sure your camera is in focus and you include the entire screen area.
- Never—repeat, *never*—use a flash! The light reflecting from the set's glass screen will wipe out your image. A semi-dark room lighting is best. All the light you need will come from the TV screen.
- A tripod is useful to steady the camera.
- A snowy picture can be cleared up somewhat by taking a time exposure *if* you are shooting a non-moving image, such as a test pattern or ID slide.

A free booklet, "Photographing Television Images" (Pamphlet AC-10), available from the Eastman Kodak Company, Consumer Markets Division, Rochester, N.Y. 14650, may be helpful.

Finally, there is a hobby club devoted to all aspects of TV and FM DXing. It is the Worldwide TV FM DX Association (Box 163, Deerfield, IL 60015). This club publishes a monthly bulletin devoted to these types of DXing activities. Also available are other guides and booklets that will help you whether you are a newcomer or a veteran DXer. Drop them a line for more information on membership. ■

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103. See brochures on *Regency's* 1975 line-up of CB transceivers & scanner receivers (for police, fire, weather, & other public service emergency broadcasts).

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

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

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

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

108. Compact is the word for *Xcelite's* 9 different sets of midget screwdrivers and nutdrivers with "piggyback" handle to increase length and torque. A handy show case serves as a bench stand also.

110. *Turner* has colorful booklets on their Signal Kicker antennas, which are computer optimized for CB. Another booklet covers their communications microphones.

111. *Midland's* line of base & mobile CB equipment, marine transceivers & accessories, and scanner receivers are illustrated in a new full-color 16-page brochure.

112. The *EDI (Electronic Distributors, Inc.)* catalog is updated 5 times a year. It has an index of manufacturers literally from A to X (ADC to Xcelite). Whether you want to spend 29 cents for a pilot-light socket or $699.95 for a stereo AM/FM receiver, you'll find it here.

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

116. Get the *HUSTLER* brochure illustrating their complete line of CB and monitor radio antennas.

117. *Teaberry's* new 6-page folder presents their 6 models of CB transceivers (base and mobile): 1 transceiver for marine-use, and 2 scanner models (the innovative "Crime Fighter" receiver and a pocket-size scanner).

118. CBers, *GC Electronic's* 8-page catalog offers the latest in CB accessories. There are base and mobile mikes; phone plugs; adaptors and connectors; antenna switchers and matchers; TVI filters; automotive noise suppressor kits; SWR Power and FS meters, etc.

146. *Robyn International* has 4-color "spec" sheets for each model of their CB (base and mobile) transceivers and monitor-scanner lines.

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

119. *Browning's* mobiles and its famous Golden Eagle base station, are illustrated in detail in the new 1975 catalog. It has full-color photos and specification data on Golden Eagle, LTD and SST models, and on "Brownie," a dramatic new mini-mobile.

120. *Edmund Scientific's* new catalog contains over 4500 products that embrace many sciences and fields.

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

122. *Radio Shack's* 1975 catalog colorfully illustrates their complete range of kit and wired products for electronics enthusiasts—CB, ham, SWL, hi-fi, experimenter kits, batteries, tools, tubes, wire, cable, etc.

123. Get *Lafayette Radio's* "new look" 1975 catalog with 260 pages of complete electronics equipment. It has larger pictures and easy-to-read type. Over 18,000 items cover hi-fi, CB, ham rigs, accessories, test equipment and tools.

124. *Mosley Electronics* reports that by popular demand the Model A-311 3-element CB beam antenna is being reintroduced. Send for the brochure.

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

127. There are *Avanti* antennas (mobile & base) for CB and scanner receivers, fully described and illustrated in a new 16-page full-color catalog.

129. Semiconductor Supermart is a new 1975 catalog listing project builders' parts, popular CB gear, and test equipment. It features semiconductors—all from *Circuit Specialists*.

130. There are over 350 kits described in *Heath's* new catalog. Virtually every do-it-yourself interest is included—TV, radios, stereo & 4-channel, hi-fi, etc.

131. *E. F. Johnson's* new full-color catalog for CB transceivers and accessories is now available. Send for a free copy. They also have a free brochure on their line of scanner receivers.

126. *B&F Enterprises* has an interesting catalog you'd enjoy scanning. There are geiger counters, logic cards, kits, lenses, etc.

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

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134. *Sprague Products* has L.E.D. readouts for those who want to build electronic clocks, calculators, etc. Parts lists and helpful schematics are included.

135. The latest edition of *Tab Books'* catalog has an extensive listing of TV, radio and general servicing manuals.

137. *Pace Communications* has a packet of information for you. The "Citizens two-way radio" answers all the questions from how to operate one to how much they will cost to operate. A booklet on Pace's scan/monitors to keep you informed is included.

138. *Shakespeare's* new pocket-size catalog lists and describes their full line of fiberglass CB antennas, mounts and accessories offered in 1975.

144. For a packetful of material, send for *SBE's* material on UHF and VHF scanners, CB mobile transceivers, walkie-talkies, slow-scan TV systems, marine-radios, two-way radios, and accessories.

145. For CBers from *Hy-Gain Electronics Corp.* there is a 50-page, 4-color catalog (base, mobile and marine transceivers, antennas, and accessories). Colorful literature illustrating two models of monitor-scanners is also available.

147. *Telex's* 4-page, 2-color folder illustrates their new line of boom microphone head-sets for CBers and hams, as well as their line of communications headphones.

149. *Cush Craft* has a catalog on Citizens Band Antennas for every purpose. The Ringo base antenna is featured, as is the new Super-fire 8-element horizontal/vertical power beam.

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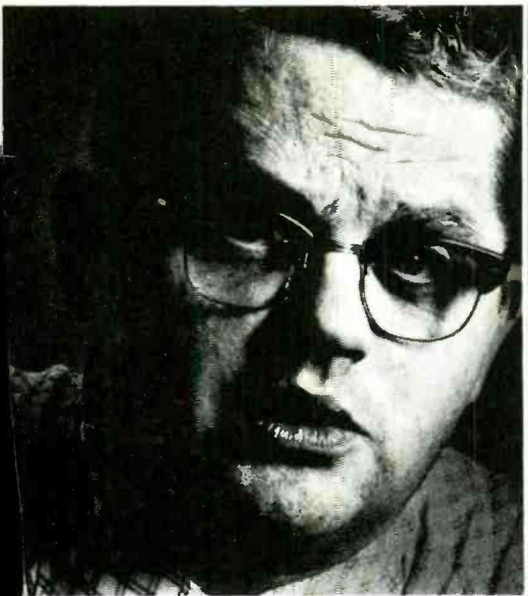
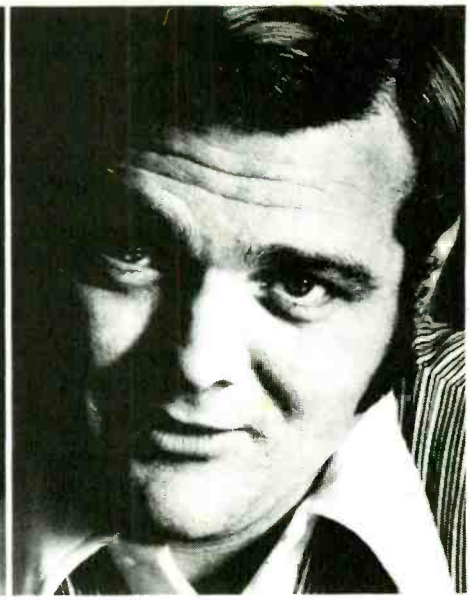
CITY ____________ STATE ____________ ZIP ____________

M/J75 Not Valid After October 17, 1975

3 GUYS WHO DIDN'T GET A FREE RIDE THROUGH COLLEGE TELL HOW THEY BECAME ENGINEERS.





BILL JOHNSON

"Get into college? After high school in Rutland, Vermont, I was glad to get into a machine shop not far away. Started as a lathe operator at 75 cents an hour. But thanks to ICS I've gone far. Studied Mechanical Engineering nights, at home. Never did take to classrooms or missed paydays. Won't say it was easy, but with the instructors' help I took it one step at a time. Today I'm Development Engineer with a paper converting plant near the Canadian border. Hunting's great. Salary's jumped 600 per cent since I started my ICS course. There's 40 men under me, future looks fine. Do I recommend ICS to my men? Yes I do."

GARY BURNASH

"Too bad, but the college I went to didn't hand out degrees in hot rodding. So after my first year my Dad and I had one of those long talks. The upshot was, it was time to get serious. So I got married, started to learn automotive tool making at Sheler Corporation outside Detroit, and signed on with ICS. They taught me everything. Print reading. Materials. Hydraulics. Even how to use a slide rule. When the boss found out, he gave me design work to take home. Pretty soon, I could talk to the big car companies in their own language. I'm making triple my starting salary now, but here's the best part—I'm a half owner in the business. If I want another raise, the man I ask is me."

JACK TERRY

"I grew up near the Okeefenokee Swamp and what that means is, you don't expect life to be a gravy train with biscuit wheels. I went to work real early with the Florida Department of Transportation as a beginner draftsman. I heard the fellows tell of ICS so I sent for the information. Before long, I got to be a First-Level Highway Engineer at twice the pay. It took five promotions but the ICS training was a real help to pass each promotion exam."

ICS

International Correspondence Schools
Scranton, Pa. 18515

You, too, can become an engineer without going to college. At home, in about an hour a day, ICS can train you from scratch for one of the many secure, well-paying engineering jobs opening each year. To find out more about these opportunities and how ICS training works, mail card for career guidance booklet and free demonstration lesson. ICS is approved for veterans training. (If card is missing, write to: ICS, Scranton, Pennsylvania 18515.)