FOIL BLACKOUTS-GENERATE EMERGENCY POWER!

02342

SEPTEMBER-OCTOBER
1974
75c

elementary Electronics

BASIC THEORY
Resistor Circuits & Inside CB Transmitters

A DAVIS PUBLICATION

Darkroom Color Exposure Meter

Beautiful color prints, first time, every time, made possible by an electronic color analyzer you can build today!
See page 31.

FET Multimeter for Only 20 Bucks

Build this valuable portable/bench meter and learn valuable multimeter theory you should know.
See page 63.

Build Our Zener Zapper

Determine the Zener voltage and knee characteristics rated at 20 volts or less. Discover how inexpensive silicon transistors can serve as Zeners. Complete plans on page 51.

Bug Mother Nature with our Parabolic/Amplified Mike

One of our most successful students wrote this ad!

Harry Remmert decided he needed more electronics training to get ahead. He carefully "shopped around" for the best training he could find. His detailed report on why he chose CIE and how it worked out makes a better "ad" than anything we could tell you. Here's his story, as he wrote it to us in his own words.

Harry Remmert gives his CIE Electronics course much of the credit for starting him on a rewarding career. He tells his own story on these pages.

By Harry Remmert

"AFTER SEVEN YEARS in my present position, I was made painfully aware of the fact that I had gotten just about all the on-the-job training available. When I asked my supervisor for an increase in pay, he said, "In what way are you a more valuable employee now than when you received your last raise?" Fortunately, I did receive the raise that time, but I realized that my pay was approaching the maximum for a person with my limited training.

"Education was the obvious answer, but I had enrolled in three different night school courses over the years and had not completed any of them. I'd be tired, or want to do something else on class night, and would miss so many classes that I'd fall behind, lose interest, and drop out.

The Advantages of Home Study

"Therefore, it was easy to decide that home study was the answer for someone like me, who doesn't want to be tied down. With home study there is no schedule. I am the boss and I set the pace. There is no cramming for exams because I decide when I am ready, and only then do I take the exam. I never miss a point in the lecture because it is right there in print for as many re-readings as I find neccessary. If I feel tired, stay late at work, or just feel lazy, I can skip school for a night or two and never fall behind. The total absence of all pressure helps me to learn more than I'd be able to grasp if I were just cramming it in to meet an exam deadline schedule. For me, these points give home study courses an overwhelming advantage over scheduled classroom instruction.

"Having decided on home study, why did I choose CIE? I had catalogs from six different schools offering home study courses. The CIE catalog arrived in less than one week (four days before I received any of the other catalogs). This indicated (correctly) that from CIE I could expect fast service on grades, questions, etc. I eliminated those schools which were slow in sending catalogs.

FCC License Warranty Important

"The First Class FCC Warranty* was also an attractive point. I had seen "Q" and "A" manuals for the FCC exams, and the material had always seemed just a little beyond my grasp. Score another point for CIE.

*CIE backs its courses with this famous Money-Back Warranty: when you complete a CIE license preparation course, you'll be able to pass your FCC exam or be entitled to a full refund of all tuition paid. Warranty is valid during completion time allowed for your course.

"Another thing is that CIE offered a complete package: FCC License and technical school diploma. Completion time was reasonably short, and I could attain something definite without dragging it out over an interminable number of years. Here I eliminated those schools which gave college credits instead of graduation diplomas. I work in the R and D department of a large company and it's been my observation that technical school graduates generally hold better positions than men with a few college credits. A college degree is one thing, but I'm 32 years old, and 10 or 15 years of part-time college just isn't for me. No, I wanted to *graduate* in a year or two, not just *start*.

"When a school offers both resident and correspondence training, it's my feeling that the correspondence men are sort of on the outside of things. I wanted to be a full-fledged student instead of just a tag-a-long, so CIE's exclusive home-study program naturally attracted me.

"Then, too, it's the men who know their theory who are moving ahead where I work. They can read schematics and understand circuit operation. I want to be a good theory man.

"From the foregoing, you can see I did not select CIE in any haphazard fashion. I knew what I was looking for, and only CIE had all the things I wanted.

Two Pay Raises in Less Than a Year

"Only eleven months after I enrolled with CIE, I passed the FCC exams for First Class Radiotelephone License with Radar Endorsement. I had a pay increase even before I got my license and *another* only ten months later.

"These are the tangible results. But just as important are the things I've learned. I am smarter now than I had ever thought I would be. It feels good to know that I know what I know now. Schematics that used to confuse me completely are now easy for me to read and interpret. Yes, it is nice to be smarter, and that's probably the most satisfying result of my CIE experience.

Praise for Student Service

"In closing, I'd like to get in a compliment for my Correspondent Counselor who has faithfully seen to it that my supervisor knows I'm studying. I think the monthly reports to my supervisor and generally flattering commentary have been in large part responsible for my pay increases. My Counselor has given me much more student service than "the contract calls for," and I certainly owe him a sincere debt of gratitude.

"And finally, there is Mr. Tom Duffy, my instructor. I don't believe I've ever had the individual attention in any classroom that I've received from Mr. Duffy. He is clear, authoritative, and spared no time or effort to answer my every question. In Mr. Duffy, I've received everything I could have expected from a full-time private tutor.

"I'm very, very satisfied with the whole CIE experience. Every penny I spent for my course was returned many times over, both in increased wages and in personal satisfaction."

Perhaps you too, like Harry Remmert, have realized that to get ahead in Electronics today, you need to know much more than the "screwdriver mechanics." They're limited to "thinking with their hands"... learning by taking things apart and putting them back together... soldering connections, testing circuits, and replacing components. Understandably, their pay is limited—and their future, too.

But for men like Harry Remmert, who have gotten the training they need in the fundamentals of Electronics, there are no such limitations. He was recently promoted, with a good increase in income, to the salaried position of Senior Engineering Assistant working in the design of systems to silence submarines. For trained technicians, the future is bright. Thousands of men will be needed in virtually every field of Electronics from two-way mobile radio to computer testing and troubleshooting.

Send for Complete Information — FREE

Many men who are advancing their Electronics career started by reading our illustrated school catalog, "Succeed in Electronics." It tells of the many electronics careers open to men with the proper training. And it tells which courses of study best prepare you for the work you want.

If you're "shopping around" for the training you need to move up in Electronics, this interesting book may have the answers you want. We'll send it to you FREE. With it, we'll also include our other helpful book, "How To Get A Commercial FCC License."

To get both FREE books, just fill out and mail the reply card. For your convenience, we will try to have a representative call. If card is missing, use coupon below.

APPROVED UNDER G.I. BILL

All CIE career courses are approved for educational benefits under the G.I. Bill. If you are a Veteran or in service now, check box for G.I. Bill information.

CIE Cleveland Institute of Electronics, Inc.

1776 East 17th Street, Cleveland, Ohio 44114

Accredited Member National Home Study Council

Cleveland Institute of Electronics, Inc.
1776 East 17th Street, Cleveland, Ohio 44114

Please send me your two FREE books:
1. Your school catalog, "Succeed in Electronics."
2. Your book on "How To Get A Commercial FCC License."

I am especially interested in:

☐ Electronics Technology ☐ Electronic Communications
☐ Broadcast Engineering ☐ Industrial Electronics
☐ First Class FCC License ☐ Electronics Engineering
☐ Electronics Technology with Laboratory

Name_____
(Please Print)

Address_____

City_____

State_____ Zip_____ Age_____

☐ Veterans & Servicemen: Check here for G. I. Bill information

EL-49

For men with prior electronics training...

Electronics Engineering Course

...Covers steady-state and transient network theory, solid-state physics and circuitry, pulse techniques, computer logic and mathematics through calculus. A college-level course for men already working in Electronics.

CIRCLE NO. **18** ON PAGE **17** OR **103**

ELEMENTARY ELECTRONICS including ELECTRONICS DIGEST (Vol 14, No. 5) is published bi-monthly by Davis Publications, Inc., at 229 Park Ave., S. New York, N.Y. 10003. One year subscription (six issues)—$3.99. Second class postage paid at New York, N.Y. 10003 and at additional mailing office.

• September/October 1974 • Vol. 14 No. 5

e/e elementary Electronics

Dedicated to America's Electronics Hobbyists

☆ Cover Highlights

Cover photograph by Jack Dressler

AUTHORS IN THIS ISSUE

F. J. Bauer, James A. Fred, Herb Friedman, Don Jensen, Janus Kodrun, C. R. Lewart, Kathi Martin, Charles Rakes, Hank Scott, and the ELEMENTARY ELECTRONICS editorial staff.

BUILD 20 RADIO
and Electronics Circuits
PROGRESSIVE HOME RADIO-T.V. COURSE

Reg. U.S. Pat. Off.

Training Electronics Technicians Since 1946

Now Includes
- ★ 12 RECEIVERS
- ★ 3 TRANSMITTERS
- ★ SQ. WAVE GENERATOR
- ★ SIGNAL TRACER
- ★ AMPLIFIER
- ★ SIGNAL INJECTOR
- ★ CODE OSCILLATOR

- ★ No Knowledge of Radio Necessary
- ★ No Additional Parts or Tools Needed
- ★ EXCELLENT BACKGROUND FOR TV
- ★ SCHOOL INQUIRIES INVITED
- ★ Sold In 79 Countries

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 solder 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. 569DJ Hewlett, N.Y. 11557

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

NAME .....

ADDRESS .....

CITY & STATE ..... ZIP .....

PROGRESSIVE "EDU-KITS" INC.
1189 Broadway, Dept. 569DJ, Hewlett, N.Y. 11557

CIRCLE NO. 9 ON PAGE 17 OR 103

elementary Electronics

Sept./Oct. 1974 **Vol. 14/No. 5**

Dedicated to America's Electronics Hobbyists

ELEMENTARY ELECTRONICS is published bimonthly by Davis Publications, Inc. Editorial and Executive offices: 229 Park Ave. So. New York NY 10003; all Subscription orders and mail regarding subscriptions should be sent to P.O. Box 2600, Greenwich CN 06830. One-year subscription (six issues)—$3.95; two-year subscription (12 issues)—$7.95; three-year subscription (18 issues)—$11.95; and four-year subscription (24 issues)—$15.95. Add $1.00 per year for postage outside the U.S.A., its possessions and Canada. For change of address, please advise 4 to 6 weeks before moving. Send us your current mailing label with new address. Advertising offices: New York, 229 Park Avenue South, 212-673-1300; Chicago, 520 N. Michigan Ave., 312-527-0330; Los Angeles; J. E. Publishers' Rep. Co., 8732 Sunset Blvd. 213-659-3810. Second-class postage paid at New York NY and at additonal mailing office.

LIVE IN THE WORLD OF TOMORROW...TODAY!

A BETTER LIFE STARTS HERE

(And our FREE CATALOG is packed with exciting and unusual ecological & physical science items—plus 4,500 finds for fun, study or profit . . . for every member of the family).

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. 1635EK (8x3x4"; 24 oz.) . . . . . $128.00 Ppd.

LOW COST "STARTER" UNIT
No. 71,809EK . . . . . $49.95 Ppd.

He-Ne LASERS FROM $99.50!

Edmund quality, TEMoo mode, cold cathode for long life. Completely self-contained units; solid state power supply; 110v AC. 0.3mW min—GREAT GENERAL PURPOSE LASER: 1.2mm beam dia., 2.0mRad beam Diverg. **Stock No. 79,061EK . . . $99.50 Ppd.**

1.0mW min—HI-PERFORMANCE LAB LASER: 1.2mm beam dia., 1 0mRad beam Diverg. **Stock No. 79,050EK . . . $150.00 Ppd.**

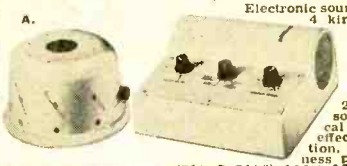
3.0mW min—DEPENDABLE HI-POWERED LASER: 1.0mm beam dia., 0.8mRad beam Diverg.
Stock No. 79,052EK . . . . . $325.00 Ppd.

THE MOST POWERFUL SOLAR CELLS

Price & technology breakthrough. Harness the sun with these 2" dia. 500 mA @ .5V silicon cells—5 *times* more efficient per cost than ever before! Need no plastic lens, are very flat, fit almost any solar application. Hook up in series for more voltage; parallel for more current.

No. 42,145EK . (TAB LEADS) . . . . . $11.50 Ppd.
PIE-SHAPED ¼ 2" DIA. 100 mA. @ .5V
No. 42,146EK . . . . . (TAB LEADS) . . . . . $7.95 Ppd.
15/16" DIA. CIRC. (1/16" THICK), 100 mA. @ .5V
No. 30,538EK . . . . . (WIRE LEADS) . . . . . $6.95 Ppd.

CAN'T SLEEP, RELAX? TRY THIS!



Electronic sound conditioner simulates 4 kinds of soothing sounds of ocean surf and rain. "White sound" helps mask unwanted noise, adds restful, intriguing background sound. Program the solid-state unit to your own need: 2 surf, 2 rain; or "white sound", proven by medical tests to have analgesic effects. Great for meditation, restlessness, sleeplessness psychology.

No. 71,997EK . . . . . (7½x7x3½") 110V AC . . . . . $79.95 Ppd.
AS ABOVE, BUT "WHITE SOUND" ONLY (A)
No. 71,980EK . . . . . (6" Rd.x3½" Hi) . . . . . $28.00 Ppd.

NEW! KIRLIAN PHOTOGRAPHY KIT!

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 objects. Each "aura" differs from another—animate aura said to change corresponding to physical changes. $50 Kit Gives everything needed except film including portable darkroom, double transformer isolated from power source; complete instructions.

Stock No. 71,938EK . . . . . $49.95 Ppd.
"HIGH VOLTAGE PHOTOGRAPHY" by H. S. Dakin
NO. 9129EK (60-PG. PAPERBACK BOOK) . . . . . $5.00 Ppd.

GET A CHARGE FROM THE SUN!

Our 12V Solar Battery Charger allows direct conversion of light-to-electricity. Compact panel put on a boat can automatically charge its 12V battery over entire daylite period. Use anywhere for a trickle charge. Big value, it comprises *30* ½V silicon solar cells in series w/ diode.

No. 71,971EK (AB. 30 W-HRS./WK.) $89.95 Ppd.
9x18" HI CURRENT MODEL (6W, 12V, 500 mA)
No. 72,010EK (AB. 150 W-HRS./WK) $420.00 PPd.
6x6" LO VOLTAGE MODEL (1.5V, .38W, 250 mA)
No. 42,172EK . . $49.95 Ppd.

MAIL COUPON FOR GIANT FREE CATALOG!

164 PAGES • MORE THAN 4500 UNUSUAL BARGAINS

Completely new Catalog. Packed with huge selection of telescopes, microscopes, binoculars, magnets, magnifiers, prisms, photo components, ecology and Unique Lighting items, parts, kits, accessories — many hard-to-get surplus bargains. 100's of charts, illustrations. For hobbyists, experimenters, schools, industry.

EDMUND SCIENTIFIC CO.
300 Edscorp Building, Barrington, N. J. 08007

Please rush Free Giant Catalog "EK"

Name_____

Address_____

City_____ State_____ Zip_____

ORDER TODAY! COMPLETE AND MAIL

EDMUND SCIENTIFIC CO
300 Edscorp Building, Barrington, N.J. 08007

How Many	Stock No.	Description	Price Each	Total

PLEASE SEND ☐ GIANT FREE CATALOG "EK" MERCHANDISE TOTAL $_____

PLEASE ADD HANDLING CHARGE:
$1.00 ON ORDERS UNDER $5.00
50c ON ORDERS OVER $5.00
TOTAL $_____

30 DAY MONEY-BACK GUARANTEE
YOU MUST BE SATISFIED OR RETURN ANY PURCHASE IN 30 DAYS FOR FULL REFUND

I enclose ☐ check
☐ money order for $_____

NAME_____

ADDRESS_____

CITY_____ STATE_____ ZIP_____

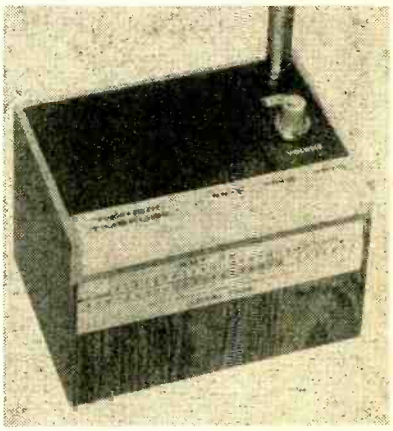
CIRCLE NO. 24 ON PAGE 17 OR 103

Hey, look me over

Showcase of New Products

Time Cube

Even if you don't have time on your hands, now you can have it at your fingertips with the new Realistic Timekube radio from Radio Shack. The Timekube provides instant push-button reception of WWV, the National Bureau of Standards radio station in Fort Collins, Colorado. WWV broadcasts continuously, giving time announcements each minute in Coordinated Universal Time (UTC, formerly called Greenwich Mean Time, GMT). A sliding scale on the front of the Timekube allows instant conversion of UTC to local time. Push-button selection of three different WWV frequencies (5, 10, and 15 MHz) is said to assure optimum reception in all parts of the country at any time of the day or night. The Realistic Timekube desk radio, in simulated rosewood case, is priced at $49.95. Operates on one 9-volt battery. Realistic products are available from Radio Shack stores and Authorized Sales Centers in all 50 states and Canada.

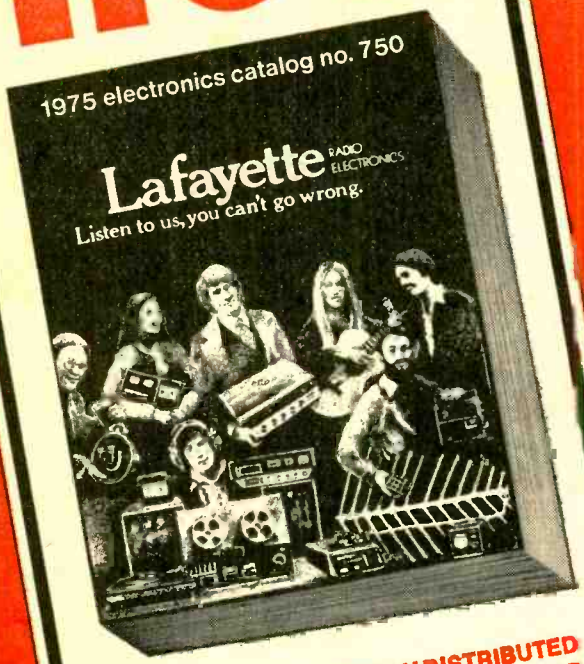


Circle No. 4 on Reader Service Page 17 or 103

Pack a Calculator

The new Heathkit IC-2006 Electronic Calculator features true pocket size (5 x 2 13/16 x 15/16-in.) and operates anywhere with internal 9-volt battery power, or may be powered with an optional AC converter. It features addition,

free



The "NEW LOOK" 1975 LAFAYETTE RADIO ELECTRONICS CATALOG

If you're interested in electronics you NEED this catalog! Completely re-designed for easier-than-ever ordering, with the newest and best Lafayette and national-brand products for '75. And you get the same quality and service that has made Lafayette a leader for 55 years. Iron-clad guarantees! Lowest Prices! Professional Service! State-of-the-art Equipment! Pick and choose from over 18,000 quality electronics products! Now, more than ever, we're your "Single-trip" shopping center for everything in electronics.

SAVE ON EXCLUSIVE LAFAYETTE PRODUCTS PLUS THE BEST MAJOR BRAND NAMES

- Stereo and 4-Channel Music Systems • Tape Recording Equipment • Car Stereo and Accessories • CB and Ham Gear • Police/Public Service Receivers • Car Stereo and Accessories • Antennas • Cameras • TV • PA and Test Equipment • Music Instruments and Amplifiers • Books • Electronic Calculators • Security Systems • PLUS PARTS, TUBES, BATTERIES, HARDWARE — ALL YOU NEED FOR QUALITY LIVING THROUGH ELECTRONICS

IT'S THE ONLY NATIONALLY DISTRIBUTED FULL-LINE CATALOG WITH A MAJOR SHOWING OF THE NEWEST NAME-BRAND ELECTRONICS PRODUCTS FOR 1975!

SEND FOR IT TODAY!

Lafayette
Listen to us, you can't go wrong.

STORES COAST TO COAST Check Your Yellow Pages or Shop by Mail

NEW! Bigger Pages
NEW! More Full Color
NEW! Easier-to-Read Type

free
MAIL TODAY!

Lafayette Radio Electronics
111 Jericho Tpke., Syosset, L.I., N.Y. 11791

25094

☐ Send me your FREE 1975 Catalog.

Name_____ Apt.____
Street_____
City_____
State_____ Zip_____

☐ Send a 1975 Electronics Catalog to my friend.

Name_____ Apt.____
Street_____
City_____
State_____ Zip_____

CIRCLE NO. 25 ON PAGE 17 OR 103

HEY, LOOK ME OVER

Circle No. 1 on Reader Service Page 17 or 103

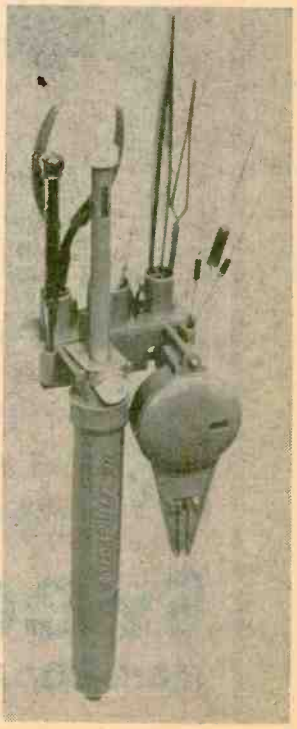
subtraction, multiplication and division, plus constant; a 17-key keyboard; and an easy-to-read 8-digit readout from ⅛-in. high LEDs with no distorting magnifier. An MOS/LSI integrated circuit performs all mathematical operations. The kit is designed for easy assembly, even for beginners, and is priced at $59.95 mail order (less battery). The GRA-43-1 AC converter sells for $3.95 mail order. For more information, write Heath Company, Benton Harbor, MI 49022.

Tool Depot

This unique handy Tool Depot, Part No. TD123, or bracket is now at arms length for repair persons that like their tools nearby. The Tool Depot can be easily mounted in your work area, making a convenient place to store all your soldering tools and supplies. Especially designed to hold Soldapullt III desoldering tool and Twip Supply Holder with lots of storage places for other tools and supplies. Simple, economical, and handy for only $1.00. Within your reach at any Edsyn Distributor. For interesting catalog-write to Edsyn, 15954 Arminta Street, Van Nuys, CA 91406.

(Turn page)

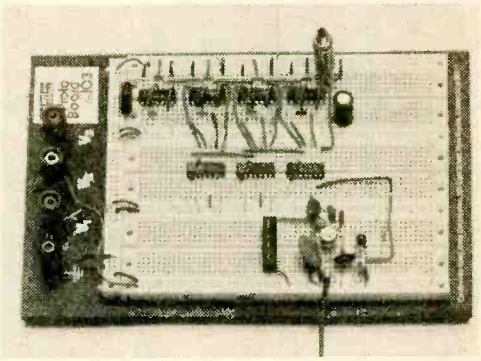
Circle No. 29 on Reader Service Page 17 or 103



HEY, LOOK ME OVER

Breadboarding System

Continental Specialties Corporation has developed and is now marketing the new Proto Board 103, a versatile breadboarding system that allows hobbyists to build, plug-in, modify, wire, test, add, or remove circuits as fast as they can think, using as many as 24-14 pin DIPs, without messy soldering or patch cords. Input/output and processing circuits separate easily by using different power bus-

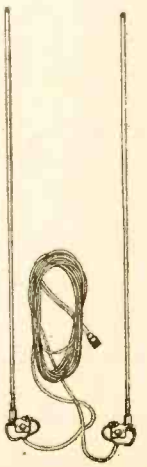


Circle No. 27 on Reader Service Page 17 or 103

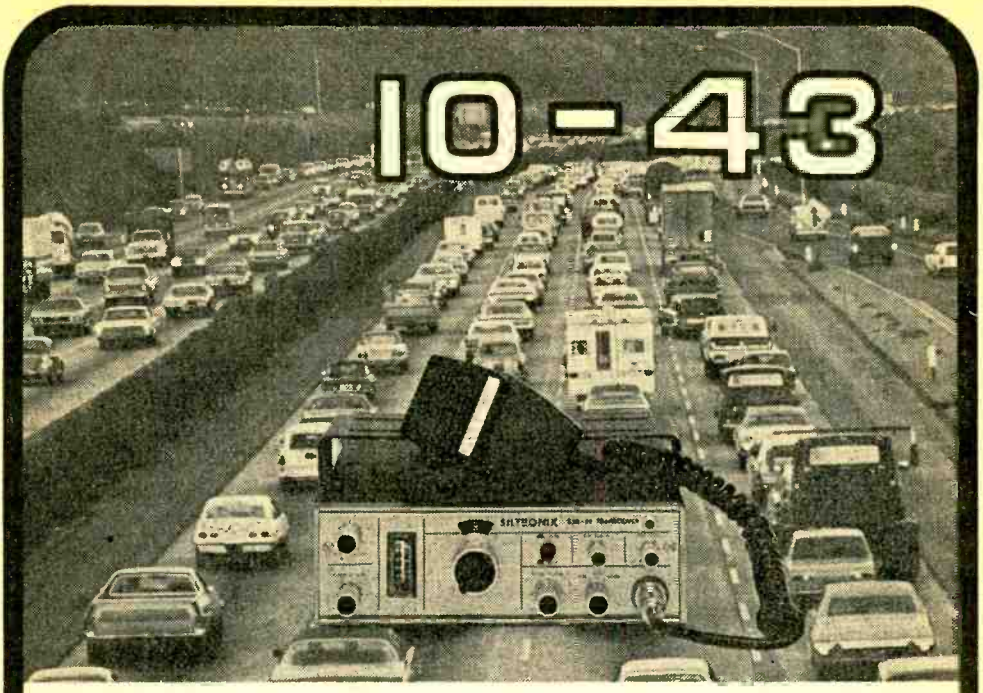
es and separate sockets for every part of the design. Each section of the user's design segment can be tested independently because users can break up power and ground lines. Further, extra ICs or components can be plugged in and interconnected with 22 AWG solid hook-up wire. The entire unit measures 6 x 9 x ⅛-in. high, and sells for $59.95. Complete information is available by writing to Continental Specialties Corp., 325 East Street, Post Office Box 1942, New Haven, CT 06509.

Double Trucker

Shakespeare's Double Trucker (Style 464-1) is a top loaded co-phased CB antenna combo that comes on strong for the long-haul truck drivers of big tractor-trailer rigs. Two four-foot fiberglass antennas are teamed with Shakespeare's Diplexer harness for perfect phasing and matching at 50 ohms mutual impedance. Easy to install with rugged, corrosion-proof single bolt mirror mounts. Also adaptable to station wagon racks or other hor-



Circle No. 30 on Reader Service Page 17 or 103



SILTRONIX BREAKS THROUGH CONGESTED TRAFFIC

Whether you're concerned with heavy communications traffic or you're caught in a freeway jam-up, rely on SILTRONIX to get your message through. When extra "talk-power" is needed, you don't have to waste half of your valuable power in the unused sideband of an AM transmission. SILTRONIX' SSB-23 fully converts your voice to far-reaching RF power in one efficient, suppressed carrier, sideband that out-performs any conventional AM signal in citizen band service.

Snarled traffic situations call for a presence of mind suggesting caution, calm patience and clear thinking. A 10-43 call will advise traffic control authorities of the problem, while a call to your office or home can avoid worry about your delayed arrival.

Presence of mind also suggests a determined search for quality when choosing a CB transceiver. After all, when you do encounter an emergency, it may well be the reliable performance of your equipment that you will depend on for help. Your investment in a SILTRONIX transceiver — now — will insure that you get the performance you expect to receive . . . when you'll need it most.

Look for an SSB-23 in the showroom of your local CB dealer. By insisting on a transceiver that carries a SILTRONIX label, you will be insisting on quality. Visit him this week.

SILTRONIX SSB-23 Transceiver
"The Tiny T-N-T"
Suggested Retail Price.....$329.00

Whatever your CB needs may be, place your confidence in authorized SILTRONIX dealers — they know the meaning of service.

SILTRONIX

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

Dealers interested in adding quality merchandise to their stock are invited to inquire on their letterhead.

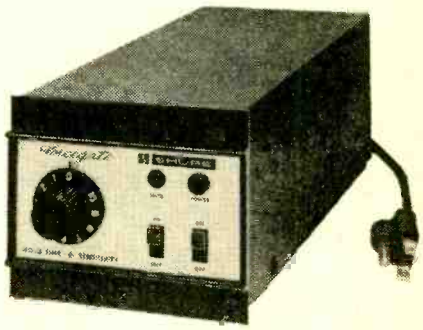
CIRCLE NO. 8 ON PAGE 17 OR 103

HEY, LOOK ME OVER

izontal bars. Complete with 21½-ft. coaxial cable and connector: only $32.95. For more information, write to Shakespeare Company, Dept. RP, P.O. Box 5806, Columbia, SC 29250.

Voice-Activated Gain Controller

Here's a gadget that deals a hands-free "death blow" to most of the background noises that often plague multiple microphone tape recording and public-address installations. It's Shure Brothers' new unit, called the Model M625 Voicegate, a voice-activated microphone gain controller with a response-shaped "voice-frequency" sensor. Functioning between the microphone and the mixer, the Voicegate attenuates the microphone out-



Circle No. 31 on Reader Service Page 17 or 103

put signal by approximately 16 dB—until the microphone is excited by a voice. The Voicegate then removes the attenuation almost instantaneously, allowing the unattenuated microphone signals to enter the mixer. Thus, it allows all microphones in a multi-microphone installation to be "on" when required—without ambient noise pickup, without feedback danger, and without the need for a sound engineer to monitor and control microphone gain. Professional net price of the Shure Model M625 Voicegate is $120.00. For additional information, contact: Shure Brothers Inc., 222 Hartrey Avenue, Evanston, IL 60204.

One For The Road

Okay, truckers, now you can get maximum CB radio coverage from over-the-road tractor-trailer rigs. Thanks to a new antenna system designed by The Antenna Specialists Company. The model MR415, nicknamed "Super Cans," has been engineered to give 360° coverage without the severe directivity that causes "dead spots." To achieve extended all-around coverage, the system uses a pair of antennas mounted on either side of the vehicle's cab. A special phasing harness is used for effective performance from the dual antennas. The antennas are also designed to be less sensitive to ground plane requirements

Another Realistic® First: The low-cost VHF pocket scanner with every big feature

The exciting PRO-4—the palm-size scanner that lets you take the 148-174 MHz "action band" wherever you go. It gets police, fire and marine calls—and continuous weather in many areas—just as good as the big sets. It scans up to 4 crystal-controlled channels in less than a second and locks on each active frequency until the message ends. Scan-delay prevents missed replies. You won't miss a thing—it's like 4 radios in one, each tuned to a different channel. Only 5½ x2-3/4x1½ ". Crystals extra, battery included. #20-168, only **99.95**

FREE New 1975 Radio Shack Catalog

OVER 2000 PRODUCTS
EXCLUSIVES ON EVERY PAGE
BEAUTIFUL FULL COLOR

Stereo • Quadraphonic • Phonos
TV Antennas • Radios
Citizens Band • Recorders • Tape
Auto Tune-Up • Tools • Batteries
Wire • Kits • Testers

164 pages of the finest in home and hobby electronics. Respected names like Realistic, Micronta, Archer, Science Fair—and they're available only at Radio Shack stores and dealers nationwide! See what's really new in electronics.

SEND FOR YOURS TODAY!
FILL OUT COUPON BELOW

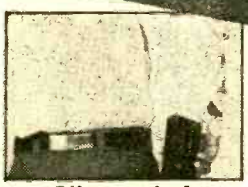
Mail to Radio Shack, P. O. Box 1052, Fort Worth, Texas 76101 (Please print). #423 1975 Catalog

Name_____ Apt. No. ____

Street _____

City _____

State _____ ZIP _____



Clips to belt

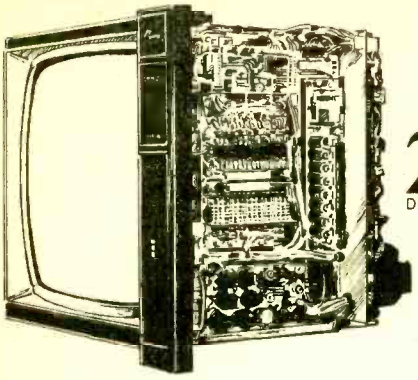
Fits in pocket

Radio Shack®

A TANDY CORPORATION COMPANY

OVER 3000 STORES • 50 STATES • 8 COUNTRIES

Retail price may vary at individual stores. Prices and products may vary in Canada.



You get the same 25" DIAGONAL hobby-kit color TV from three different schools.

You get this designed-for-learning 25" DIAGONAL color TV only with NRI training.

No other home-study school gives you a TV like the one you build with NRI's Master Course in Color TV/Audio servicing. Some schools give you three or four plug-in sub-assemblies off the production line to put together a commercial set. Others give you a hobby-kit bought from outside sources. And because neither type was originally designed to train people for TV servicing, lessons and experiments must be "retro-fitted" to the set as it comes.

That's why we went to the trouble to engineer our own, exclusive solid-state TV. It's the only way a student can (1) get the feel of typical commercial circuitry, (2) learn bench techniques while building a complete set from the "ground" up, (3) perform over 25 "inset" experiments during construction, and (4) end up with a beautiful 25" diagonal solid-state color TV with wood-grain cabinet and all the modern features for top performance. Nobody else can give you this combination of advantages because nobody else invested the time and money to design a set with learning in mind.

More know-how per dollar

That's what it all boils down to, the quality of training you get for the money you spend. In our 60-year history, almost a million students have come to NRI and we're fully approved for the G.I. Bill. We must be teaching something right.

Some of those "right" things are bite-size lessons to ease understanding and speed learning... personal grading of all tests, with comments or explanations where needed... a full-time staff of engineer/instructors to help if you need it... plenty of "real-life" kits and experiments to give you hands-on training... and fully professional programs oriented to full- or part-time career needs.

NRI passes the savings on to you

This unique TV doesn't cost you more... it costs you less, because NRI engineering eliminates the extra cost of buying from an outside source. NRI training also costs less because we sell only by mail. No salesmen. We pass the savings along to you in the form of lower tuition fees, extras like the TV cabinet (another $140 with other courses) and a solid state radio you learn on as you build, plus the actual instruments you'll need to service TVs... triggered sweep oscilloscope, integrated circuit TV pattern generator, and digital multimeter. You can pay as much as $800 more for a similar course and not get a nickel's worth extra in training and equipment.

Widest choice of career opportunities

NRI offers not one, but five excellent TV/Audio servicing courses so you can tailor your training to your budget. Or, you can study other opportunity fields like Computer Electronics, Communications, Aircraft or Marine Electronics, Mobile Radio, and more. Free catalog describes them all, showing lesson plans, equipment and kits, and career opportunities. There's no obligation and no salesman will ever call, so send for your copy today. See for yourself why NRI experience, selection, and exclusives give you something no other school can.

If card is missing, write to:

NRI SCHOOLS
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue.
Washington, D.C. 20016

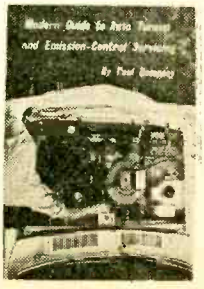
BOOKMARK
BY BOOKWORM

Packed with Circuits. This practical handbook, *Circuit Design Idea Handbook* edited by Bill Furlow, offers electronic designers and technicians design ideas that might fit a problem exactly or that might suggest a hitherto unthought-of design modification. Here, in one handy reference volume, are nearly 300 circuit designs chosen from the award programs of EDN and EEE magazines. In selecting these

Hard Cover
209 pages
$16.95

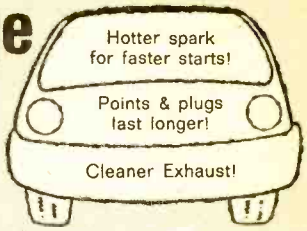
designs, the editors of the two magazines looked for originality and innovativeness as well as practicality and applicability. The authors, all professional design engineers, have breadboarded and verified each circuit. The useful cross-index at the end of the book lets the reader locate a particular design quickly. The book is divided into seven broad classifications: analog, linear, and communications designs; digital and pulse circuits; signal sources; power supply circuits; switching techniques; test circuits; and miscellaneous design ideas. Published by Cahners Books, 89 Franklin Street, Boston, MA 02110.

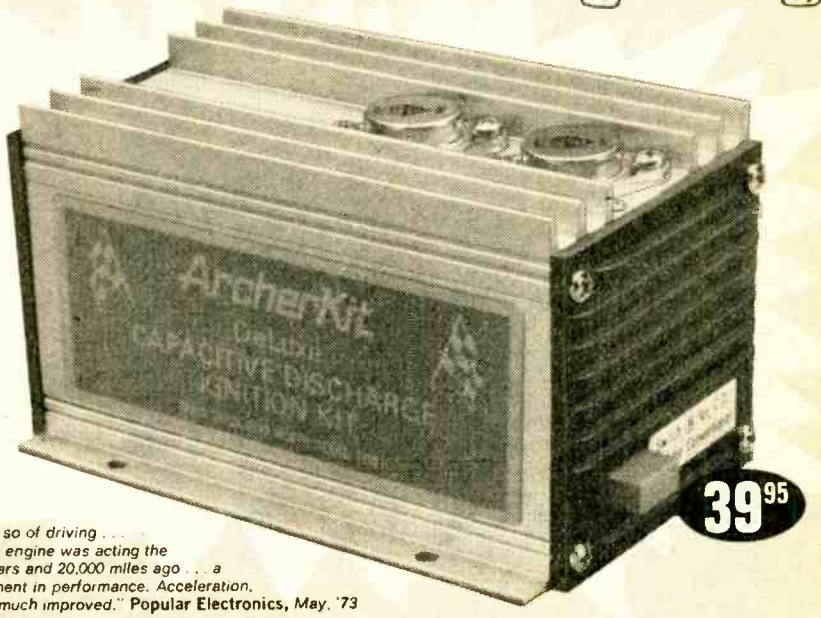
Saving Gas. Here is vital service information for anyone who owns a late-model car and wants to keep it running like new. It's all packed into *Modern Guide to Auto Tuneup & Emission-Control Servicing* by Paul Dempsey. You don't have to be economy-minded to want



Soft cover
240 pages
124 illustrations
$4.95

Improve your gas mileage with this ArcherKit™ from Radio Shack!





"After an hour or so of driving . . . we noted that the engine was acting the way it did two years and 20,000 miles ago . . . a definite improvement in performance. Acceleration, specifically, was much improved." **Popular Electronics,** *May, '73*

FREE New 1975 Radio Shack Catalog

OVER 2000 PRODUCTS
EXCLUSIVES ON EVERY PAGE
BEAUTIFUL FULL COLOR

Stereo • Quadraphonic • Phonographs
TV Antennas • Radios • Citizens Band
Kits • Recorders • Tape • Tools
Auto Tune-Up • Electronic Parts
Test Instruments • More!

SEND FOR YOURS TODAY #424

Mail Coupon Below to Radio Shack, P. O. Box 1052, Ft. Worth, TX 76101
RUSH YOUR 1975 CATALOG TO:
(Please print)

Name _____ Apt. No. ____

Street _____

City _____

State _____ ZIP [ ][ ][ ][ ][ ]

Radio Shack's capacitive discharge ignition system puts more "go" in every gallon! It delivers 50% extra spark power for more complete combustion. That means you get easier starting, better mileage and your points and plugs will last 3 to 10 times longer. An in/out button lets you make performance comparisons with your standard ignition. And it makes tuneups easier. The thorough step-by-step manual makes it easy for even a first-time kit builder to assemble. Easy installation, too—no rewiring. Improves any 12-volt negative ground vehicle. #28-3203.

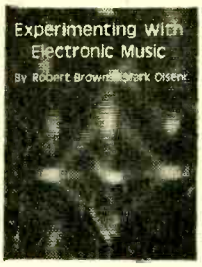
ArcherKit at Radio Shack®

A TANDY CORPORATION COMPANY
OVER 3000 STORES • 50 STATES • 8 COUNTRIES
Prices and products may vary in Canada.
Retail price may vary at individual stores.

BOOKMARK

to save gasoline these days. The demands of our environment for cleaner air tend to work against the demands of our economy for better gas mileage. There is an "optimum," though, in which a delicate balance between the conflicting extremes of these two requirements can be maintained. This book tells how to achieve this balance in every modern car—by proper maintenance of the engine and its vital fuel and distribution systems, and by careful adjustment of the critical emission-control equipment. Starting with engine and ignition basics, the text also covers auto electrical fundamentals before digging into actual tuneup and servicing. Complete descriptions are included of every major automotive system, along with all the important "how to's" of servicing. Also included are practical tips to save you time and money in troubleshooting and repair. This book should pay for itself with a single tuneup! Published by Tab Books, Blue Ridge Summit, PA 17214.

Do's and Diodes. By duplication of audio waveforms, the sounds of virtually any musical instrument can be simulated—and *Experimenting With Electronic Music* by Bob Brown & Mark Olsen shows how to do it! From the simplest sine-wave tone generator to the complex "synthesis" sound source, from the simple "reverb" to the sophisticated waveform-shaping "enhancers," they're all together in this single volume written especially for today's generation of music/electronic buffs. Despite the complex appearance of many audio waveforms, they can



Soft cover
180 pages
103 illustrations
$4.95

generally be closely duplicated with deceptively simple circuitry. But synthesis and tone generation make up only a part of the overall electronic-music picture. By incorporating such techniques as variable attack and decay, selective reverberation and echo, and other tone-sustaining and amplification measures, a seemingly endless array of special effects can be created, from futuristic spacelike pulsations to the wah-wah of a modern guitar. It's all done with simple electronic stages that can be used alone or with existing instruments to tailor any sound to any preference. Published by Tab Books, Blue Ridge Summit, PA 17214.

GIANT NIXIE CLOCK KIT

For factories, offices, and commercial establishments, and those people who like large displays, characters appear as a bright continuous line which can be read from distances as great as 150 feet. All drive circuits are solid state, and unit employs new custom LSI clock chip. Indicates hour, minutes, and seconds. May be wired for 24 hour or 12 hour operation with a simple jumper change. Kit offered complete with or without case for custom installations. Parts include P.C. board, sockets, solid state components, hardware, resistors, caps, viewing filter, etc.

☐ Giant Nixie Clock Kit $99.50

TELSA COIL KIT

Here's a truly basic kit for those who like to "roll their own." All the parts for an exciting adventure into high-frequency, high voltage. Add your own metal housing — a small chassis or universal box is ideal.

Tesla coils are patterned after the design of Nikola Tesla (1857-1943) an American electrical genius who built versions many feet tall. His dream was to light and power entire cities with energy radiated from such coils — but no luck!

Today's Tesla coils are popular with experimenters and students, and especially for science fair and educational demonstrations. Ours is a high-frequency push-pull oscillator coupled to a television flyback transformer, which steps up an external 12 VDC power supply to many thousand volts.

SPECIAL NOTE: Although current output is relatively low, some hazard is inherent in all high voltage devices. This kit is intended for the experimenter who is mature enough to observe reasonable precaution in its use.

TESLA COIL KIT $7.50

COMPUTER GRADE CAPACITORS

We have a large inventory of computer grade caps, difficult to get now because of an aluminum shortage. Priced at a fraction of O.E.M. cost. Here are a few of the most popular types, our catalog contains complete listing, excellent for Hi-Power audio amp supplies.

☐ 15,000 MFD @ 10V ..... $ .60
☐ 66,000 MFD @ 6V. $1.00
☐ 3,100 MFD @ 75V $1.00
☐ 3,750 MFD @ 75V $1.50
☐ 74,000 MFD @ 10V $1.50
☐ 140,000 MFD @ 6V $2.00

CLOCK/CALENDAR ALARM CHIP

These large scale integrated (LSI) chips eliminate literally thousands of components or hundreds of chips in the construction of a clock. For most applications only a single supply and a minimum of components are required.

☐ 7001 Chip — Features 28/30/31 day calendar, 12/24 hour clock, 24 hour clock, 24 hour alarm, snooze alarm, 6 digit display, direct drive to luminescent anode tubes or LED segments, single transistor interface with Sperry displays. Segment and digital outputs can be "wire or 'D'" to share calculator displays. $14.75

☐ MM5314 Chip — Features 6 digit seven segment output, operates from 50 or 60 Hz input, use for Minitrons LED's, Luminescent or Sperry displays. $9.75

☐ MM5311 Chip — Same as 5314 but with additional BCD outputs, ceramic pkg. $12.50

FUNCTION GENERATOR CHIP, TYPE 4038

This chip gives simultaneous sine, square, sawtooth, and triangular outputs. Great for music synthesizers, or voltage controlled function generators and oscillators.

☐ Function Generator Chip $7.75

LUMINESCENT 7 SEGMENT NUMERIC READOUTS

Bright Blue-Green display Tube. Very pleasing to the eye. Tube exhibits fast display speed and easy to read characters of 0.57"H x 0.36"W, with decimal point. Complete with instructions to make a decade counting unit or a 6 Digit Clock. Tubes are manufactured by Tung-Sol, part number 1705.

☐ 7SDD-1705 READOUT $1.70
6 for $8.50
10 for $14.00

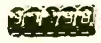
one of the world's largest manufacturers, has sold us his surplus of multiple digit clusters with one bad digit per cluster. They were for use in the calculator, DVM, and other products. The remaining digits are guaranteed perfect in all respects and are intensity graded (marked on the back with letters A thru F) and matched, so that several strips can be combined and still result in a perfect match. These monolythic GaAsP displays require as little as 7 mW per digit, are highly readable at arm's length, and lend themselves well to hand-held portable applications.

Applications include hand-held calculators, digital thermometers, stopwatches, darkroom timers, DVM's, clocks and watches, or any other product requiring low cost, low power, long lifetime indicators.

The unit is common cathode, set up for multiplexed operation. Two decimal point styles are available; center decimal for PN 7804/05, and right decimal for PN 7814/15, as illustrated. The following configurations are available, where "8" represents a perfect digit, "X" a non-functioning digit:

X8888	7405-1 or 7415-1,	X888	7414-1
8X888	7405-2 or 7415-2,	8X88	7414-2
88X88	7405-3 or 7415-3,	88X8	7414-3
888X8	7405-4 or 7415-4,	888X	7414-4
8888X	7405-5 or 7415-5,	X88X	7556-1

All products are available at the following price rate:



1 — 24 digits . . . $1.875/digit
25 — 99 digits . . . $1.50/digit
100 — 499 digits . . . $1.25/digit
Higher quantity price on request.

For the following applications we recommend the following configurations:

Pocket calculators: 7405-1 & 7405-5, which results in X88888888X, eight consecutive perfect digits @ $1.875 = $15.00.

Recommended Calculator chips:

Nortec 4204 @ $19.75 ($15.00 when ordered with displays).
Caltex 5005 @ $9.75 ($7.50 when ordered with displays).

Clocks: 7405-3 & 7556-1, which results in 88X88X88X, six perfect digits at $1.875 = $11.25.

Recommended clock chips:

National MM5314 @ $9.75 ($7.50 ordered with displays).
National MM5316 @ $19.75, includes alarm. ($15.00 ordered with displays).

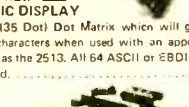
For only hours and minutes, order 7405-3 only.

Digital thermometers, DVM's, stopwatches, darkroom timers, frequency counters, etc., order 7415-1 or 7415-5 for four digits ($7.50) or 7414-1 or 7414-4 for three digits ($5.60). Use Solitron CM 4102AE 3½ digit counter decoder @ $19.00, ($15.00 ordered with displays).

Schematics for calculators, clocks and counters using these components free with order.

ALPHANUMERIC DISPLAY

☐ This is a 5x7 (35 Dot) Dot Matrix which will generate alphanumeric characters when used with an appropriate generator such as the 2513. All 64 ASCII or EBDIC codes can be generated. $9.75



I.C. SOCKETS

Mfg. by T.I., Cinch, high quality, most gold plated. Use for SSI, MSI, and LSI chips.

☐ 14 Pin Solder Tail ..... 3 for $1.00
☐ 14 Pin Wire Wrap ..... 2 for $1.00
☐ 16 Pin Solder Tail ..... 3 for $1.25
☐ 16 Pin Wire Wrap ..... 2 for $1.25
☐ 24 Pin Solder Tail ..... 2 for $1.25
☐ 28 Pin Solder Tail ..... 2 for $1.50
☐ 40 Pin Solder Tail ..... $1.00 each
☐ 10 Pin Round for to-5 style ..... 3 for $1.00
☐ 3 Pin Transistor Sockets ..... 10 for $1.00

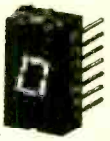
COSMOS & MISC. CHIPS

☐ Harris 256 Bit Programable Read only memory $2.50
☐ 2501 256 Bit RAM $2.50
4000AE Dual 3 Input NOR & INV ..... $ .99
4001AE Quad 2 Input NOR ..... $ .99
4002AE Dual 4 Input NOR ..... $ .99
4006AE 18 Stage Shift REG $4.99
4007AE Dual Comp Pair ..... $ .99
4009AE Hex Buffer, Inv. $2.19
4010AE Hex Buffer, NON-Inv. $2.19
4011AE Quad 2 Input NAND ..... $ .99

0.3 HEIGHT L.E.D. NUMERIC DISPLAYS

Always a good seller, we are now offering these displays at the lowest price ever. Use for clocks, counters, and other applications. We have previously sold these for as much as $6.75 per digit.

☐ 0.3 inch height red LED $2.25
6 for $12.00



0.3 HEIGHT GREEN L.E.D. NUMERIC DISPLAY

This is the first time we have had green LED's at an economical price.

☐ 0.3 inch height green LED *$3.95*
6 for $21.00

0.3 HEIGHT YELLOW L.E.D. NUMERIC DISPLAY

Vary your display colors for coding or Variety.

☐ 0.3 inch height yellow LED. . . *$3.95*
6 for $21.00

GIANT 0.750 INCH HEIGHT RED L.E.D. NUMERIC DISPLAY

This is one of the largest LED Displays made. Used in applications where the displays must be read at greater than average distances, or for commercial and advertising purposes.

☐ 0.750 inch LED
Numeric Readout $5.75
6 for $30.00

LOWEST PRICE EVER ON DISCRETE L.E.D. LAMPS

These high quality red LED's are useful for Logic and Computor readouts, as Pilot Lights, or at this low price, they can be grouped together to build your own Giant size Alphanumeric Readouts.

☐ Discrete LED's ..... 10 pcs. $1.75
100 pcs. $15.00
1000 pcs. $125.00
5000 and up $ .10 each

GREEN L.E.D. LAMPS

☐ Same as above, but Green.
..... 3 for $1.00
100 for $30.00 10 for $4.00
1000 for $250.00

YELLOW L.E.D. LAMPS

☐ Same as above, but Yellow.
..... 2 for $1.25
10 for $5.00

RED WITH BUILT-IN RESISTOR

☐ Same, but no resistor required for 5 Volt operation ..... 2 for $1.00
10 for $4.00

CALCULATOR CHIPS

☐ Nortec 4204 — Eight Digit, floating point, constant operation single supply operation, very low power consumption. $19.75
($15.00 with purchase of 7400 series LED's.)

☐ 5001 — Twelve Digit, fixed decimal point, no constant, may be used for six digit display. $9.75
($7.50 with purchase of 7400 series LED's.)

3½ DIGIT COUNTER CHIP

This chip is useful in building dim's DPM's and small counters, provides multiplexed seven segment output for LED displays, Solitron 4012 or Equivalent. $19.00
($15.00 with purchase of 7400 series LED's.)

LAST MINUTE SPECIAL! 1/16 inch copper clad board, single side phenolic-brand new individual tissue wrap, 8X10 inches ..... 2 for $1.00 16X20 inches ..... 2 for $2.00

Send in an order and get on our special customer Mailing List.

CATALOG: Check reader's card or write.

POSTAGE EXTRA ON ALL ABOVE ITEMS

CHARGES WELCOME!

Phone in charges to 617 531-5774 or 617 532-2323. Bank Americard — Mastercharge. $10.00 minimum. No C.O.D.'s please.

B.&F. ENTERPRISES Mass. 01960
Phone (617) 531-5774
119 Foster Street
Peabody, Mass. 01960

CIRCLE NO. 21 ON PAGE 17 OR 103

newscan

Electronics in the News!

The Dummy Ate a Good Meal

Would you believe a real live dummy? In a simulated car crash, a human volunteer (the dummy) has successfully reached a test speed of more than 30 miles per hour with no injury, pain, or negative after-effects. The force of the crash impact was totally absorbed by a new, energy-absorbing automotive seat belt webbing developed by Takata Kojyo Co., Ltd., of Tokyo, Japan. According to the National Highway Traffic Safety Administration, the tests "are the highest injury-free tests ever attained by human volunteers restrained by automotive type lap and shoulder belts" in a simulated crash condition.

The Takata webbing consists of parallel bundles of man-made fibers. The webbing is engineered to cushion the forward motion of the occupants in car crashes at various speeds.

U.S. Navy volunteer in horizontal accelerator just before a simulated 30 miles per hour car crash in which the volunteer experienced no injury, pain or negative after-effects.

The energy-absorbing Takata webbing was tested with United States Navy volunteers in a series of tests at the U.S. Naval Air Development Center in Philadelphia. During the test program, which spanned several months, volunteers were accelerated in a series of dynamic sled tests in increments of 2.5 miles per hour. The ultimate crash velocity reached on the test equipment totalled 30.4 miles per hour. At

(*Continued on page 95*)

Be amazed!

Add Realistic® 4-channel sound to any stereo system this low-cost, easy Radio Shack way

FREE New 1975 Radio Shack Catalog

• OVER 2000 PRODUCTS • FULL COLOR

Stereo • Quadraphonic • Phonographs
TV Antennas • Radios • Citizens Band
Amateur Radio • Auto Tune-Up • Wire
Tools • Kits • Test Instruments • More!

SEND FOR YOURS TODAY!

MAIL COUPON TO:
Radio Shack, P.O. Box 1052
Fort Worth, Texas 76101

RUSH YOUR 1975 CATALOG TO:
(Please Print) 425

Name _____ Apt. No. ____
Street _____
City _____
State _____ ZIP [ ][ ][ ][ ][ ]

Quatravox® uncovers a new world of hidden sound . . .

The magic of reflected sound: It's responsible for the spaciousness and magnificence of a live performance. But it lies buried in your stereo—until you add Quatravox QV-3. It uncovers that hidden, reflected sound to recreate the feeling of a live show. It's amazing—for the first time you'll experience *all the music* on records, tapes and FM. The QV-3 beats the competition with *two* synthesizer circuits, blend and rear-level controls, plus all hookup cables. Just add two speakers. Our price is pretty amazing, too. #40-2011, only. **21.95**

Radio Shack®
A Tandy Corporation Company
OVER 2500 STORES • 2000 CITIES • 50 STATES

Retail prices may vary at individual stores.
Prices and products may vary in Canada

DX central reporting

A world of SWL info!

By Don Jensen

☐ For shortwave "country hunters" there is a double-barreled bit of good news to report. First, a new station will be operating shortly—in fact it may be testing by the time you read this—from the tiny African country of Swaziland. It won't be the first SWer in the country. There has been another shortwave outlet, *Swazi Commercial Radio*, broadcasting for several years. But it has been very hard to hear in North America. The new station, with high powered transmitters and, hopefully, favorable frequencies, promises to open up a new DX target to many more SWLs.

And, secondly, another shortwave operation has been announced for the Pacific island of Guam, a spot heretofore unrepresented by a shortwave broadcasting station. Its on-the-air date is uncertain so far, but apparently is somewhat further down the pike.

The link between these two DX "goodies" is that both will be operated by the same broadcasting organization, *Trans World Radio*. TWR, as most SWLs know, is the religious organization that presently broadcasts from missionary stations on Bonaire in the Netherlands Antilles, and at Monte Carlo, Monaco.

Why did TWR choose Swaziland? Some 20 years ago, the groundwork was laid for a religious station designed to reach listeners in the more than 3 million square miles of Africa south of the equator. It was said that southern Africa presented the biggest blank spot on the world missionary broadcast map.

The last word from TWR was that on-air tests were expected sometime during the summer months, with regular programing slated to begin later in the year. And thus the long dream will be a reality and TWR Swaziland will fill missionary broadcasting's biggest blank spot. And half a world away, another long range project of Trans World Radio is moving toward reality.

Ten years ago, TWR first attempted to establish an international shortwave station on U.S. soil. But there was a "freeze" imposed on shortwave transmitting stations. In 1971, TWR unsuccessfully sought to have the FCC accept

(Continued on page 95)

CB Rules and Regs

How do I get a copy of the CB regulations?

—N.M., Salt Lake City, Utah

A complete copy of Part 95 of the FCC Rules and Regs is printed in the 1974 CB YEARBOOK. Get your copy by sending $1.25 to this magazine with your order.

Underground Request

What kind of cable should I use to travel underground from my house to an outdoor post for illumination purposes?

—L.E., Latrobe, PA.

Dual-purpose plastic cable (so named because it can be used indoors or out) may be buried in the ground subject to local codes. Check with your local electrician before you proceed.

Cheapie Kit

I want to put together an inexpensive treasure finder kit. Can you supply me with a diagram and parts list? What will it cost?

—S.G., Waterford, CN

No and yes. It is not our policy to supply what you asked for in your letter. However, you can get everything for only $9.95 when you buy an Eicocraft Treasure Finding Kit (No.EC-1900) at your local dealer.

No Playing Allowed

I am very interested in CB transceivers, but there are a number of different types of mobile transceivers on the market. Which one would be the best type for a beginner?

—M.P., Chicago, IL

None! You pick a CB rig to do a job, not cater to your hobbyist needs. If you are serious about using CB, pick up a copy of the 1974 CB YEARBOOK or write to this magazine for it and enclose $1.25.

Play A Tune

What is the frequency of the piano keys around middle C? I want to align my piano with an audio generator.

—D.J., Pennsville, NJ

A-220, A#-233, B-247, C-262, C#277, D-294, D#-311, E-330, F-349, F#370, G-392, G#415, A'-440. Lots of luck! ■

NOT JUST ANOTHER PRETTY FACE.

At 6 lbs., 12 oz., there isn't an ounce of fat on the Cobra 132. It's one of the smallest SSB units ever made.

But with 15-watt P.E.P. input, 100% modulation and Dynaboost voice compression, this AM/SSB two-way radio has what it takes to send a booming signal over land or sea.

You have 23 AM and 46 SSB sending/receiving modes. Two separate transmitters give you the best of each, with overload protection.

As for reception, this Cobra has the crispest, cleanest sound ever. Over 60 dB cross modulation interference rejection completely eliminates bleedover.

Cobra's drift-free Voice Lock lets you locate and lock-in sideband signals over a wide range. Three filters—one crystal, two ceramic—keep adjacent channels under wraps.

And when you kick on Cobra's AM/SSB noise blanker, noise levels drop unbelievably.

In addition, the Cobra 132 has an adjustable AM/SSB RF gain control. Backlit RF output/S meter. And full-function controls.

Ask your CB dealer for the solid-state Cobra 132. Its beauty is more than skin-deep.

COBRA 132
AM/SSB
$340.00
microphone included

Product of Dynascan Corporation, 1801 West Belle Plaine Avenue, Chicago, Illinois 60613

CIRCLE NO. 11 ON PAGE 17 OR 103

elementary SEPT-OCT 1974 Electronics

NOW—
keen color quality at home with...

A Darkroom Color Analyzer

Today it's easy to make bright color prints at home with modern color chemistry and an electronic color analyzer!

One of the shutterbug's most satisfying accomplishments is producing his own color prints. For years the time spent on and the cost of making color prints were discouraging, but with modern color chemistry, such as the Beseler system, you can turn out quality color prints *in less time than for black and white* (about 3 minutes), and the prints will be far superior to anything you're likely to get from a color lab.

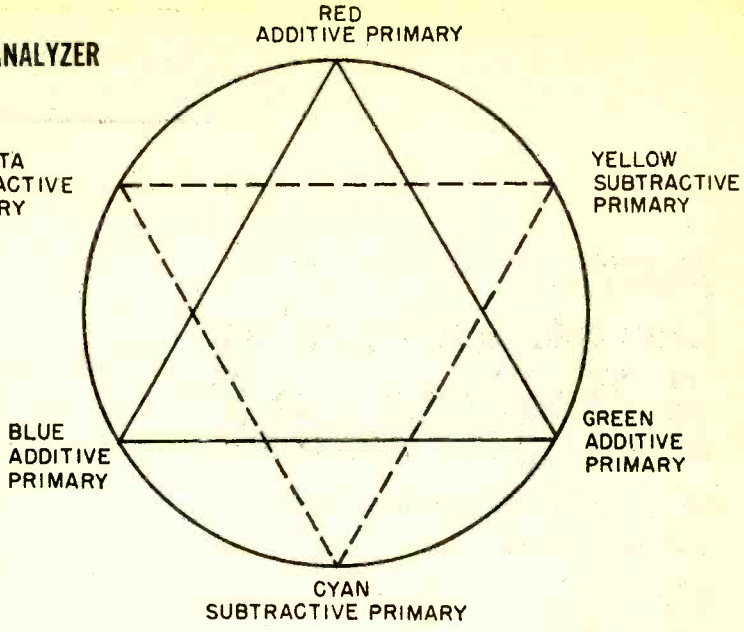
One thing that takes the drudgery out of color work—besides the chemistry—is a color analyzer, a device that gives you the correct filter pack and exposure time at the very first crack. Most often, the very first print made with the analyzer will be good. At most, it will take perhaps 0.10 or 0.20 change of filtration for a *superb* print. This is a lot less expensive and time-consuming than making test print after test print. In fact, it's really the color analyzer that puts the fun into making your own color prints!

COLOR ANALYZERS ARE NOT CHEAP. A decent one

(Turn Page)

by Herb Friedman

e/e COLOR ANALYZER



Any one of the primary colors on this circle is composed of its immediately adjacent colors in equal amounts. It is the balancing of additive primary colors of photographic light sources and subtractive-type color filters that provides control in color print photography.

costs well over $100, and a good one runs well over $200. But if you've got even a half-filled junk box you can make your own color analyzer for just the junk parts and perhaps $10 to $15 worth of new components.

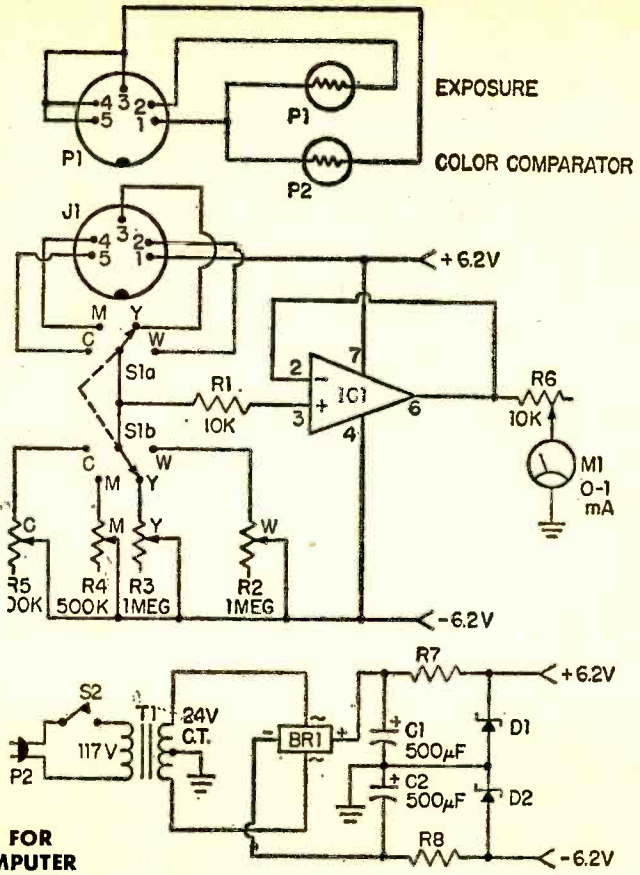
A color analyzer is basically a miniature computer. You make a "perfect" print the hard way—by trial and error—and then calibrate the analyzer to your filter pack and exposure time. As long as you use the same box of paper and similar negatives, all you need to do to make a good color print is focus the negative, adjust the filter pack and exposure so the analyzer reads "zero," and hit the enlarger's timer switch. Even if you switch to a completely different type of negative, the analyzer will put you well inside the ballpark, so your second print is a winner. (And even if the filtration is off, the exposure will probably be right on the nose.)

Construction. The color analyzer shown was specifically designed for the readers of this magazine—essentially an electronic hobbyist with an interest in photography. All components are readily available in local parts stores or as junk-box parts. Several protection devices have been designed into the circuit so accidental shorts won't produce a catastrophe. The printed circuit board template has foils for both incandescent and neon meter lamps, as well as extra terminals so you can use either a socket and plug or hard wiring for the color comparator and exposure sensor. In short, you can make a lot of changes to suit your individual needs.

The template for IC1 uses a half-minidip, Signetics V type package lead arrangement. However, you can also use an IC with a round (TO-5) configuration. If anything is wrong with the IC you can get the TO-5 out easily. The half-minidip removal might result in destruction of the PC board. We'll explain how to install the TO-5 IC on the PC board later.

You can either buy or make the printed circuit board (see parts list). Either way, the first step is to prepare the printed circuit board. If you do it yourself, make it any way you like, using free-hand or template resist. Nothing is critical, but be certain there are no copper shorts between the terminals for IC1. Use a number 56 bit for all holes. Then use a larger bit for transformer T1's mounting screws (#4 or #6 screws), a ¼-in. bit for resistor R6, and a number 30 to 40 bit for the line cord connections (any bit that will allow the linecord wires to pass through the board).

Assemble the power supply and check it out before any other components are installed. Install transformer T1 first. Any 24 volt or 25.2 volt center-tapped transformer that will fit on the board will be fine. Get



PARTS LIST FOR COLOR COMPUTER

BR1—Bridge rectifier, silicon, 50 PIV, 0.5 amp or higher (Radio Shack 276-1151 or equiv.)

C1, C2—500 μF capacitor, 10 VDC or better (Radio Shack 272-957 or equiv.)

D1, D2—Zener diode, 6.2 volts, 1 watt (Radio Shack 276-561 or equiv.)

IC1—Type 741C operational amplifier, see text (Radio Shack 276-010 or equiv.)

J1—DIN type 5-pin socket (optional, see text) (Radio Shack 274-005 or equiv.)

M1—0 to 1 mA DC meter, see text (Radio Shack 22-052 or equiv.)

P1—DIN type 5-pin plug (optional, see text) (Radio Shack 274-003 or equiv.)

P1, P2—Photocell, Clairex CL5M5L, do not substitute

R1—10,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R2, R3—1-megohm potentiometer, see text (Radio Shack 271-211 or equiv.)

R4—500,000-ohm potentiometer, see text (Radio Shack 271-210 or equiv.)

R5—100,000-ohm potentiometer, see text (Radio Shack 271-092 or equiv.)

R6—10,000-ohm trimmer patentiometer (Mallory MTC-14L4 for exact fit on PC board; Radio Shack 271-218 or equiv. for point to point wiring)

R7, R8—820-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

R9—100,000-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)

S1—Rotory switch, 2-pole, 4-position (Allied Electronics 747-2003; adjust stops for 4 positions)

S2—Switch, SPST (Radio Shack 275-1551 or equiv.)

T1—Transformer, 117 volt primary to 24 or 26.6 volt secondary, see text (for point-to-point wiring, Radio Shack 273-1512 or equiv.) Note—you can also use two less expensive 12 volt transformers with secondary windings connected in series-aiding, if you have the space.

The printed circuit board for the Color Computer is available direct from Electronics Hobby Shop, Box 192, Brooklyn NY 11235 for only $4.85 (includes postage and handling). Canadian shipments add $2 extra. NY state residents must add sales tax. No foreign orders, please. Postal money orders will speed delivery. Otherwise allow 6-8 weeks for delivery.

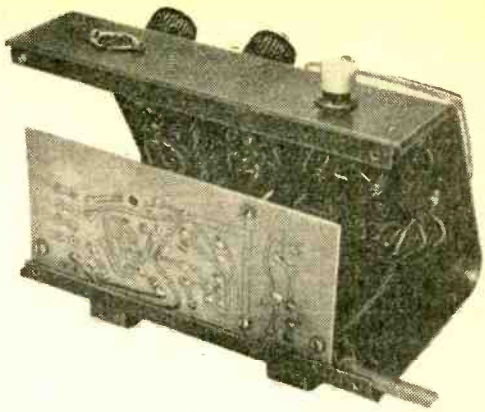
Misc.—Cabinet, pilot lamp for meter, 2-in. or 3-in. size Kodak Wratten filters #70, #98, and #99 (available from photo supply dealers), calibrated knobs, wire, solder, hardware, etc.

something small, like 100 milliamperes. A Wescom 81PK-100 is a perfect fit.

Bridge rectifier BR1 is the low cost "surplus" found in many distributors. This type has the positive and negative outputs at opposite ends of a diamond. The AC connections are the remaining opposite ends. Note that BR1 is installed in such a manner that its negative output is farthest from transformer T1 while the positive output is nearest to T1. Make certain your bridge rectifier has the same lead configuration; if it is different, modify the printed circuit template to conform to the rectifier you're using. Get it right the first time.

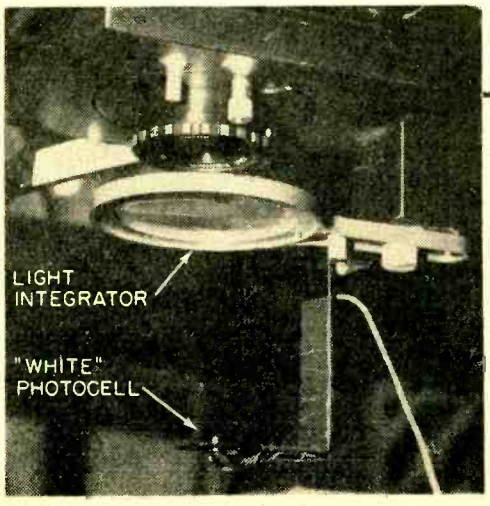
Finally, install C1 and C2, R7 and R8, and zener diodes D1 and D2. Take care so the capacitors and zener diodes are installed with the polarity correct. If the capacitors have their negative leads marked with an arrow or line, these markings face the *opposite edges* of the PC board (negative to the outside). The zener diodes are installed so that their cathodes (the banded ends) face each other towards the center of the board.

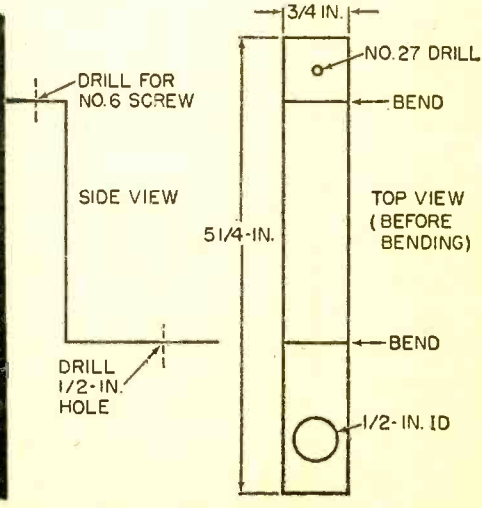
Initial PC Checkout. When the power supply is completed, temporarily connect a linecord. Connect the negative lead of a meter rated 10 volts DC or higher to the foil between T1's mounting screws (that's ground). Connect the meter's positive lead to the junction of R7 and D1, which is in the center of the board; the meter should indicate approximately+6.2 volts DC. Then connect the positive meter lead to the R8 and D2 junction, which is near the edge of the board. You should get approximately –6.2 volts DC. If the voltages are far apart in value, or if the polarity is wrong, make certain you find the mistake *before* installing IC1.



Rear view of author's color analyzer shows vertical mounting of electronic ckt board.

Disconnect the linecord and complete the PC assembly. If you use a 24 or 28 volt pilot lamp to illuminate the meter you connect to the holes adjacent to T1's secondary (24 V) leads. If you plan to use a neon illuminator, install a 100,000-ohm resistor





The color comparator photocell Z-bracket is installed under a light integrator. If your enlarger has a filter holder under the lens, attach the Z-bracket to the holder.

(R9) on the PC board and connect the lamp to the holes marked "neon." The lamp must have as little illumination as possible. Incandescent 24 or 28-volt lamps must be the miniature or "grain of wheat" type rated approximately 30 to 60 mA; the lamps come with attached leads. Do not use pilot lamps of the 100 to 500 mA variety. The excessive light will confuse the analyzer.

To install IC1 when it is the metal can TO5 type, fan out the number 1 to 4 leads and number 5 to 8 leads so they form two straight lines. Note that the lead opposite the tab on a TO5 package is #8. Insert the leads into the board leaving about ¼ inch between the IC and the board. The IC is correctly installed if the tab faces *away* from the transformer towards the nearest edge of the PC board. Solder IC1 and cut off the excess lead length.

The edge of the PC board nearest IC1 has four sets of paired foil terminals. These are provided as mounting terminals if you connect the photocell comparator and sensor without the use of a plug and jack. However, we strongly suggest the use of the specified DIN type connectors as they allow for easy repairs if the connecting wires break. (The connectors aren't *that* costly.

Potentiometers R2 through R5 can be linear or audio taper, though audio taper gives a slightly smoother adjustment—use whatever you have in stock.

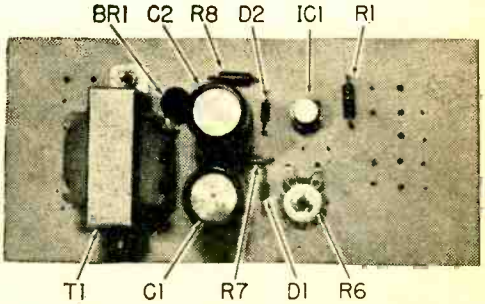
The analyzer shown is built in a Bud 7-inch AC-1613 Universal Sloping Cabinet. This is the least critical item and you can substitute whatever cabinet you prefer. Just be certain the cabinet will accommodate the type of meter you use.

Meter M1 should be O-1 mA with a zero-center scale. But these are expensive, so you can substitute any standard 1 mA meter you want. You will simply calibrate the instrument for zero-center.

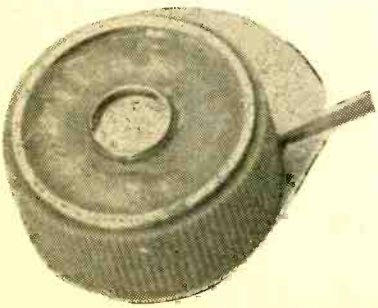
If you use a neon pilot lamp mount it directly above the meter and shield the forward brilliance with a piece of black tape; the lamp should radiate straight down onto the meter scale. If you use the meter in the parts list, remove the front cover by pulling it forward. Then remove the meter scale. As shown in the photographs, place a black dot approximately 3/16-inch wide at the center of the scale. If you want, you can also modify the meter for the incandescent lamp. Drill a ¼-inch hole in the lower right of the meter *from the rear.* Position the meter in the cabinet and mark the location of the meter hole on the panel. Remove the meter and drill a ⅜-inch hole in the panel. When the meter is installed you can pass a "grain of wheat" lamp through the panel into the meter. Reassemble the meter and complete assembly.

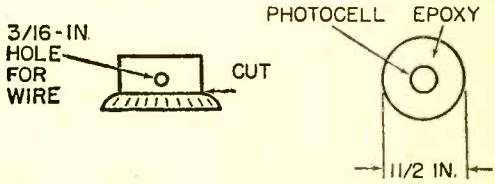
The Comparator. The photocells used for the comparator and exposure sensor, P1 and P2, must be Clairex type CL5M5L. Make no substitutions. From a piece of

(Continued on page 40)



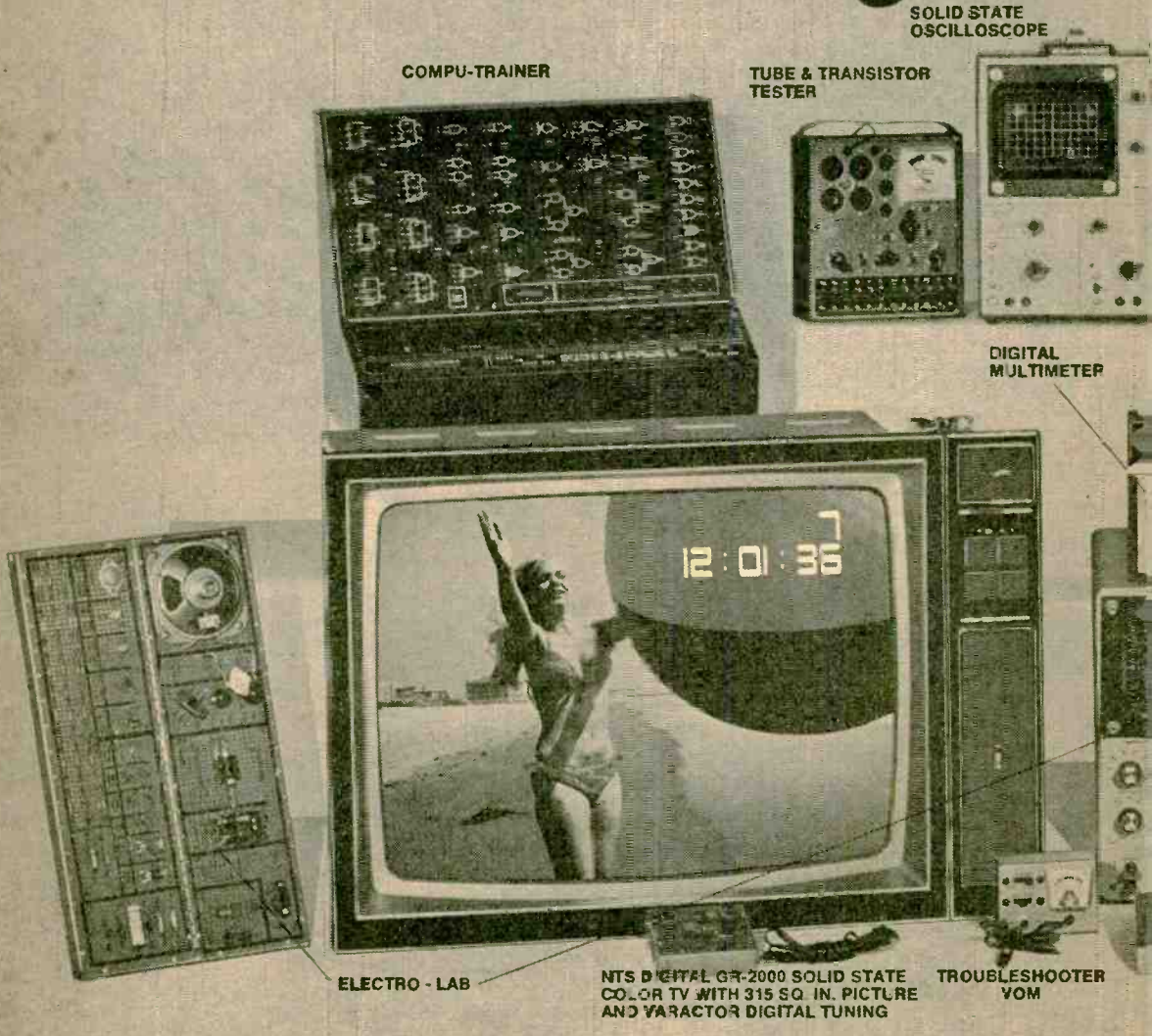
This is the parts location when our PC board is used. To get a free template of the PC board, send a Self Addressed Stamped Envelope to: Davis Publications, Dept. T, 229 Park Ave. S., New York NY 10003





The exposure sensor photocell is mounted in anything that will keep it in place on the easel. This example was epoxy cemented into a large control knob after the outside dial section was ground off. In typical operation, the sensor is placed under the lens with the light integrator or filters.

The better the the better you

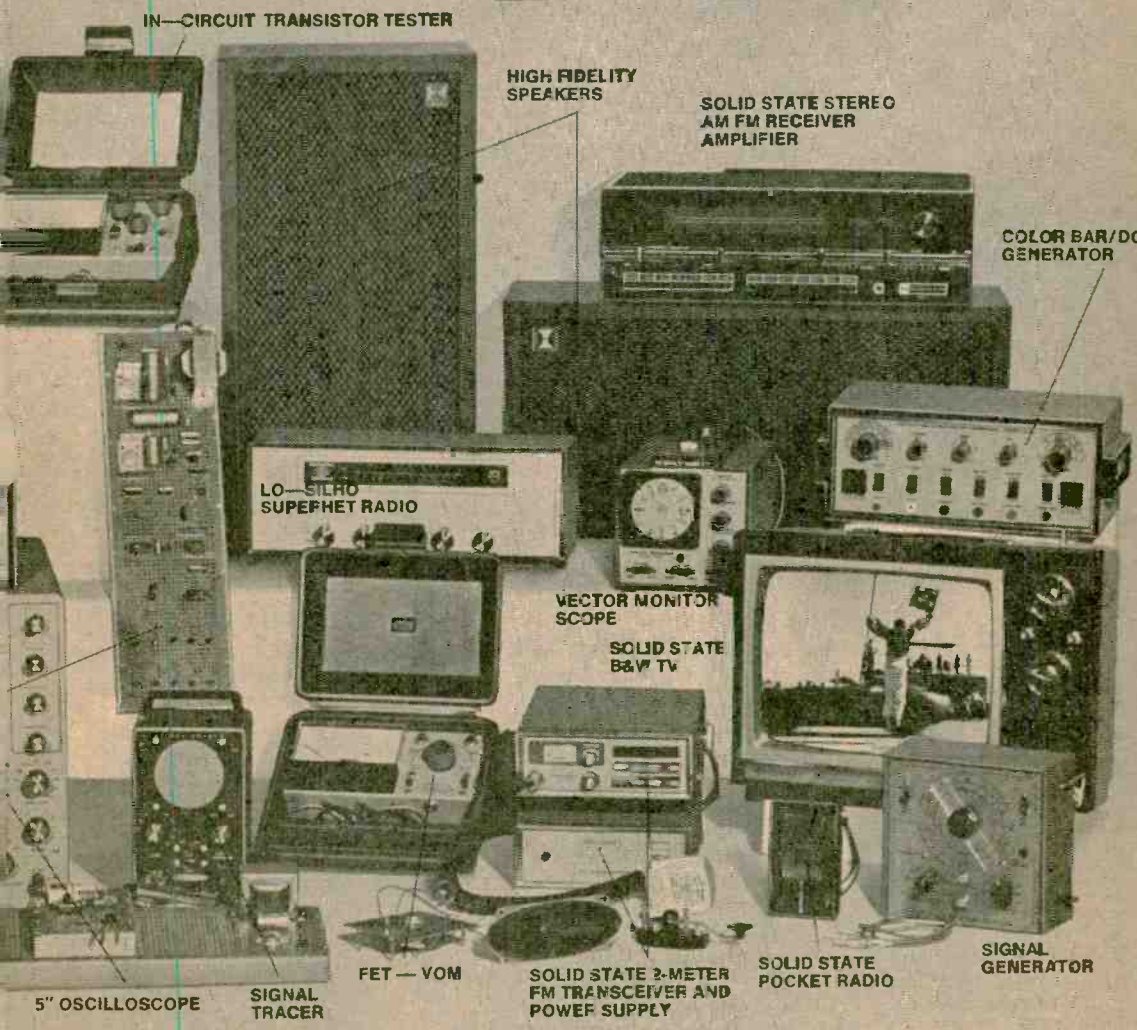


As an NTS student, you'll acquire the experience and know-how that comes with first hand training on NTS "pro" equipment. Equipment you'll build and keep. Our courses include equipment like the 5" solid-state oscilloscope, a transistor and tube-tester, a vector monitor scope, 74 sq. in. B&W TV, or a solid-state stereo AM-FM receiver. The unique new **NTS Digital GR-2000 Color TV** with first-ever features like silent varactor diode tuning; digital channel selection, digital clock, an option at additional cost; and big 315 sq. in. ultra rectangular screen. This is just a sampling of the kind of better equipment that get you better equipped for the electronics industry.

By following the easy-to-read NTS lessons, you learn the theory behind these tools of the trade. You'll learn and develop skill and confidence fast.

Choose from 12 NTS Electronics Courses, including Color TV and B&W TV Servicing, Electronics and Computer Technology, Electronics Communications & FCC, and Industrial & Automation

equipment
ll be equipped.



Electronics. All courses can provide you excellent opportunities to expand your career in the exciting world of electronics! So get started right now by checking the coupon and mailing it today.

COMPARE WHAT WE OFFER IN KITS AND LESSONS. COMPARE OUR TUITION.

Classroom Training at Los Angeles. You can take classroom training at Los Angeles in sunny Southern California. NTS occupies a city block with over a million dollars in facilities devoted exclusively to technical training. Check box in coupon.

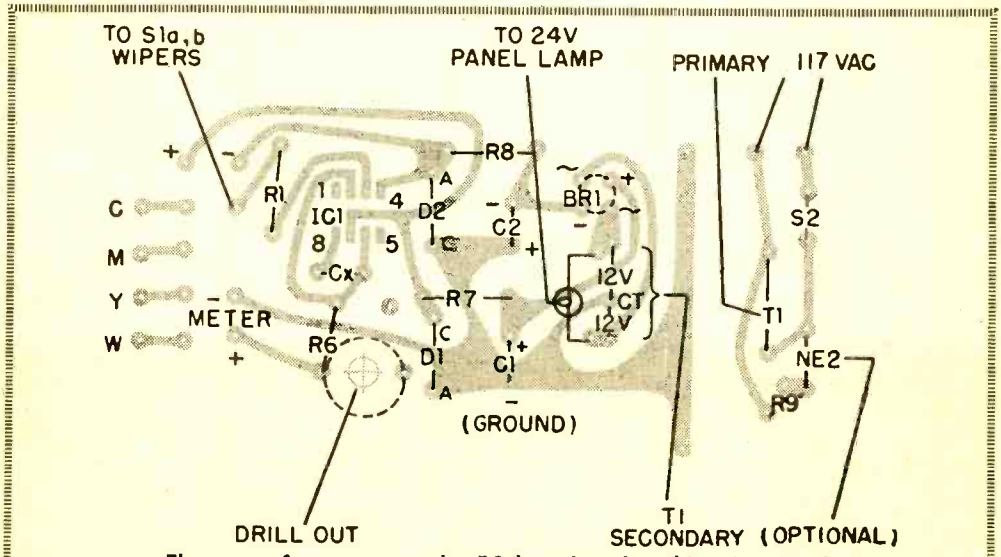
Approved for Veteran Training. Accredited Member: National Association of Trade & Technical Schools; National Home Study Council.

NATIONAL TECHNICAL SCHOOLS

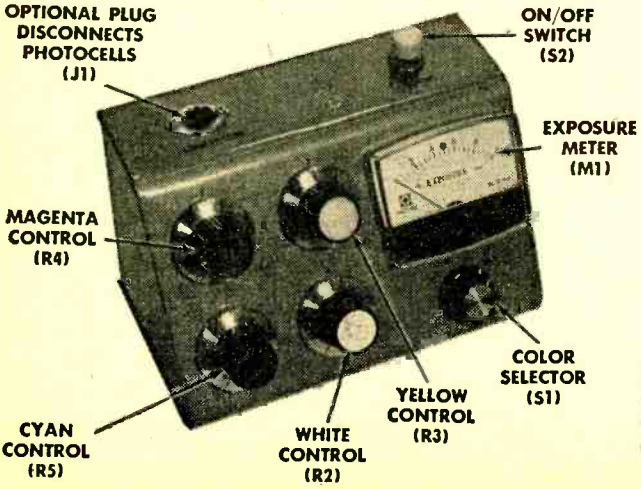
TECHNICAL-TRADE TRAINING SINCE 1905
Resident & Home Study Schools
4000 South Figueroa St., Los Angeles, Calif. 90037

scrap aluminum ¾ to 1-inch wide fashion a Z-bracket to the dimensions shown. Drill a ½-inch hole close to the end of the longer Z-leg. Fasten the other end of the Z-leg to your enlarger's under-lens filter holder. If your enlarger does not have a filter holder, or if it has a permanent swing-away red filter under the lens, mount a Paterson swing-away light integrator (available from local photo shops) under the lens. Fasten the short leg of the Z-bracket to the integrator—which has pre-drilled holes—in such a manner that the ½-inch hole is on the optical center of the lens. Then cement photocell P2 in the hole and attach the connecting wires; these can be extra-thin zip cord such as used for short-length speaker connections. (This whole bit reads a lot more complicated than it is. Use the photographs as a guide.)

Photocell P1, which measures the exposure light, can be mounted in anything heavy enough to hold it in place on the easel. The photographs show the photocell



There are few parts on the PC board and nothing is critical. Modify the board if you wish. Trimmer potentiometer R6 should be a flat mount, so it can be adjusted through a hole in the cabinet.



epoxy-cemented in an oversize control knob.

When the complete analyzer is assembled, attach oversize calibrated knobs such as the Calectro E2-715 to R2 through R5. The knob calibrations are important so they

(Continued on page 104)

To avoid upsetting a control setting while groping for the on-off switch in the darkroom, mount switch S2 as far as possible from the controls.

It's modern chemistry and electronic control for . . .

Fine Color Prints from Your Own Darkroom

Look how todays techniques give home darkrooms exciting color print capability!

by Herb Friedman

THOUGH MOST PHOTO HOBBYISTS can turn out a superior black and white print using a minimum of equipment, few realize that it is even easier to turn out superior color prints by using modern color chemistry and an electronic color analyzer. The hobbyist can, in fact, generally produce color prints infinitely superior to what he can get from the local drugstore or camera shop.

Until recently, the average hobbyist could figure on spending an entire evening just making one quality color print. Typically, he first had to make a test strip for exposure, then a test print for color balance, then a final print, and possibly even a fourth print for optimum color. If he changed negatives, or the enlargement ratio, he had to repeat at least two steps, possibly more. Considering that each try could take from 10 to 20 minutes effort, you can see why the average photo hobbyist found it easier to drop off the film at the drugstore—even if the commercial prints weren't all that good.

But with modern techniques you can turn out a superior color print the first time, in less than three minutes from start to finish. Even if you change negatives, or the enlargement ratio, your first print will be a good print, greatness will be attained on the second print.

The first thing you need is a high speed chemistry, such as the two-step Beseler system which can produce a finished print in two minutes. The second item you need is an electronic color analyzer (for which you'll find plans in this issue). A color analyzer is simply a memory device that remembers all the conditions *you selected* to obtain the type of color print *you like best.*

Color Variables. Color materials such as the negative, printing paper, enlarger lamp, and even color correction filters vary in their sensitivity to light colors from batch to batch, roll to roll, and time to time. Even the enlarger's optical system can have a color cast. For this reason it is generally impossible to place a negative in your enlarger, expose the paper, and develop a good, let alone decent, color print.

One way we can correct for these variables is through an *additive* exposure, exposing the paper through blue, green, and red filters for differing lengths of time. Since blue, green, and red create all the colors in additive printing, any correction can be obtained by controlling the precise timing of each exposure. The additive system is a pain in the neck for the hobbyist, for the slightest desired change in color rendition or saturation (exposure) can involve changes in the exposure through all three filters.

An easier to use and more favored printing system used by hobbyists is the *subtractive* exposure. A single filter pack made up of two of the filters known as YELLOW, MAGENTA, and CYAN makes all the color corrections at the same time. This filter pack is placed between the enlarger lamp and the negative; virtually all modern enlargers have a drawer in the lamphouse to accommodate a filter pack. A single exposure through the filter pack is all that's required to make a color print. Some of the more expensive enlargers have what is termed a "dichroic head" with variable filters as part of the light system; the exact value of filtration is simply dialed by the user. Again, all the color correction is provided at one time by the dichroic head so only a single exposure is needed.

More Info. A full and complete treatment of both types of color printing is contained in the Kodak publication *Printing Color Negatives;*

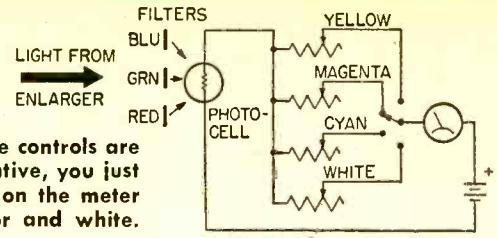
Provides a wealth of worthwhile info for photographers interested in the color print techniques available from Kodak or your photo dealer. Their publication No. E-66.

this book is a required reference for anyone who wants to make quality color prints. The book also gives the most convenient operating procedures for electronic color analyzers.

The subtractive printing procedure is particularly well adapted to use with a color analyzer, is the easiest method for the amateur, and is exceptionally fast-handling, so the illustrations to follow will refer to the subtractive system.

An electronic color analyzer basically consists of a photocell (vacuum tube photomultiplier or photoresistor) positioned under the lens, blue, green, and red filters mechanically positioned over the photocell (or positioned over the cell by hand) and a meter that indicates

e/e FINE COLOR PRINTS



The basic color analyzer. Once controls are matched to a "standard" negative, you just select filters for a null on the meter for each individual color and white.

the amount of light falling on the cell. The meter is connected to the photocell through independent potentiometers as shown in the figure. Color analyzer readings will be accurate for most negatives and lighting situations as long as the same box of printing paper is used. The system needs to be recalibrated only when the printing paper is changed (so purchase boxes of at least 100 sheets to avoid extra work).

First step is to make a really fine print from a decent negative. You can do it the hard way, one print at a time, or use a Beseler Subtractive Calculator which puts you inside the ball park on the first try. When you have made a print with satisfactory flesh tones and color saturation don't disturb the enlarger or timer controls.

To Continue . . . Place the color analyzer's probe on the easel or swing it under the lens (if it is mounted on the enlarger). Install a light integrator—which is nothing more than a piece of ground glass or its equal—under the lens, between the lens and the analyzer's probe. The light integrator scrambles the picture into a diffused "white light" which contains all the color elements of your negatives and the filter pack. Place a blue filter (Kodak Wratten 98) on top of the light integrator. (Note that most hobbyist analyzers have a selector switch that also mechanically positions the correct filter over the photocell). Turn on the enlarger and adjust the analyzer's *yellow* control for a convenient reference meter reading. (Usually, center-scale or "null" is used as the reference reading, but any meter reading can be used as a null.)

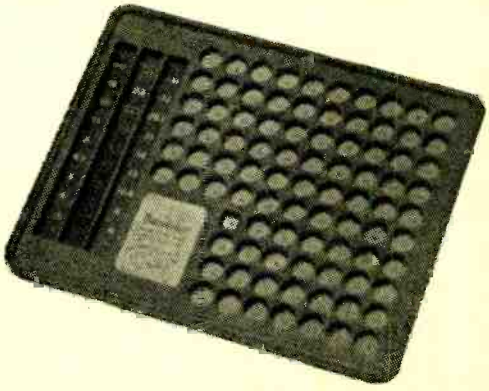
Remove the blue filter, install a green filter (Kodak Wratten 99), switch the analyzer to MAGENTA and adjust the *magenta* control for a null meter reading. Remove the green filter, install a red filter (Kodak Wratten 70), switch the analyzer to CYAN and adjust the *cyan* control for a null meter reading (the color controls yellow, magenta and cyan refer to the color of the subtractive filters in the filter pack). Finally, remove all filters from under the lens, switch the analyzer to WHITE and adjust the *white* control (exposure control) for a null meter reading.

(The color analyzer in this project uses a separate photocell for the exposure. If you look at the easel you'll see a shadow cast by the Z-bracket holding the color comparator cell. Position the exposure cell on the easel so it is just off the edge of the shadow. If you prefer, you can place several thicknesses of opaque paper over the color comparator cell and use it for the white measurement, though we suggest you use the separate cell.)

When all the controls are adjusted you have programmed the color characteristics and exposure of your "reference" print into the analyzer, and you should note the control settings and exposure time for future use.

Down To Business. Now assume you want to make a print from another negative. First you set the degree of enlargement and focus, leaving the lens wide open. You place the analyzer's probe under the lens, install the light integrator and set the analyzer's switch to CYAN. Install the red filter on top of the light integrator and adjust the lens aperture until the meter indicates null. Switch the analyzer to MAGENTA, install the green-reading filter and note the meter reading. If it is not at null, add or remove magenta filters (from the filter pack) until the meter shows a null. Then switch the analyzer to YELLOW, install the blue-reading filter and modify the yellow filtration in the filter pack until the meter shows a null. Finally, set the analyzer to WHITE, remove all reading filters and adjust the lens aperture for a null indication.

Through the color analyzer you have now established a new filter pack and exposure time for the new negative. If the new negative uses similar lighting to the reference negative the



Modern color print chemistry techniques from Beseler include this subtractive color calculator to aid filter selection.

print should be perfect. If the lighting was considerably different the print will be good—acceptable to most people, but requiring just a slight filter pack modification for a great print.

Swinging Filters. In the previous example the filter pack would wind up with magenta and yellow filters—which is what is generally needed. Some Kodacolor negatives, however, might require cyan filters plus magenta *or* yellow (but never all three). This information will have been programmed into the color analyzer, so you will have no difficulty if you make a slight modification in procedure. The first meter reading, the one where you adjust the lens's aperture, should be made for the filter you are *not* using in the filter pack. For example, if your basic filter pack has cyan and magenta, switch the analyzer to YELLOW, place the blue-reading filter in position on the light integrator, and close down the lens for a null indication. Then proceed with the other readings. If your reference negative did not require cyan in the filter pack, if it had yellow, magenta, or both, and you find a new negative just can't be pulled in for null meter readings with yellow and magenta filters, it indicates the new negative requires cyan filtration, so start with the assumption that yellow is not required. If you still can't null the meter, it means magenta should *not* be in the filter pack.

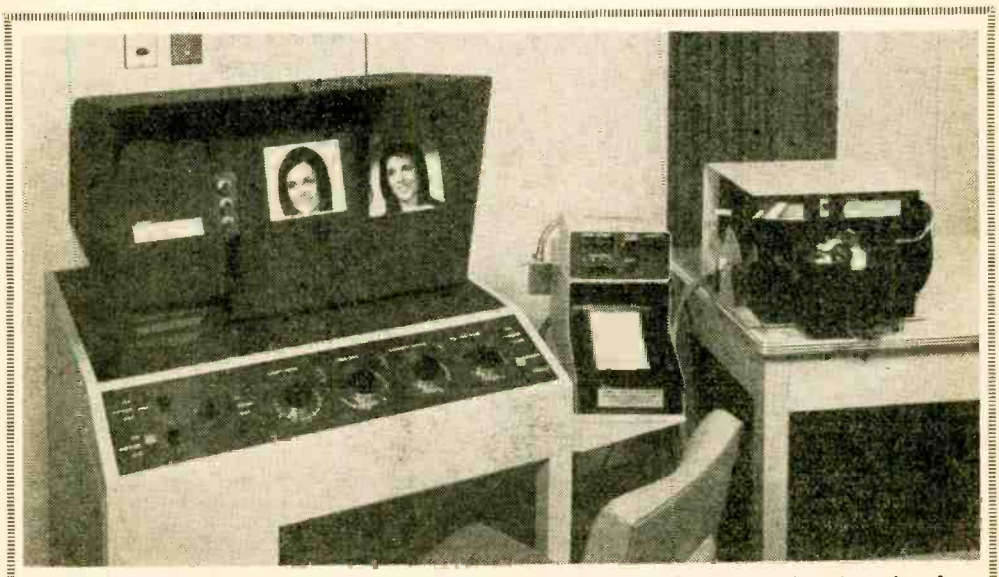
As we mentioned, a more thorough discussion and procedure for using a color analyzer is found in Kodak's *Printing Color Negatives.*

Most, but not all, commercial color analyzers use photomultiplier tubes which have no light memory, nor are they confused by infrared from the enlarger lamp. These units are, as you would expect, relatively expensive. Low cost models use photoresistors, such as used in the construction project found in this issue.

Kodak color printing filters. Typical filter designation CP20Y means *color filter with a .20 density;* the color is *yellow.*

More Data. Photoresistors are infrared sensitive and they have a light memory, both of which can confuse the meter. The infrared is easily handled by installing a heat or infrared filter glass in your enlarger (it should be there to protect the negative anyway). The light memory is handled by using a consistent measurement procedure. The best way is to turn the enlarger off, install the reading filter and the light integrator, turn off the bright room lights, count to five, and then turn the enlarger *on.* Take the meter reading, or adjust the appropriate color control, slide the new reading

(Continued on page 102)



Professional equipment used by color labs includes this Kodak Video Color Negative Analyzer. It uses a 5-in. color TV screen to assist an operator in selecting the correct filter.

e/e is hot for...

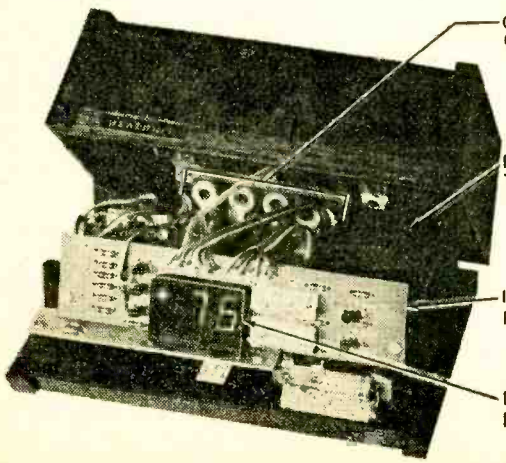
Heathkit Digital Electronic Thermometer

The ID-1390 kit monitors indoor and outdoor temperature

CALL IT a *conversation piece, op-art,* or just plain *camp,* it is nevertheless true that Heath's ID-1390 digital thermometer is a functional, useful, and certainly most attractive piece of consumer hardware. The thermometer uses Sperry-type digital readouts (approximately ½ in. high) to indicate indoor temperature, outdoor temperature, or both alternately every four seconds. Furthermore, at the flick of a switch the readout is in degrees Fahrenheit (°F) or centigrade (°C).

Everything except the temperature sensors is housed in the black plastic cabinet with teak finish vinyl decorator panels. The sensors are special diodes which are resin encapsulated in aluminum cups about the size of the tip of a pencil. Cables from each sensor (one for indoor, one for outdoor) terminate in phono plugs which fit matching sockets on the rear of the cabinet. The completed sensor assemblies are waterproof and can be secured with the supplied clamps in any indoor or outdoor location. The connecting wire to the sensors resembles ultraminiature coaxial or shielded cable, and is easily concealed along baseboards and moldings.

The total temperature working (indicating) range is -40° F to +120° F or -40° C to +50° C. The temperature is indicated directly to three places with the appropriate "+" or "–" symbol. To the right of the digits are two small windows which light to indicate whether the *indoor* or *outdoor* temperature is being displayed. When the switch on the rear labled ALTERNATE and HOLD is set to ALTERNATE the readout alternately displays the indoor and outdoor temperatures, switching back and forth



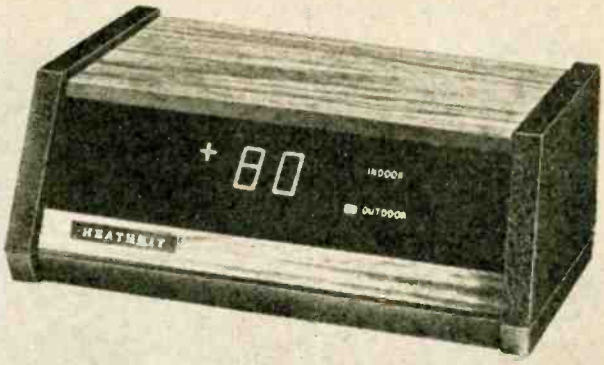
Put it all together it spells "convenience" at home and job. At a glance, you know indoor and outdoor temperature, even in degrees centigrade if you're a metric nut. Heath will send you all the specs plus other product info if you write direct to Heath Company, Benton Harbor, MI 49022. Price: $59.95

SPECIFICATIONS

Temperature Range:
Fahrenheit −30° to +120°
Centigrade −30° to +50°

Typical Accuracy:
±1° C or F except at very low temperatures ±2° C or F below −15° C and +20° F

Power Requirements:
110-130 VAC, 60 Hz, 4 to 6 Watts

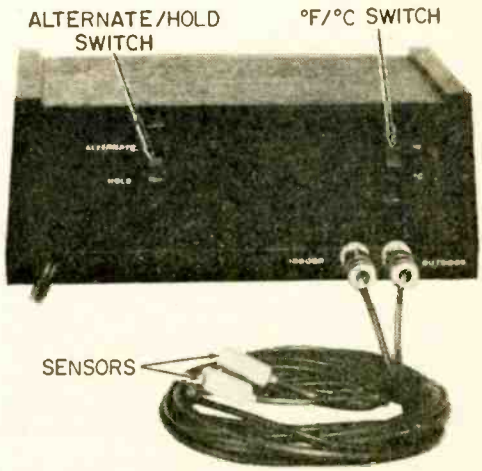


approximately once every four seconds. When the switch is set to HOLD the thermometer stays locked to the indoor or outdoor mode; to change, you simply set the switch to ALTERNATE until the unit switches to the desired mode and then restore the hold.

Putting It Right. Calibration is notably easy; all you need is a glass of ice water and the precision reference thermometer which is supplied with the kit. A total of four calibration controls—two for Fahrenheit and two for centigrade—are provided. Once calibrated, the digital thermometer's accuracy is ±1° F from +20° F to + 120° F and ±2° F from −40° F to 20° F. The centigrade accuracy remains proportionally the same.

It's a Counter. As is typical of digital readout instruments, the digital thermometer is basically a counter. The temperature sensors determines how many pulses from a self-contained oscillator are fed to a counter which is calibrated to display the pulse count in terms of temperature. For example, the counter starts counting down from 200 to zero. If the sensor permits 120 pulses to pass, the temperature is 200 minus 120, or 80° (Fahrenheit or centigrade depending on your mode selection). If the temperature is cold enough so the counter counts all the way down to zero, the "−" (negative) indicator is triggered and the counter switches to count up from zero until the pulses are turned off. In this manner a below-zero thermometer reading can be indicated.

Fun to Build. Because a counter is involved, as you'd imagine the digital thermometer is a rather complex kit. Most of the components, however, mount on three small PC boards, and each board is completed just about the time boredom starts to set in. In short, the kit is assembled in small bites, rather than one large swallow, and you can knock off, knowing you completed one full assembly unit. If you're the type that doesn't quit until a kit is finished, figure one long evening is all you need, two evenings if you watch TV while you work. Price is $59.95 mail order. For additional information on the Heathkit ID-1390 Electronic Digital Thermometer circle No. 1 on the Reader Service Coupon on page 17 or 103. ■



Everything is up back! Switches change readings from °F to °C, and alternate indoor-outdoor, or lock on either.

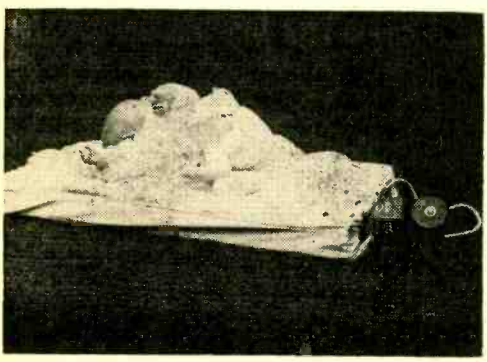
Wired Pram Bans Snatches

Young mother, concerned that her baby might be kidnapped, invents a baby-carriage alarm system

☐ A young British housewife, worried about the safety of her baby, has invented a baby-snatcher alarm that is believed to be foolproof. She says she had been thinking about it for a long time, and when someone else's baby was taken from its perambulator, "It made me hurry on, and with the help of a friend or two, this device got designed."

The key to this invention is a modified baby-carriage mattress, with a pressure-sensitive pad between the usual foam sheets, connected to a battery and a loud bell.

Although hesitant to reveal the details, the inventor did say that the system is preset during construction to four pounds. Most babies weigh more than four pounds, and thus the alarm system can be used in principle for any baby.



Baby on one of the anti-snatching matresses, with the battery and alarm bell visible at right. The bell has a clip on the back for attaching it to the rim of the baby-carriage, so as to produce the loudest sound possible.

A British manufacturer has taken on the system, and the production line is said to be already making 1,000 such mattresses a week. The complete system, with special mattress and alarm, sells in England for the equivalent of $12.00, which is about double the price for an ordinary baby mattress there.

There is a hidden switch "somewhere" to turn the device on or off. This is the standard switch supplied with the system, but if the user of the baby-carriage wants a special on/off switch, located where only she will know, then that can be installed instead, at extra cost. When the device is not switched on, the baby can be put on the mattress. Then one switches the device on. Should anyone but the mother lift or remove the baby from the carriage, a loud bell begins to ring; with the battery supplied, it could ring for at least three hours. The sound is particularly penetrating, the inventor says, "And there's no doubt that it will be heard even when there's a lot of traffic noise. The sound of the bell is special in a way, because of the penetrating ring." Should a kidnapper try to cut the visible wire before trying to snatch the baby, the alarm will also go off.

The experimenter could build a similar device using something like the Lafayette Tapeswitch mats, which are activated by less than five pounds of pressure, in a normally-closed circuit. ■

by Kathi Martin KAI0614

KATHI'S CB CAROUSEL

There's one thing a girl who travels alone quickly learns: there are many wierdos in this world! I had one clown—while I was driving on a dark, nearly deserted road—signal that my tires were flat, the car was leaking water, boiling over, and, well, you name it. They've tried every trick in the book to get this gal to pull over so they can "help." I've been parked at roadside rests checking my map when these lover boys sidled up to the car and tried to get in; I've had them zip past only to find them two miles down the road flagging me down for an "emergency" (while their friend lies stretched out on the shoulder feigning injury); and I've had them just plain try to drive me off the road.

Fortunately . . . I've always had a CB rig since the day I got my driver's license, and the first thing I do is grab the mike and raise someone on Emergency 9. (Before the days of the National Emergency Channel, you kept track of those roadside signs giving the channel number of local emergency teams.) Nothing, but nothing gets these wierdos off your back like talking into a mike and looking for all the world as if you're giving out a car's license number and description. Once I even raised a couple of mobiles that caught up and put me in the middle of a "convoy" to the next town.

My friends and neighbors know how much I depend on CB to keep out of tight situations, so it was no suprise when the seventeen year old "mantrap" down the block got her driver's license to find her Mom and Pop knocking at my door to help keep the bees from their honey. Daughter Cynthia had latched onto a night job at the local burger stand so she could save up for a 'Vette, and the junior hoods were hassling her at closing time and on her way home. Did I think CB could keep the homefolks ready to help if Cynthia needed some extra muscle—like her two weight-lifter brothers?

If there is anything a young girl should have along if she drives, it's a CB rig! I don't mean one of those complex gold-plated transceivers that takes several minutes to figure out if everything is set to go. Rather, a girl's best friend is an easy-to-use, extremely dependable system that re-

The model M-410 citizens band antenna is from The Antenna Specialists Company, 12435 Euclid Ave, Cleveland, OH 44106 and costs $34.50 (list price).

Local gal puts finishing touches on a base-loaded Big Momma CB antenna from the Antenna Specialists Co.; Circle 5 on page 17.

quires only hitting the PTT switch on the mike. As far as I am concerned, this means a minimum-control AM transceiver with at least two channels and one heck of a reliable antenna system—preferably one of those smaller antennas you don't have to release from an antenna hold-down clip. With the rig always set to *on* and tuned to the family channel, or channel 9, all one has to do is squeeze the mike and yell for help.

I suggest at least two channels so a damsel in distress can raise the family when tooling around the neighborhood, or switch to channel 9 when she's out of range of the base.

Antenna Assistance. The weak link in many a CB installation is the antenna system; when you figure it's going to be used by someone with absolutely no technical experience or desire to know about SWR, high resistance joints, and corrosion, the antenna and all its connections must be first class all the way. In this instance I don't go for the full-length whip because it often winds up in the rain-gutter clip, and the last thing I'd want to do is run the window down when there are unfriendly hands trying to get in the car. A better choice is one of those short "loaded" whips you can forget about—small enough to clear the car wash machinery, the toll both lamps, and the garage ceiling.

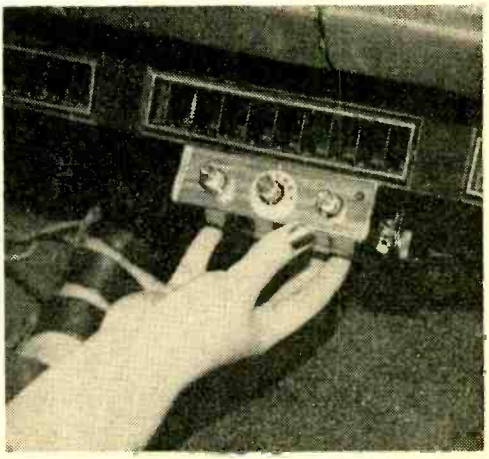
One of my long-time antenna favorites for the non-technical CBer is The Antenna Specialists Model M-410 Big Momma. This is a "short" antenna that secures to the edge of the trunk lid with two screws. The coaxial transmission line is supplied attached at the antenna end, and a solderless coaxial connector is provided for the transceiver end. The stainless steel mini-whip is secured by a screw into a miniature shock spring that sits on top of a weatherproof loading coil. Since all that's required for installation is the tightening of three screws (with the supplied Allen key), there are no mounting problems. The only thing you have to check is that the antenna doesn't slam into the rear window when the trunk is opened. I generally suggest the antenna be mounted on the side of the trunk lid so the whip swings clear of the window and car body when the trunk is opened.

Out Of Sight. The transmission line can usually be passed through the driver's side of the trunk past the rear seat and into the car's wiring channel. This channel is usually under the door sills; remove the two or three screws that secure the sills, look straight down and you'll probably find all of the car's front-to-rear wiring lying in a channel. Just slip the transmission line into this channel and bring it out somewhere above the brake or gas pedal. Attach the coaxial connector and the antenna is ready for use.

If you want to keep costs down to rock bottom I suggest a small but adequate transceiver such as the Realistic Mini-Six shown in the photographs. As you can see,

(Continued on page 98)

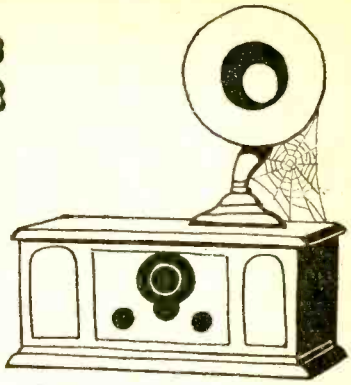
The best way to make a neat installation is to use the car's cable channel just under edge molding located on the driver's side.



Select a small-size CB rig and mount in the usual manner under the dash. You can keep costs down with a low-priced 6-channel rig.

ANTIQUE RADIO CORNER

by James A. Fred



☐ Hello out there in Radioland! We are back again with interesting facts about collecting antique radio and wireless equipment.

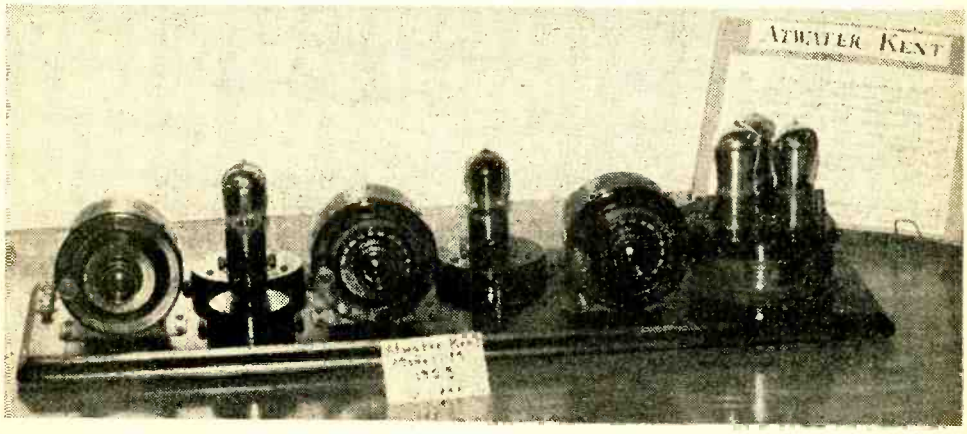
I am trying to get more information about the Evansville Radio Laboratory which was located in Evansville, Indiana during 1920, 1921, and 1922. Their trademark was EV-RA-LAB. Will anyone who has one of the radios built then, or parts, or literature, please write me in care of this magazine. I am compiling a history of radio manufacturing in Indiana prior to 1930 and need this material for the book.

In the 1930s there was a radio station in Muscatine, Iowa that was operated by a man who disliked chain stores. He sold groceries and other items by radio. If anyone has any written information about this man I would appreciate copies of it.

In Shreveport, Louisiana there was a radio station in the '30s that had an announcer who said, "Hello world, doggone your buttons." I would also like information about this radio station and announcer.

The reprint of the Gernsback 1927 Encyclopedia is now available and I have read my copy. For any collector it is an invaluable source of information and illustrations of almost every part used in radios, every person connected with radio, and the history of radio as it was up to 1927. It is a slightly reduced in size, very well printed and bound copy of the Encyclopedia originally published in 1927. The last issue of ELEMENTARY ELECTRONICS listed the price and source for this book.

Like New. Old tubes are still available if you want to pay the price. Recently I have seen advertisements offering 201As, 200As, WD11s and other very ancient tubes. Prices quoted are $5.00 to $6.00 for new 200As and 201As new and in boxes, and $3.00 to $4.00 in good used condition. New WD11s are quoted at $25.00 each. You may find these tubes offered in The Horn Speaker and in Antique Radio Topics. The Fact Sheet offered by this magazine



This Atwater Kent breadboard is one of the many variations of the model 10. The model 10 is relatively easy to find, and many collectors have two or more.

will give you the address.

For those of you who do not want to spend that much money for tubes for your old radio, it is possible to use type 30 tubes or VT24/864 tubes with the correct filament voltage. The April issue of Antique Radio Topics contains an article telling how to adapt these tubes to plug into sockets made for 201As. The Fact Sheet will tell you how to get a sample.

Replacing Power Transformers. Several readers have purchased radios with burned out power transformers. Some readers are under the impression that they can buy a new transformer, bolt it to the chassis, and solder it into their 1928 model radios. This just isn't so.

However I can give you some help if you choose this second solution. Is the transformer in a big can filled with tar or pitch, or is it a neat little package bolted to the chassis? In either case disconnect each wire lead on the transformer and label each wire with a tag, or identify the wires by color. If the transformer is potted, remove the potting compound (see the May/June 1974 issue of ELEMENTARY ELECTRONICS for the methods of doing this). After it is removed you must decide whether to have it rewound or substitute other transformers.

To substitute other transformers you should know what voltages and current you will need. It is simple to figure filament voltages and currents. Look in an old tube manual for the tubes your set uses. For instance most rectifier tubes were the type 80 with 5-volt, 2-ampere filament. Let us say that the radio uses four type 26s with 1.5-V 1.05-A filaments for a total of 4.2-A, and one type 27 tube with a 2.5-V, 1.75-A filament. The power amplifier tube might be a type 71A with a 5-V, .25-A filament. Don't use the same winding for both the 80 rectifier and the 71A even though they both require 5 volts. The set just won't work if you do. Now, to figure the "B" voltage is more difficult. If you don't have a schematic drawing you are in bad shape. Let us assume that you need a plate voltage of 180-VDC, also assume an 80 full wave rectifier tube. You may have a voltage drop across a speaker field of up to 100 volts, and maybe a drop across a filter choke. In this case you may need an unfiltered "B" voltage as high as 280 to 300 VDC. To get this amount of voltage you will need a transformer with a high voltage winding of 400 VAC each side of a center tap. To find the current rating of this winding go back to the tube manual and add up the plate currents (and screen grid current if it applies) of all the tubes in the radio except the rectifier, add about 10% as a fudge factor and you will have all the information you need to select a replacement transformer (or transformers).

ANTIQUE RADIO FACT SHEET

☐ Collectors of antique radio and wireless equipment can get a 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. ■

Your next problem is to find a vendor who has a transformer you can use. There is hardly a radio parts distributor who stocks power transformers anymore. You have to look for parts distributors who started in the 1930s who haven't thrown out their old stock. Allied Electronics in Chicago, an industrial parts distributor, has the largest catalog stock I know of. Burstein-Applebee, Kansas City, Missouri has the next largest stock listed.

If you have a transformer problem you cannot solve you can write to Antique Radio Press, P. O. Box 42, Rossville, IN 46065 for help. If you enclose a circuit diagram of your set explaining what transformer you need (power, audio, or speaker output) along with a check for $2.00, an experienced old time radio repairman will make a recommendation for you. If you do not have a circuit diagram, but do list the type and number of tubes your radio has, speaker field resistance, model number, etc., they still may be able to help you. If they cannot help you, your $2.00 will be refunded. This help does not apply to the early Atwater Kent AC-operated radios as they are a problem all their own.

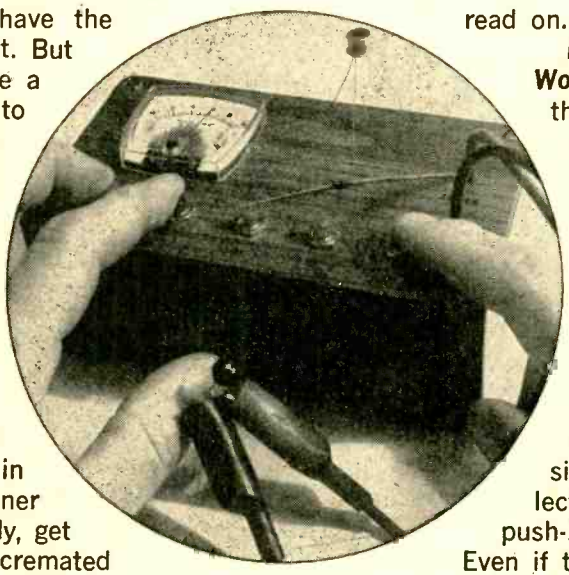
That is all for now. We will be back again with collector club news, technical hints on restoring old radios, and other interesting information for collectors of antique radio and wireless equipment. ■

ZENER ZAPPER

Blasts a batch of constant current to any under-20-volt zener to check it out. Plus—this device spots cheap transistors that can substitute for expensive zeners.

by Charles Rakes

ONE OF THE MORE EXPENSIVE semiconductors, next in line to the transistor and diode in usage, is the *zener* diode. Zeners are semiconductor voltage regulators which are not difficult to test if you have the proper equipment. But if you don't have a tester designed to test zeners, then you must gather together a current meter, voltmeter, suitable power source, and a maze of clip leads.



If, while testing, you forget to add a current limiting resistor in series with the zener and power supply, get ready to bury the cremated zener and untangle the current meter's needle while controlling your good temper.

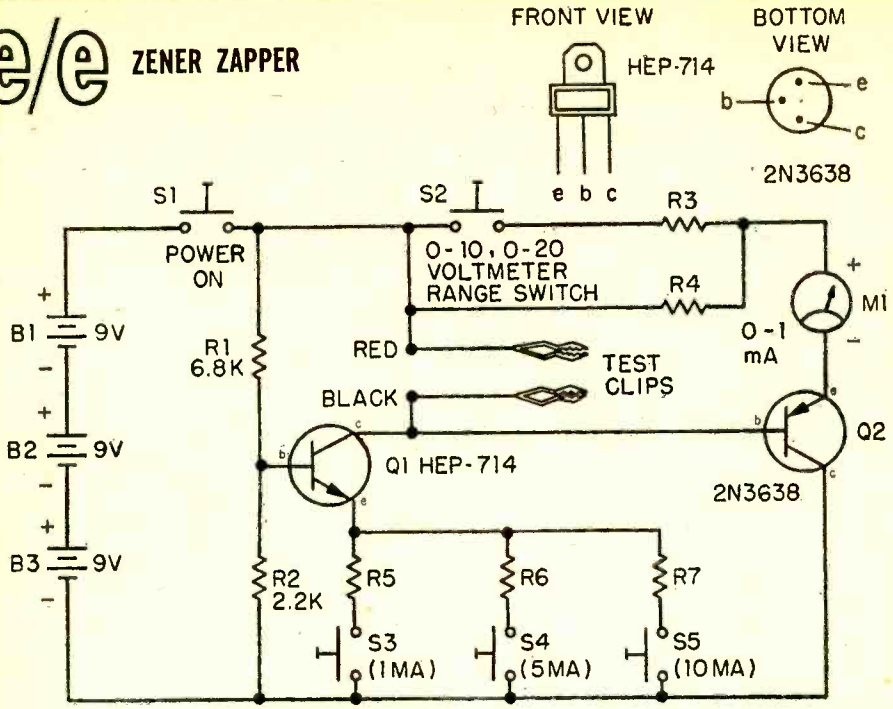
You can save those tears by spending less than ten bucks and a few hours time building this Zener Zapper. A little jewel like this will allow you to determine the zener voltage and knee characteristics, in seconds, of any zener diode with a zener voltage of less than twenty. The *Zapper* will allow you to turn the most common silicon transistor, that normally costs less than one-half that of most zener diodes, into one of the best zeners available at any cost.

Want to learn more? Then read on.

How The Zapper Works. Referring to the schematic diagram, Q1 is connected in a constant current circuit that supplies a constant current source to the test leads. The emitter of Q1 is connected to three current setting resistors that are selected by one of three push-button switches. Even if the test leads are shorted together the maximum current allowed to flow is limited to the value selected by the push-button switches. So no damage will occur to either the zener under test or to the Zapper.

Transistor Q2 is connected as an emitter follower to operate as a high impedance DC voltmeter that monitors the voltage developed across the test leads. S2 adds a special feature which

e/e ZENER ZAPPER



PARTS LIST FOR THE ZAPPER

B1,B2,B3—9-volt transistor battery, 2U6 type (Radio Shack 23-464)
M1—0-1 mA meter (Radio Shack 22-018 or equiv.)
Q1—NPN transistor, 2N3725, HEP714
Q2—PNP transistor, 2N3638 (Radio Shack 276-2021 or equiv.)
R1—6800-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R2—2200-ohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R3 to R7—Selected 10% resistors (see text)
S1 to S5—Pushbutton switch, normally open (Radio Shack 275-1547 or equal.)
Misc.—6¼ x 3¾ x 2-in. case, battery holders, five-terminal terminal strip, red and black test leads, two test lead clips, battery clips, wire solder, etc.

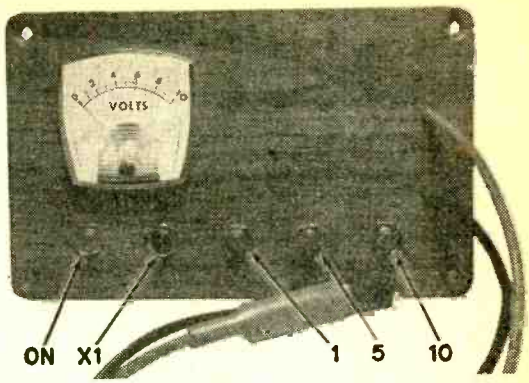
allows the meter range (20-volts) to be changed to a full scale voltage of ten.

Three 9-volt transistor radio batteries are used to supply the tester; under normal use they should last nearly their normal shelf life. Power switch S1 is a pushbutton (spring-return type) that must be operated with each test to conserve battery life and to insure that the *Zapper* isn't left on.

Building a Zapper. Our unit was constructed in a 6¼ x 3¾ x 2-in. plastic case with the meter, terminal strip, S1, S2, S3, S4, and S5 mounted to the front panel. The three batteries are kept in place in the back of the case with three metal holders.

Since the component layout isn't critical and since nearly any wiring scheme will do, you can build the *Zapper* in about any enclosure that you choose, but if you want to duplicate our unit just follow the general layout shown. Only a single bit of advice is necessary in the construction, and that is to take extra care in drilling the holes in the plastic case. Calibrating the *Zapper* requires a well stocked resistor junk box or a resistance decade box. With only resistors R1 and R2 connected, as shown in the schematic, connect a resistance decade box between the emitter of Q1 and battery negative. Connect a 0 to 10 mA meter to the test clips, press the power switch S1, and adjust the resistance to produce a current of 1 mA. This resistance value should be near 6000 ohms and may be made up of one or more 10 percent resistors. This is the resistor value used for R5. Select resistors R6 for a 5 mA reading and R7 for a 10 mA meter reading in the same manner. Resistor R6 will be near 1000 ohms in value and R7 approximately 500 ohms.

Operation is simple: just connect the zener diode, push and hold the on button and one or more of the numbered buttons, which represent current in mA. The zener voltage is shown on the meter on a 0 to 20 volt scale. If the meter reads half scale or less, push the X1 button; the meter will change to ten volts full scale. See text for more detail.



To calibrate the voltmeter circuit, parallel-connect a 25,000-ohm pot and an external voltmeter, capable of reading 20 volts, to the test clips. Connect a resistance decade box for R4.

Press switches S1 and S3 and adjust the 25,000-ohm variable resistor until the external meter indicates 20 volts, then adjust the decade box until the Zapper meter reads full scale (20 V). Resistor R4 should be close to 20,000 ohms in value and may be made up of one or more 10 percent resistors. The value of R3 is the same as R4.

Make The Most Of Zapper. Select a zener to be tested and connect the cathode to the positive (red) test lead and the anode to the negative (black) test lead. Press S1 and S3 and read the zener voltage on M1. If the reading is under 10 volts, press S2 and change the meter range to 10-volts full scale. If, while changing from S3 to S4 or S5, the meter reading changes appreciably, this indicates that the zener's knee is sloppy and would not make a very good reference zener.

Some zeners require more than 1 mA to produce a good knee characteristic and should be checked at 5 and 10 mA for this test. If a greater current is desired, more than one push-switch may be operated at one time. With all three pressed, the test current will be about 16 mA.

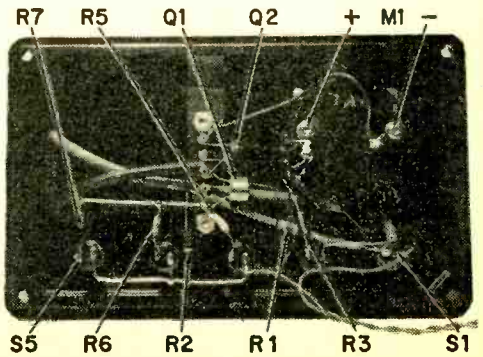
Transistors can be used as zeners. Almost all silicon transistors can be used as zener diodes. The base emitter junction is reverse biased to produce the zener action. Most will produce a zener voltage of between 5 and 15 volts. Connect the positive (red) lead to the base and the negative (black) lead to the emitter of a PNP transistor for testing, and reverse the leads of an NPN transistor.

After testing many different types of silicon transistors for their zener characteristics, we found that more often than not the transistor produced a zener with a knee characteristic as good or better than most zener diodes.

Turn the bargain zeners and transistors into the bargains they should be by building your very own zener zapper. ■

Something About Zener Diodes

What makes a silicon diode zener? Apply a difference of potential (a voltage) and a diode will either conduct (forward bias condition) or conduct very little or not at all (reverse bias condition). But if you exceed a certain magnitude of reverse bias, the diode will "avalanche" and conduct heavily—much as it does in its "forward bias" condition. There is, however, one interesting difference. It will avalanche only down to a certain level called the zener voltage. Manufacturers' tricks make diodes "zener" to a desired level. What was a rather poor diode with a low reverse bias specification became a highly stable voltage reference; that is, the zener voltage remains relatively consistant despite any changes in the voltage applied through a limiting resistor.



Since the circuit is quite simple, it can be built around a five-lug terminal strip.

If you can use any of these tools...

You could build this Bell & Howell 25-inch diagonal color TV with digital features!

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

It's just part of a fascinating learn-at-home program in electronics from Bell & Howell Schools!

Simulated TV picture

If you're handy with a set of tools, you may already have some of the skills you'll need to build Bell & Howell's color TV . . . the TV with digital features! This program is the perfect way to discover the exciting field of digital electronics . . . and best of all, you can do it all at home, in your spare time. Get free information now about this first-of-a-kind learn-at-home program prepared for you by skilled instructors at Bell & Howell Schools.

Discover a new way to spend your spare time hours on evenings and weekends

Even if you have no prior background in electronics, you'll find digital electronics a fascinating world to explore. You'll enjoy spending hours reading about the new systems of digital circuitry, performing experiments to test what you learn, and building this advanced color TV. It's completely absorbing, and you're spending your spare time learning something new that could open up extra income opportunities for you.

Find out all about electronics equipment and how it works

Once you complete this learn-at-home program, you'll have the specialized skills to service color TV's plus the knowledge that you can apply to repair a variety of home electronic equipment. And because this Bell & Howell Schools' program includes the study of digital circuitry, you'll be among the first with professional home training in digital electronics, a field that's growing in importance every day.

No electronics background necessary

We start you off with the basics. You'll receive a special Lab Starter Kit with your first lesson so that you can get immediate "hands on" experience to help you better understand newly-learned electronics principles. Later, you'll use your knowledge and learn valuable skills as you build the color TV. You can take full advantage of our toll-free phone-in assistance service throughout the program and also our in-person "help sessions" held in 50 cities at various times throughout the year where you can "talk shop" with your instructors and fellow students. You learn valuable skills in electronics through experiments and testing as you build this advanced-design color TV.

You build and work with a revolutionary color TV

Discover the technology behind such extraordinary features as channel numbers that flash on the screen, an on-screen digital clock that flashes the time in easy-to-read numbers, and an automatic pre-set channel selector that allows intermixing of VHF and UHF channels in any sequence. You'll enjoy probing into advanced performance features like silent all-electronic tuning, Black Matrix picture tube, "state of the art" integrated circuitry, and the 100% solid-state chassis that makes possible a brighter sharper picture with long life and dependability.

You also build Bell & Howell's exclusive Electro-Lab® electronics training system

You get valuable experience performing experiments and later testing your TV with a digital multimeter, solid-state "triggered sweep" oscilloscope, and design console you build yourself.

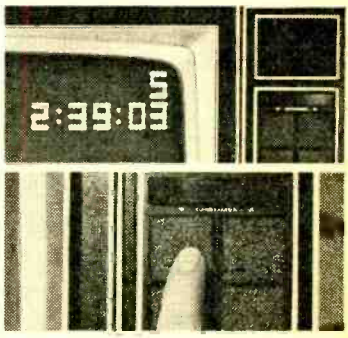
The skills you learn can lead to part-time income or a new career in a business of your own

While many of our students do not ask for employment assistance, it is available. We will help you look for a job in a field of electronics that best fits your interests and abilities. Of course, no assurance of income opportunities can be offered. One thing you can be certain of: no better or more practical at-home training in electronics is available anywhere.

Channel numbers that flash on the screen

Digital clock that flashes on the screen

Automatic pre-set channel selector



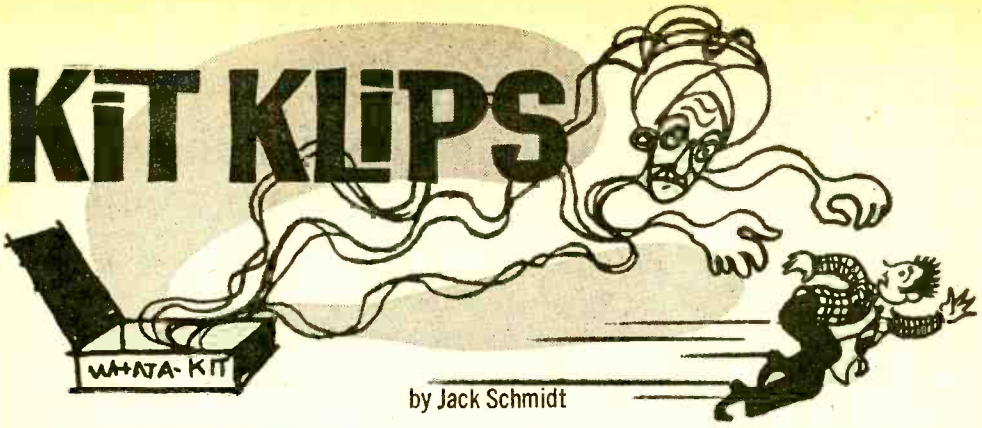
Find out more about this fascinating program . . . mail the card today for full details, free!

This Bell & Howell Schools' program is approved by the state approval agency for Veterans' Benefits. Please check the box on the card for free information.

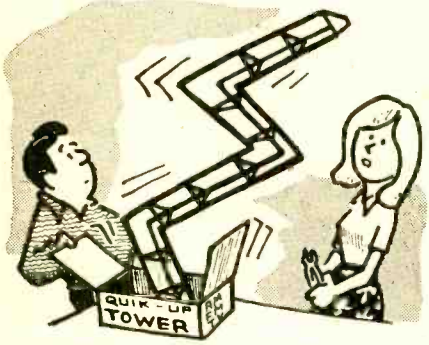
If card has been removed, write:
An Electronics Home Study School
DeVRY INSTITUTE OF TECHNOLOGY
ONE OF THE
BELL & HOWELL SCHOOLS
4141 Belmont, Chicago, Illinois 60641

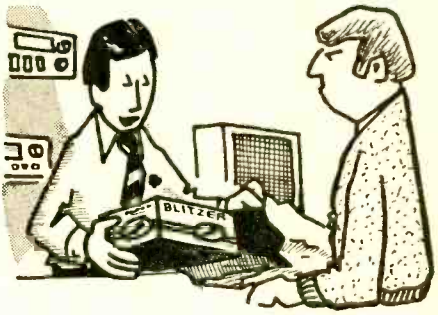
667R2

KiT KLiPS

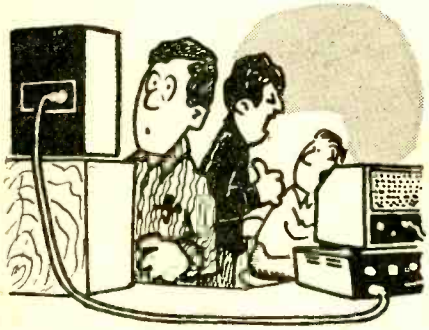


by Jack Schmidt

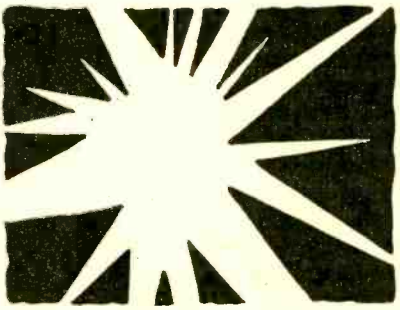




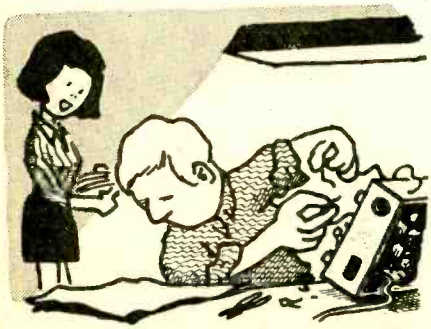
"You should thoroughly enjoy this kit, sir. A child can build it."



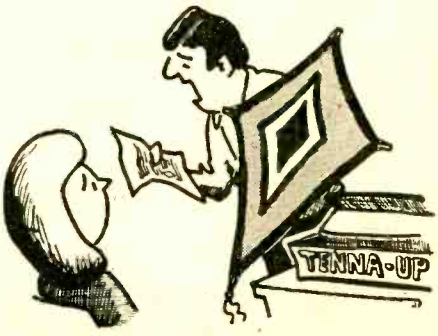
"Too much power to the strobe flash!"



"Be careful, Marvin, the red one is . . ."



"If you're having trouble, it's because you're reading my dress pattern."



"The ad calls it "the world's lightest and highest antenna."

Build this long range microphone and . . .

Bug Mother Nature

by F. . . Bauer

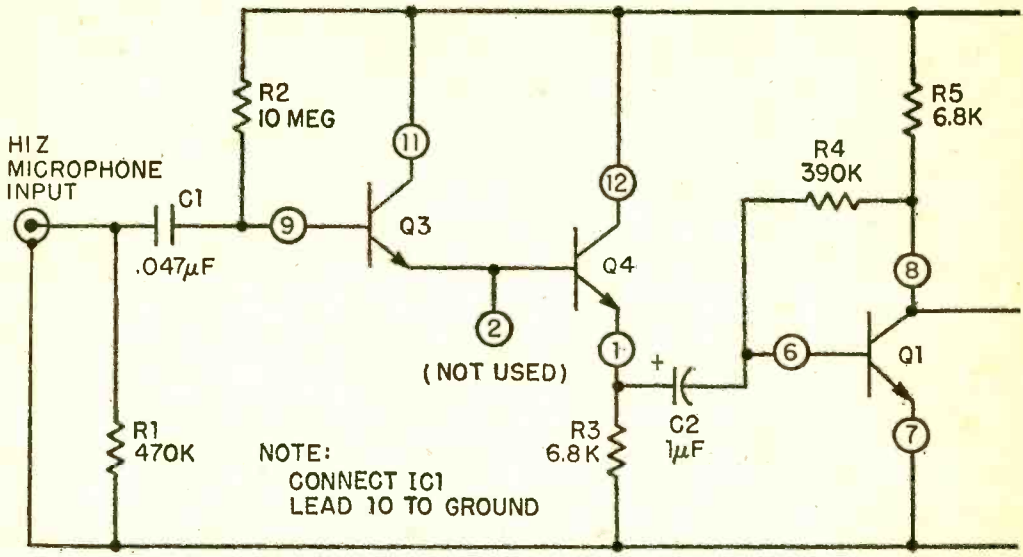
With a parabolic mike offering sonic and electronic amplification you're in tune with Helix Aspera to Yellow-bellied Sapsuckers!

Englishman George Riley lives in Kent, works in London and goes home to an unusual hobby.

"It all started about a couple of years ago when I borrowed a friend's parabolic directional microphone dish. This type of equipment is hyper-sensitive and can be pinpointed to record a sound without external noise interference. I was using it to record the sound of crickets when I suddenly heard a strange 'slurping crunching' sound. This turned out to be a large snail making the most of some hard grass. From then on I was hooked," says George.

Experts such as zoologist Donald J. Borror have used the parabolic microphone technique to produce 33⅓ rpm records that sonically illustrate ornithology books and booklets.*

After stumbling over a couple of radar antenna dishes a few years ago, I finally decided to put one of them to work. Since I was no microwave expert I decided to try an acoustic application. After all, I reasoned, a parabolic dish is a parabolic dish whether it is used for reflecting and focusing microwaves or sound waves. The result is the parabolic microphone described in this article.



PARTS LIST FOR A PARABOLIC MICROPHONE

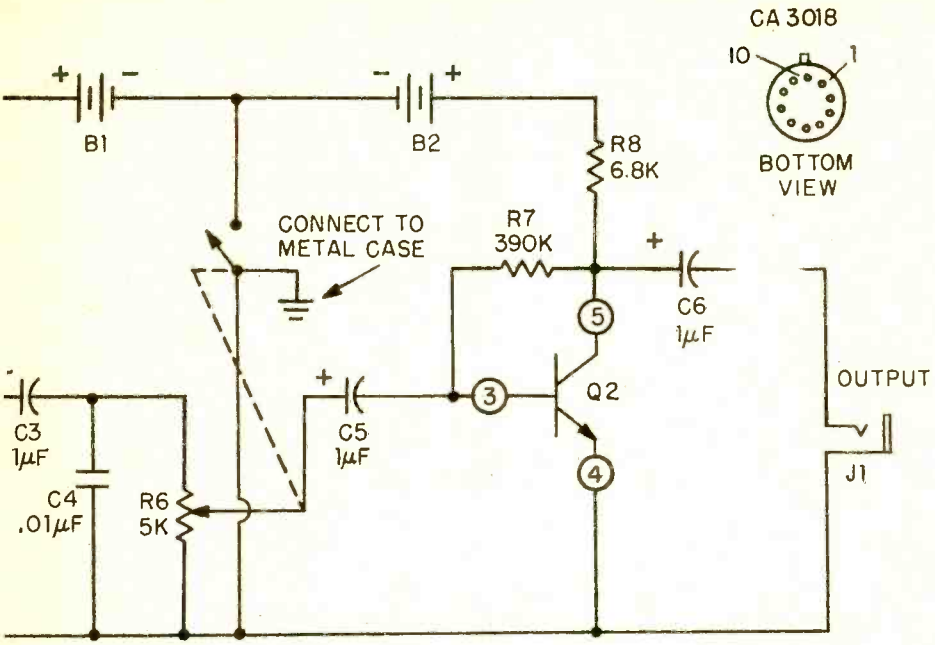
B1, B2—9-volt battery, 2U6-type (Radio Shack 23-464 or equiv.)
C1—0.047 μF disc or tubular capacitor (Radio Shack 272-1052 or equiv.)
C2 C3, C5, C6—1 μF capacitor, electrolytic (observe polarity) or tubular, 35 volts or better (Radio Shack 272-1055 or equiv.)
C4—0.01 μF capacitor, ceramic disc (Radio Shack 272-131 or equiv.)
IC1—3018 integrated circuit (RCA CA3018) Available from Circuit Specialists Co., Box 3047, Scottsdale, AZ 85257; $2.00 postpaid.
R1—470,000-ohm, ¼-watt resistor (Radio Shack 271-1800 or equiv.)

If you want to go all out for added gain, look over the surplus dealers' list for an 18 inch or larger aluminum model. As nearly as I can tell with the test equipment available, the 18-inch reflector adds about 10 dB gain to the microphone.

The other end of George Riley as he searches for optimum mike placement to record feeding snails. Cassette recorder also drives earphones for real-time monitoring.

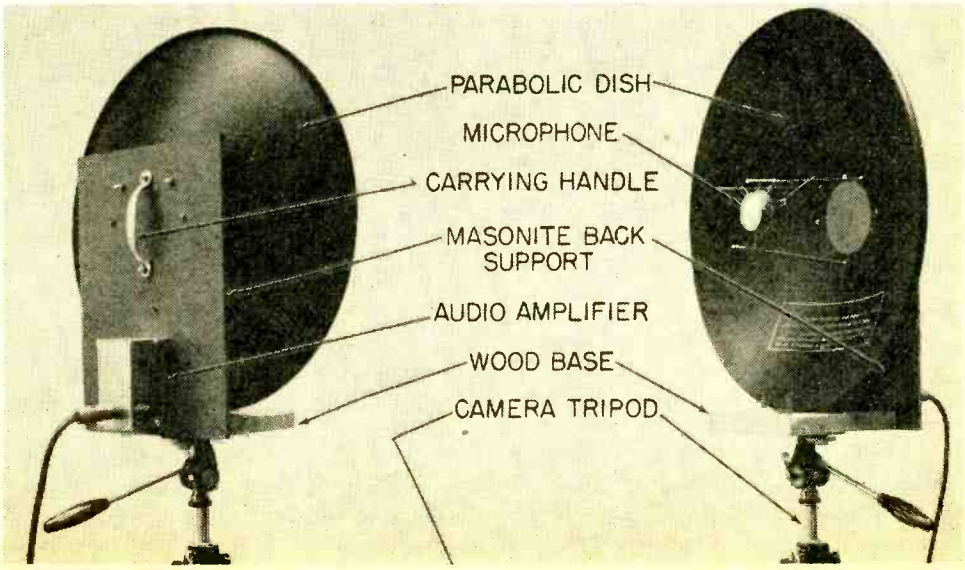
Suspend the microphone you use from rubber bands that extend to the support rods. Or, a clamp wrapped in foam packing material holds Riley's microphone securely.

Construction. It's simple enough as reference to the photos will reveal. The mount for the dish is made of wood and masonite. The dish is held in place by three threaded rods which also serve as the microphone support. Almost any kind of rod material will do, as long as it is or can be threaded. I happened to have some odd pieces of 9-gauge aluminum clothesline which threaded easily with a 10-32 die. Make the rod length about 7½ inches to allow sufficient leeway



R2—10-megohm, ½-watt resistor (Radio Shack 271-000 or equiv.)
R3, R5, R8—6800-ohm, ¼-watt resistor (Radio Shack 271-1800 or equiv.)
R4, R7—390,000-ohm, ¼-watt resistor (Radio Shack 271-1800 or equiv.)
R6—5,000-ohm potentiometer, audio taper, with spst switch (Radio Shack 271-1725 or equiv.)
Misc.—Aluminum case (Radio Shack 270-231), 2 x 4-in. perf board. plugs, jacks, hardware, push-in terminals, microphone (high impedance crystal, see text, or hand-held type such as Radio Shack 33-907) wire, solder, etc.

Note: The ETCO catalog lists a "government surplus" aluminum parabolic reflector on page 36. ETCO Electronics, 464 McGill Street, Montreal 125, Canada.

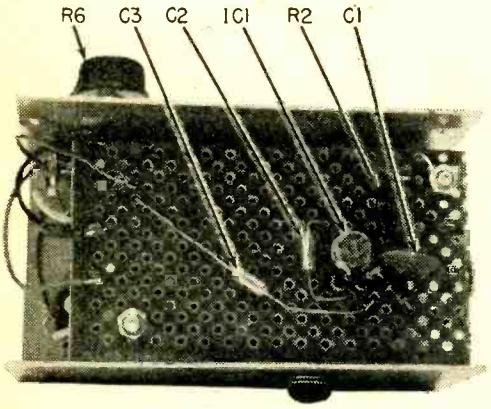


for adjusting the microphone for optimum focus. A small bracket or block may be added where the dish touches the wooden base to add rigidity, and a hole in the center of the base will make it convenient to mount the whole assembly on a camera tripod.

Any low priced ceramic or crystal microphone cartridge will work well with this reflector. The one shown in the photograph happens to be out of a pre-WW II hearing aid!

Mount the microphone cartridge on the rods with rubber bands. The exact method of attaching the rubber bands to the microphone cartridge is left to the ingenuity of the builder, since this will largely depend upon the physical configuration of the microphone.

Next route a 16-inch piece of shielded microphone cable from the microphone



Place components above and below the raised perf board. High impedance circuit makes it necessary to shield the amp in a metal box.

along one of the rods, through the dish (but inside the back plate), and terminate the cable in a phono plug. The cable should have sufficient slack so it may be easily plugged into the amplifier box. Also, be sure to allow sufficient lead slack at the microphone end of the cable so that the shock mount effect of the rubber bands is not nullified. This will complete the microphone reflector assembly, which should be set aside until the amplifier is built.

Electronics. The amplifier is a three stage affair using an RCA CA 3018 integrated circuit. Transistors Q3 and Q4 are used as a Darlington pair in an emitter-follower circuit in the first stage. This provides the necessary high input impedance required by the crystal microphone. The two following stages utilize Q1 and Q2 respectively as conventional common emitter amplifiers. The average gain per stage is about 38 dB.

Capacitor C4 across audio gain control R6 provides a 3 dB roll-off at 15 kHz, thus limiting amplifier frequency response to the desired audio range. In addition to limiting the frequency response, this capacitor also reduces the tendency of the amplifier to oscillate at higher frequencies, which could result in instability and low output. The 3 dB point at the low frequency end is about 70 Hz, sufficient for this application.

Two 9-volt transistor batteries are used to power the amplifier; not because of high current drain but, rather, to avoid common coupling between the output stage and earlier stages of the amplifier. An RC decoupling network could, of course, be used instead of two batteries, but it was found that oscillation would occur in spite of the decoupling network after the batteries had been in service for awhile. Two batteries absolutely guarantee against amplifier instability during the useful life of the batteries. The total current drain of the amplifier, by the way, is only 1.5 mA.

No trouble should be experienced with the amplifier if the original layout is followed. All amplifier components are mounted and wired on the perf board as shown. The volume control, capacitor C4, and the earphone jack are mounted on the part of the minibox that serves as a cover and battery holder. All connecting wires are soldered to push-in terminals on the perf board, and the perf board is mounted above the batteries with small bolts and spacers. After assembly, connect the microphone to the amplifier input with a short piece of cable.

Check Out. When testing the amplifier on the bench, either have the microphone connected to the input terminals or substitute a half-megohm resistor for the microphone input. If you have a hum problem it is probably caused by nearby AC wiring. (I had to turn off power to the workbench

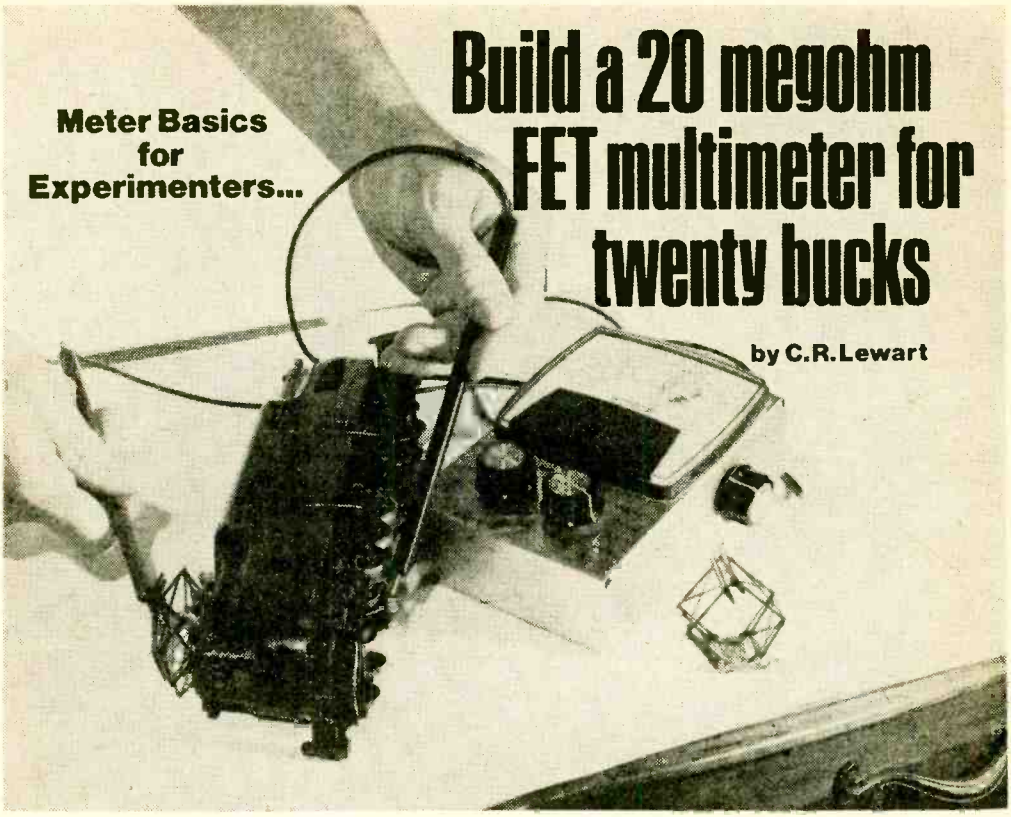
(Continued on page 101)

*Common Bird Songs, the title of a boolket and record by Borror, is available from Dover Publications, 180 Varick Street. New York 10014 for $3.50 postpaid; order number 21829-5. It provides songs of sixty species such as the Robin, Cardinal, Bluejay, Bobolink, and Tufted Titmouse!

Meter Basics for Experimenters...

Build a 20 megohm FET multimeter for twenty bucks

by C.R. Lewart



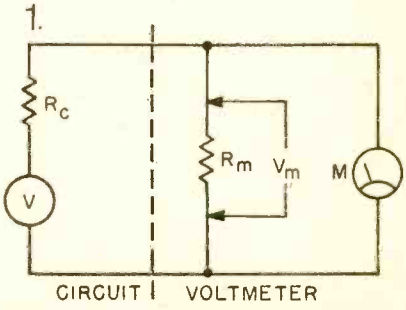
Discover valuable multimeter theory while you build this useful shop tool!

☐ THIS PROJECT IS A MODERN VERSION OF the VTVM of yesteryear—a battery operated field effect transistor volt-ohm meter with a very high (20 megohm) input resistance on all ranges. The cost of this project should be around $20—about what you can spend on a run-of-the-mill volt-ohm meter. Accuracy of this experimenter's meter may not be as great, however, since costs have been kept low by specifying 5 and 10 percent resistors.

A meter like the one shown can be built with features such as high input resistance on all ranges, polarity reversal switch, protection against meter over-voltage on all ranges, long battery life, and 1 percent resistors in the range divider for greater accuracy. Plus, this meter has been designed for up to ten voltage and four resistance ranges, but it can be built with fewer ranges and only one function (voltage or resistance measurements) if you wish.

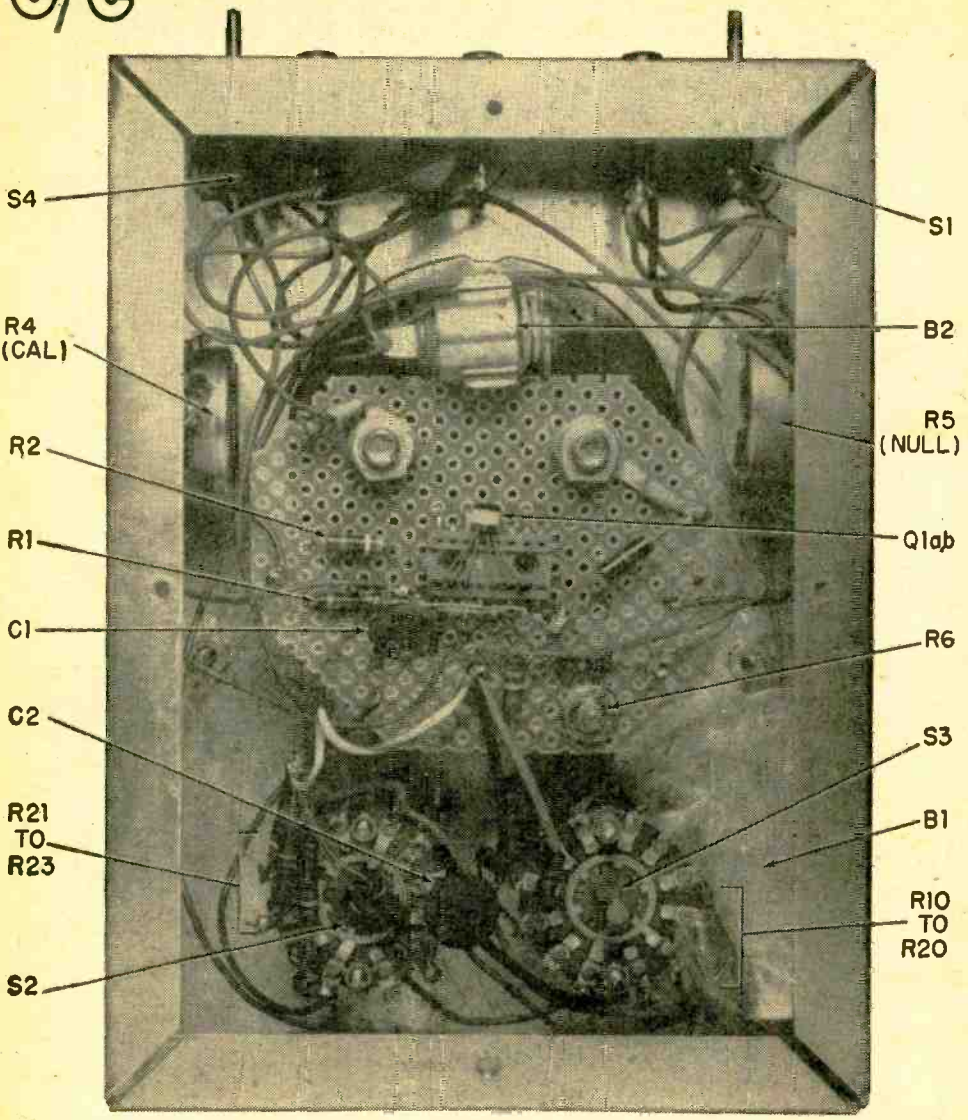
What Is Meter Resistance? No matter what circuit you are measuring, figure 1 describes what you are doing.

There is a voltage (V) which you are trying to determine. The resistance (R_C) of the circuit can be anything from a few tenths of an ohm (a fresh battery) to several megohms (the grid circuit of a tube). R_M is the resistance of the voltmeter. What you are actually measuring is V_M which can be very close or very far from V depending



This is what actually happens. Voltage "V" to be measured is divided across a series resistor set Rc and Rm. See text.

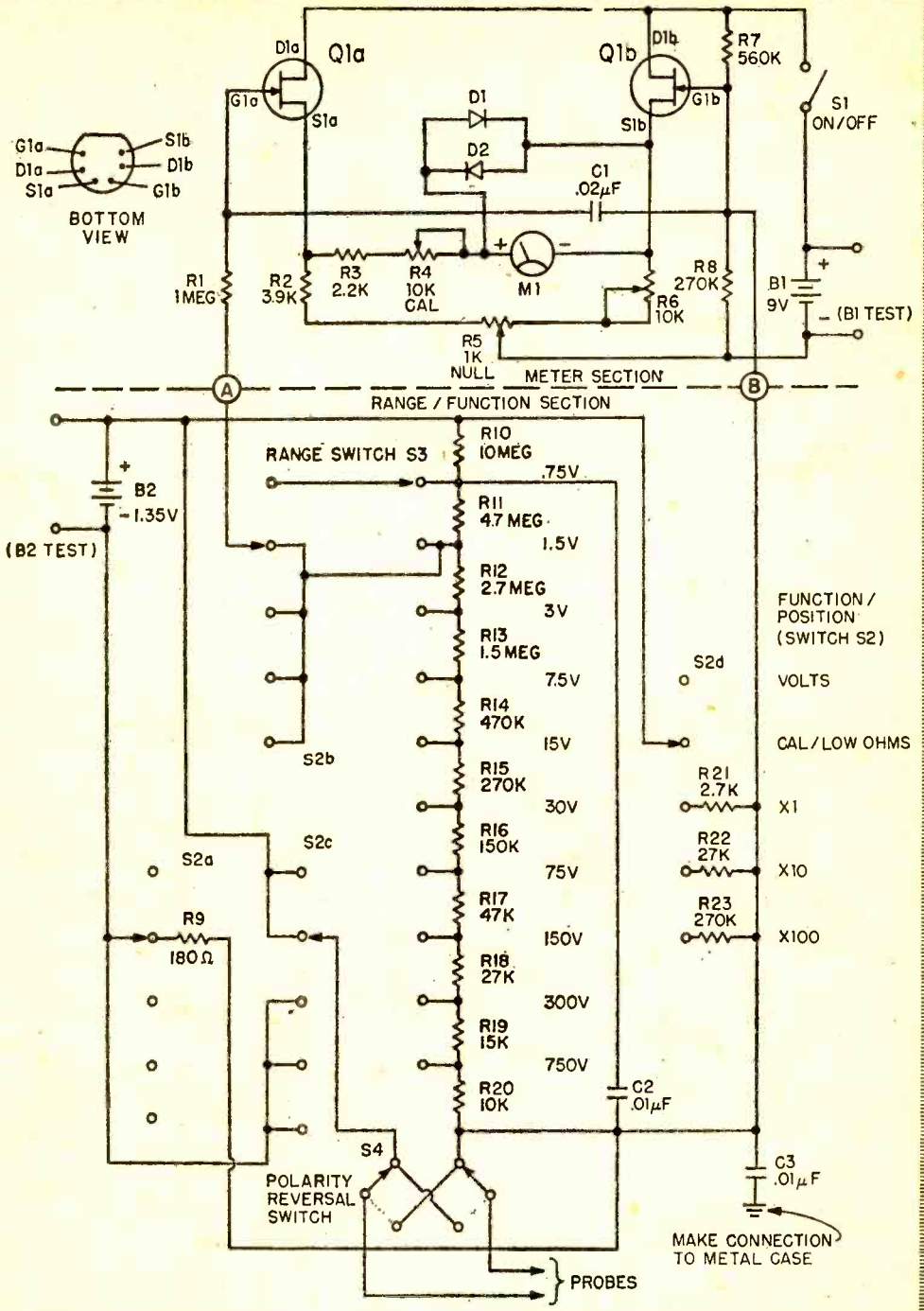
e/e FET MULTIMETER



PARTS LIST FOR A FET MULTIMETER

B1—9-volt battery, 2U6-type (Radio Shack 23-464 or equiv.)
B2—Mercury cell, Mallory RM640 or equiv. (Radio Shack 23-1515)
C1—0.02 μF capacitor, 100 VDC or better (Radio Shack 272-1056 or equiv.)
C2, C3—0.01 μF capacitor, 600 VDC or better (Allied Electronics 926-6895 or equiv.)
D1, D2—Silicon diode, general purpose type such as 1N914 (Radio Shack 276-1101 or equiv.)
M1—50 to 100 μA full scale meter (see text)
Q1a, Q1b—Dual FET (Calectro K4-636)
R1—1 meg, ½-watt resistor (Radio Shack 271-000 or equiv)
R2, R6—3900-ohm, ½-watt resistor
R3—2200-ohm, ½-watt resistor
R4—10,000-ohm potentiometer, linear taper (Radio Shack 271-1715 or equiv.)
R5—1000-ohm potentiometer, linear taper
R7—560,000-ohm, ½-watt resistor
R8, R15, R23—270,000-ohm, ½-watt resistor
R9—180-ohm, ½-watt resistor
R10—10 meg, ½-watt resistor
R11—4.7 meg, ½-watt resistor

Note: All ½-watt resistors can be Radio Shack 271-000 series; specify value when ordering under this number.

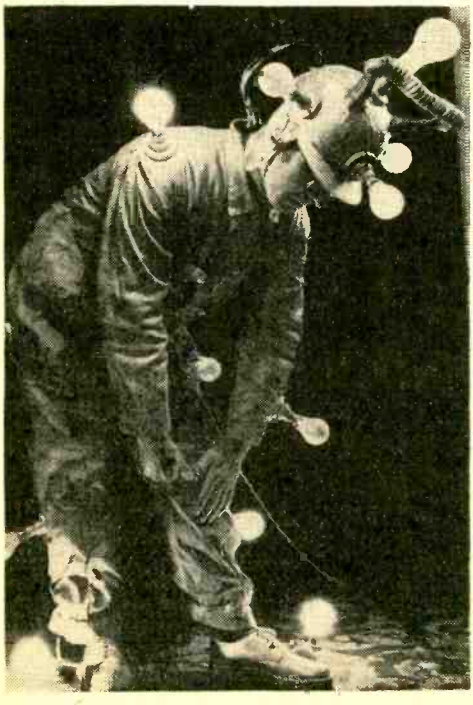


R12—2.7 meg, ½-watt resistor
R13—1.5 meg, ½-watt resistor
R14—470,000-ohm, ½-watt resistor
R16—150-ohm, ½-watt resistor
R17—47,000-ohm, ½-watt resistor
R18, R22—27,000-ohm, ½-watt resistor
R19—15,000-ohm, ½-watt resistor
R20—10,000-ohm, ½-watt resistor
R21—2700-ohm, ½-watt resistor
S1—Spst switch (Radio Shack 275-612 or equiv.)
S2—4-pole 6-position rotary switch (function) (Allied Electronics 747-2011 or equiv.)
S3—1-pole 11-position rotary switch (range) (Radio Shack 275-1385 or equiv.)
S4—Dpdt switch (Radio Shack 275-614 or equiv.)
Misc.—Probes, jacks, case, wire, solder, etc.

LIGHT MUSIC IS ELECTRI-FYING

by Janus Kodrum

Tom Platt gets rich on a night club act that would kill most men!



The Electric Martian, Tom Platt, checks out his aluminized suit before stepping on stage to shock his night club audience.

□ Tom Platt's nightclub act is really shocking—so much so that when he performs, electricians insist on his signing a waiver, relieving them of all responsibility!

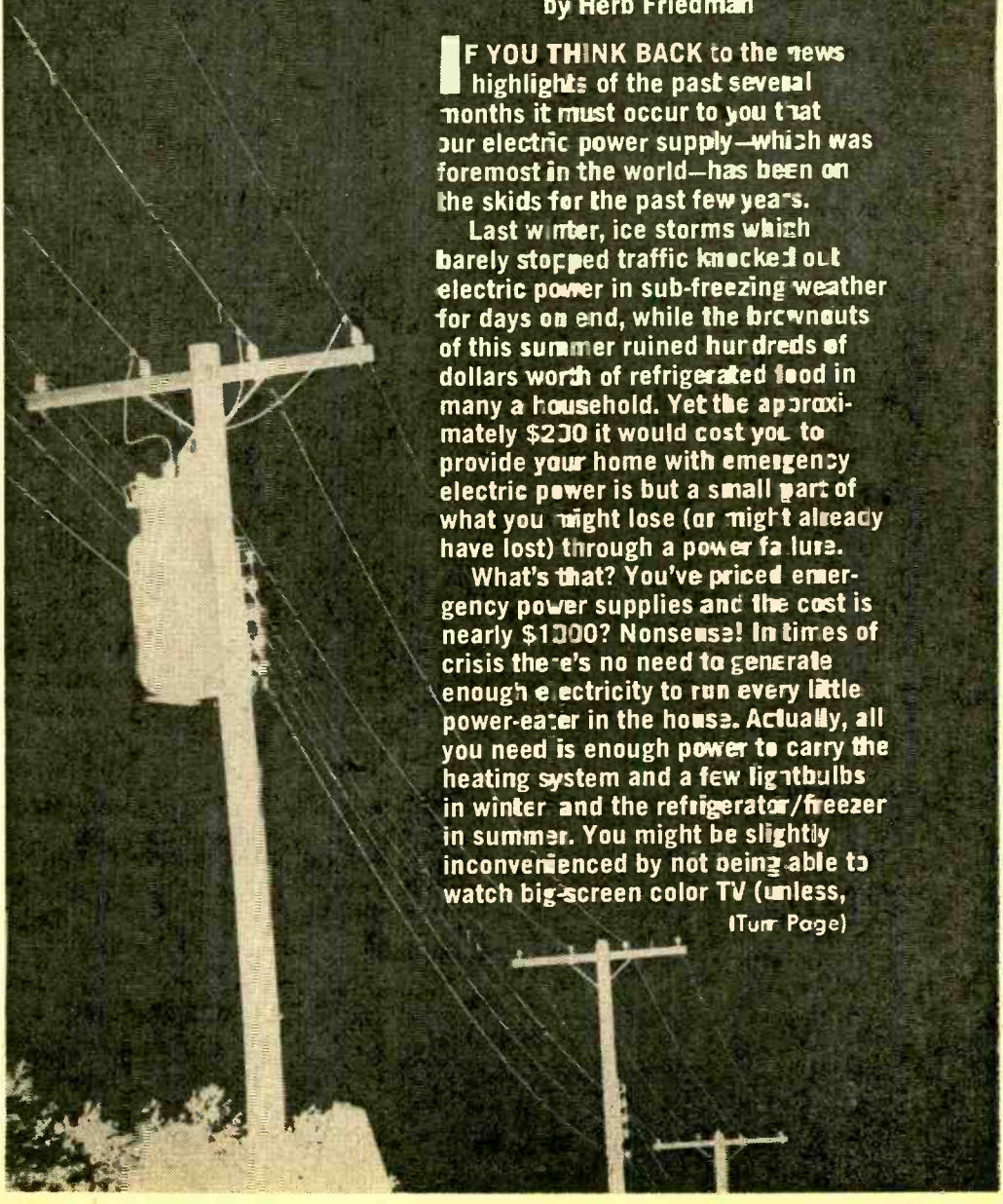
Years ago Tom Platt received a 5,000-volt electric shock while working as a shipyard electrician. This would have put most people off electricity for life—literally—but not Tom. He has developed one of the most original and mystifying nightclub acts ever seen. Tom plays the "spoons" electrically. When he performs his act, wearing a suit covered with electric light bulbs, it appears that 230 volts of lethal electricity pass through his body. When he plays a song the lights on his suit light up in time with the rattling of his spoons. As the spoons make and break the contact, the electricity surges through his body, and one can often see a wince of pain as the bulbs light up. (The Editors are sceptical about Tom's claims.)

Tom's act is made possible by a carefully-designed outer suit and apparatus designed to offer unusual illusions and at the same time protect Tom from self-destruction. The illusions and entertainment value of this nightclub act increase dramatically as alcohol consumption increases. ■

BLACKOUT
Generate Your Own Power

Be prepared with emergency power when you need it most!

by Herb Friedman



IF YOU THINK BACK to the news highlights of the past several months it must occur to you that our electric power supply—which was foremost in the world—has been on the skids for the past few years.

Last winter, ice storms which barely stopped traffic knocked out electric power in sub-freezing weather for days on end, while the brownouts of this summer ruined hundreds of dollars worth of refrigerated food in many a household. Yet the approximately $200 it would cost you to provide your home with emergency electric power is but a small part of what you might lose (or might already have lost) through a power failure.

What's that? You've priced emergency power supplies and the cost is nearly $1000? Nonsense! In times of crisis there's no need to generate enough electricity to run every little power-eater in the house. Actually, all you need is enough power to carry the heating system and a few lightbulbs in winter and the refrigerator/freezer in summer. You might be slightly inconvenienced by not being able to watch big-screen color TV (unless,

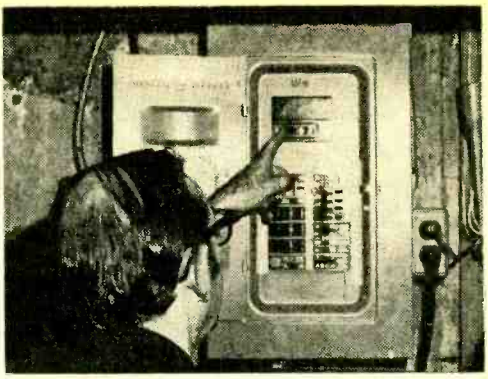
(Turn Page)

perhaps, it's all solid-state), but at least you'll have heat and wholesome food.

You get all this for about $200 worth of equipment plus a little common sense. You won't have an automatic start on the emergency generator, and you won't have automatic transfer of the power lines to the generator, but a trip out to the garage to start the generator is certainly better than sitting in a freezing home hoping the water pipes don't burst.

The key to successful low cost emergency power is the small portable electric generator like those sold by Sears, Penney's and local hardware dealers. These generators put out about 1200 watts, give or take a few hundred, and will run about 3 hours on one tank of gas—about 3/4 of a gallon. All have standard convenience power outlets, and some have built in overload fusing. A particularly attractive generator is the McCulloch Model H-1500, which puts out a legitimate 13 amperes, enough to run an oil-fired hot water heating system with circulator pump, a medium size tube-type TV and a few small lightbulbs (that's real comfort when everyone else is cold and in the dark).

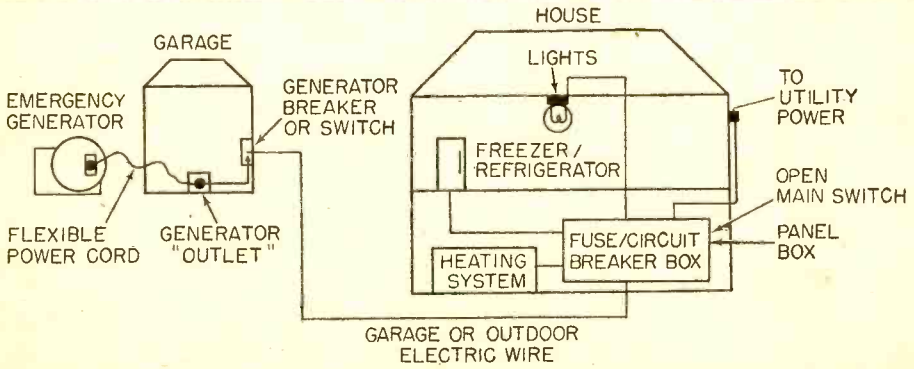
How Much Power? Make certain you get a generator with enough capacity to run the heating system or refrigerator/freezer. Here's how you do it. Let's say you have a hot water heating system. Each pump motor, the oil burner motor, and the ignition coil have a metal plate with the current requirements—either in amperes or VA (VA being the rated line voltage multiplied by the current). The heating system for the installation shown in this article pulled 4.1 amperes for two circulator pumps, 2.4 amperes for the oil burner motor and 0.3 amperes for the ignition coil, all adding up to 6.8 amperes. Allow approximately 25 percent additional capacity for the motor starting current, or 6.8 x 125% = 8.5 amperes (about 1020 watts). Subtract 8.5 amperes from the generator's rated capacity (say, 13 amperes) and you have the available power reserve for other equipment—4.5 amperes. You can safely use 75 percent of the reserve, or 4.5 x 75% = 3.37 amperes or, about 404 watts. These 404 watts can be used to power any non-motor appliance such as a small TV, electric lights, a radio, etc.



Important! You must use the master breaker or fuse block to isolate your generator and home from the power company. Don't forget!

As a general rule, if you are running just motor powered equipment such as a freezer/refrigerator, you can use 75 percent of the generator's rated capacity.

Setting Up. First step is to add a low-noise muffler to the gasoline motor because

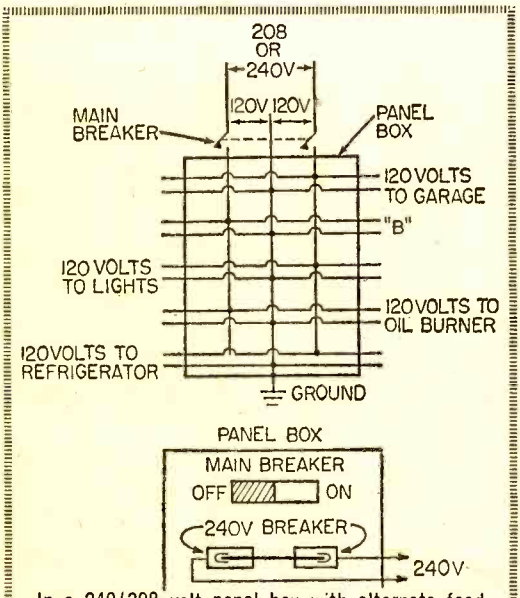


In most instances the existing house wiring will serve to carry the emergency generator's power to the required circuits. After the main power switch in the panel box is pulled to disconnect the house from the electric utility's power line, the generator's output can be fed directly into a garage outlet, from where it will flow to the panel box and then into the necessary circuits.

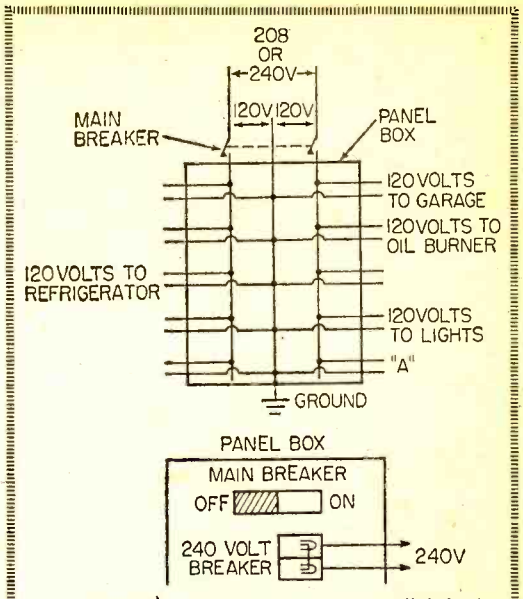
the original equipment muffler does virtually nothing towards reducing the generator's roar. Then, check out the generator with a voltmeter so you don't panic when the lights burn extra bright. You'll find that with no load, or a very light load such as a couple hundred watts (of lightbulbs), the generator's output voltage will read between 150 and 175 VAC. This is normal. The generator's unloaded output is usually considerably higher than under full load, and the generator's output is a sort of squared (flat topped) sine wave, which causes the voltmeter to indicate an erroneously high voltage.

Do not attempt to lower the output voltage by adjusting the generator's speed regulator (slowing the motor). Reducing the motor speed also reduces the frequency, which is factory-set to 60 Hz (or 50 Hz on special order).

When you're certain the generator is working properly you're ready to make the electrical connections. First, make certain your garage or outdoor electric outlet is on a separate circuit breaker (or fuse). If it isn't, install a separate breaker in the house.



In a 240/208 volt panel box with alternate feed on each side of the box every other circuit is the same side of the line. In this illustration the emergency power coming in from the garage will be fed to the oil burner, lighting and refrigerator/freezer. The circuit marked "B" will not receive power from the emergency generator. You can tell if your panel box is alternate feed by looking at a breaker which controls a 240 volt appliance. If both breakers (one for each side of the line) are on the same side of the box, as shown, the panel is alternate feed.



In a 240/208 volt panel box with parallel feed, the circuit breakers (or fuses) on the right side are all on one side of the power line while all circuits on the left side are on the other side of the power line. In this illustration the emergency power coming in from the garage would be fed to the oil burner and lighting, but not to the refrigerator/freezer. To feed the refrigerator it is necessary to move the wiring to the refrigerator to the other side, to the circuit marked "A". You can tell if your panel box is parallel feed by looking at the dual-breaker which controls a 240 volt appliance such as an electric stove or air conditioner. If the circuit has one breaker on each side of the box, as shown, the panel is most likely parallel feed.

If the generator does not have internal fusing, install a circuit breaker rated no higher than the generator's rated output between the orginal garage wiring and a new outlet, which will be used only for the generator. You can also substitute a fuse for the generator's circuit breaker. The generator's fuse and/or circuit breaker should be rated no higher than the current capacity of the garage or outdoor outlet wiring: for copper wire, 10 amperes for #16 wire, 15 amperes for #14 wire.

Make up a short connecting cord of flexible wire (#16) with *male plugs on both ends*. It's not the safest arrangement in the world but recessed male plugs aren't much safer, and they're hard to come by. This cord will be used to connect the generator's

(Continued on page 105)

Sylvania goes

TV reception simulated

one better.

We give you two TVs instead of one.

With Sylvania's Master TV Career Program you get not just one but *two* TV sets to build. Color *and* Black & White. Both Solid State.

With all Sylvania Career Programs you get our exclusive Autotext method of instruction, a modern, step-by-step approach to learning, which gets you through the basics of electronics quickly and easily.

An optional Cassette System, a technique that adds an extra dimension to learning. It's almost like having an instructor right in your own home. As you play the tapes, he'll guide you through your lessons, explaining as you read, going over schematics and reinforcing everything you learn!

Plus a choice of Programs that can lead to any number of career goals. In TV, communications, automation, digital and solid-state electronics. And in fields you haven't even dreamed of.

Plus specialized advanced training and carefully-engineered Project Kits for that "hands-on" training you need to make it in the world of electronics.

Throughout your training, Sylvania makes that extra effort to go one better.

Send the card or mail in coupon today for our FREE Catalog. And go with Sylvania.

SYLVANIA Technical Schools
Home Study Division 246-409-0
Sylvania Technical Systems, Inc.
909 Third Avenue
New York, N.Y. 10022

Please send me FREE illustrated career catalog. I understand that I am under no obligation.

Name _____

Address _____

City _____

State _____ Zip _____

Age _____

Veterans: Check here ☐

GTE SYLVANIA

cabinet optional

Between microphone and antenna

CB INSIDE TRANSMITTERS

by the Elementary Electronics Editorial Staff

☐ Unlike receivers, which can be essentially similar up to the detector in both the AM and SSB rigs, there's a world of difference between AM and SSB transmitters; except for the oscillator (the circuit that generates the crystal-controlled operating frequency) there's no similarity between the two.

Amplitude Modulation (AM) transmitters are the easiest to design, adjust, check, and service, for there is little that can go wrong. In fact, between the least expensive and most expensive CB transceivers there might be little, if any, difference in the transmitter circuits. Figure 1 shows the block diagram for a solid-state "single channel" transmitter—single channel meaning a transmitter with from one to five or perhaps eight channels. In these models the user adds channels by plugging in transmit and receive crystals for the desired channel coverage. The transmitter line-up usually consists of a crystal controlled oscillator, a buffer amplifier to prevent changes in the antenna circuit from reflecting back to the oscillator, and an RF power amplifier, which amplifies the miniscule RF drive from the oscillator to about 3 watts RF output. In some transmitters the buffer amplifier is eliminated and the oscillator feeds directly into the RF power amplifier, just as is done in tube-type transmitters.

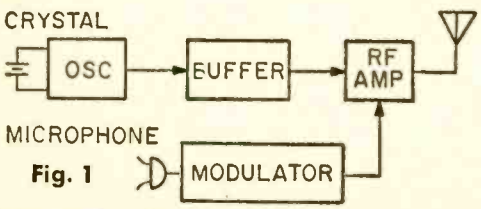


Fig. 1

This basic AM transmitter without crystal synthesizer is used in most 3 to 6 channel sets, although sometimes without a buffer.

High efficiency amplifiers, known as class "C" amplifiers, have efficiencies in the order of 80 percent, so if the DC power input to the RF amplifier is 5 watts (legal limit) the RF output will be about 4 watts or slightly less depending on the overall design parameters.

Final Amplifier Facts. In modern CB transceivers the RF amplifier feeds into a pi-network, bandpass, or low-pass filter before the signal is fed to the antenna. Any of these filters sharply attenuates the television-interference-producing harmonics caused by the distortion of class C amplifiers. In addition to the harmonic attenuation produced by the RF amplifier's filter, additional attenuation of TVI (television interference) is generally secured by placing a notch filter—tuned to the second harmonic of 27 MHz—at the transceiver's output jack.

In the days when the vacuum tube was king, virtually all CB transceivers had the RF amplifier tuning controls on the rear apron, accessible to the user for so-called "peaking" of the transmitter. Because solid-state devices are extremely critical in regard to tuning, virtually all modern CB transceivers now have factory adjusted transmitter tuning which is usually sealed, or located inside the cabinet. As a general rule, the factory tuning cannot be improved, and "tweaking" the transmitter tuning controls can easily result in destruction of the RF amplifier transistor!

The TVI filter is something else. Maximum attenuation of harmonic interference is generally attained when the filter is specifically adjusted for the particular transmission line and antenna used, so you'll usually find the TVI filter tuning available on the rear of the transceiver.

When the transmitter has full 23-channel coverage, a crystal synthesizer is almost universal, and the basic transmitter is very similar to the arrangement shown in Fig. 1. The major difference is the synthesizer, a device that "beats" the outputs from two or more oscillators so that something like half the required 46 crystals are needed for full 23-channel coverage for both the transmitter and receiver. In the most modern transmitters, fewer than 15 crystals are needed for full-23 coverage.

The problem with "beating" the outputs of two or more oscillators is that the resultant output contains the frequencies needed plus many which are not needed; these are known as *spurious* signals. If these spurious signals get through the transmitter to the antenna they will cause interference to other radio services. The spurious signals are eliminated by passing the output of the crystal synthesizer through a bandpass or tuned filter which allows only the desired

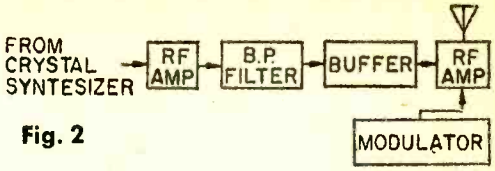


Fig. 2

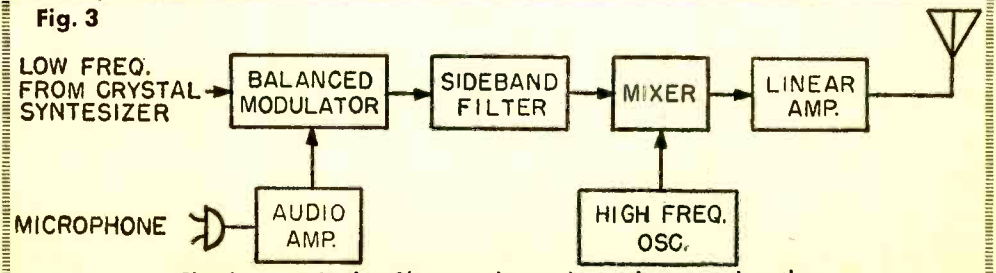
A filter in series with the RF path removes those spurious signals produced by crystal synthesizers. The filter can be the LC type.

27 MHz signals to pass on through to the RF amplifier. A typical synthesizer transmitter arrangement is shown in Fig. 2.

Single Sideband. SSB has no resemblance to AM transmitters other than it is a way to carry modulation to a distant point without the need for wires. SSB transmitters are highly complex, and would require so many different circuits that it would appear to be prohibitively expensive. Fortunately, as we'll show, a substantial part of the amplification required for SSB transmitters involves the same type of circuitry as needed for an SSB receiver; so that in CB transceivers, where both the receiver and transmitter are in the same cabinet, it is possible for both the receiver and transmitter to share one of the most complex and costly circuits, thus making the whole bit economically feasible.

There are several types of SSB transmitter design. One of the most popular and easiest to understand is the so-called filter SSB generator, for which a basic arrangement is shown in Fig. 3. A low frequency output from the crystal synthesizer is fed into a balanced modulator where it combines with the modulation from an audio amplifier. The balanced modulator's output consists of both modulation sidebands but virtually no carrier; the carrier is suppressed in the modulator. This RF signal is then passed through a highly selective IF amplifier which sharply

Fig. 3



Circuitry required to filter out the carrier and one, or the other, sideband is more costly but worth every penny in terms of improved communication capability. Sideband filter is usually the crystal type.

attenuates the undesired sideband. The IF amplifier might have a crystal or a mechanical filter; either type is adequate as long as the selectivity is such that only the desired sideband can pass through. In CB transceivers, the transmit IF amplifier is also used as the receiver IF amplifier; this is the reason why SSB transceivers have such high receiver adjacent channel rejection.

To Complete the Cycle. The output of the IF amplifier, which now consists of only one modulation sideband, is fed into a mixer where it beats with a signal from a crystal controlled high frequency oscillator. Of the many different frequencies appearing at the mixer's output, one is a CB frequency corresponding to a single modulated sideband. The other mixer output frequencies are attenuated by a balanced mixer design, or the mixer's output is passed through a 27 MHz bandpass filter. The mixer's 27-MHz signal is then fed to a *linear amplifier*, for we cannot use an ordinary class C amplifier which would distort the RF signal since that would also distort the modulation.

Linear amplifiers have an efficiency in the range of 50 to 70 percent. Though this is less than the nominal 80 percent efficiency of class C amplifiers used in AM transmitters, the modulated RF output of SSB is actually greater than the modulation energy of a class C AM output (explained in Part 1 of this series—E/E May/June 1974).

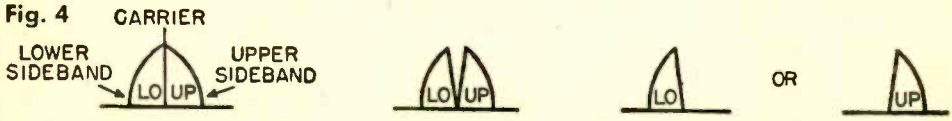
Since without modulation there is no RF output from the transmitter, power input to the final RF amplifier cannot be calculated by multiplying the applied DC voltage by the average DC current; the DC current varies with the modulation. As a general rule it is nearly impossible to measure the equivalent average DC power input of a linear amplifier because the test will usually result in destruction of the amplifying stage. Instead, SSB transmitters—because of their linear amplifier—are rated in p. e. p. meaning *peak envelope power*, which is the input that would be indicated by a voltmeter and a milliammeter *if* the amplifier were driven continuously by a single RF signal with a peak amplitude within the limits the amplifier could handle (with allowable limits of distortion). Now that's a real mouthful, but in short it means you'll probably blow the amplifier if you try it.

To Calculate SSB Power. Quite often, the differences in p.e.p. input power ratings between two or more CB SSB transmitters is more a question of how the manufacturer chose to calculate the value rather than any effective difference in RF power output. More than a numerical value supposedly representing power output, the important point to keep in mind about p. e. p. meter readings is that a meter, any meter, *cannot* represent anything about SSB p. e. p. other than to indicate that some energy is going into the amplifier or some energy is coming out.

Single sideband CB transceivers also feature the AM mode of operation, so a single unit can be used to communicate with *all* CB stations. AM is easily obtained in an SSB transceiver by simply re-introducing the carrier. As we said, the output of the balanced modulator consists of two sidebands and a suppressed carrier. By deliberately unbalancing the modulator the carrier is not cancelled, and the degree of carrier insertion can actually be controlled by design. Since the sideband filter following the balanced modulator has only suf-

(Continued on page 98)

Fig. 4



AM SIGNAL
CONSISTS OF BOTH UPPER AND LOWER SIDEBANDS WITH CARRIER

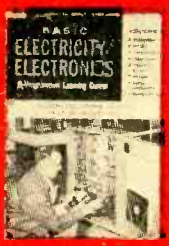
DSB SIGNAL
DOUBLE SIDEBAND SUPPRESSED CARRIER (OUTPUT OF BALANCED MODULATOR)

SSB SIGNAL
SINGLE SIDEBAND (OUTPUT OF SIDEBAND FILTER AND TRANSMITTER)

In the process of removing the carrier signal in SSB transceivers, an insignificant part of the sidebands are sacrificed as depicted by the V-shaped gap in the double sideband signal representation, above.

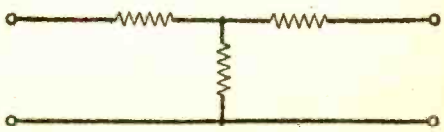
e/e's

ALL NEW BASIC COURSE in ELECTRICITY & ELECTRONICS



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

RESISTORS IN COMBINATION



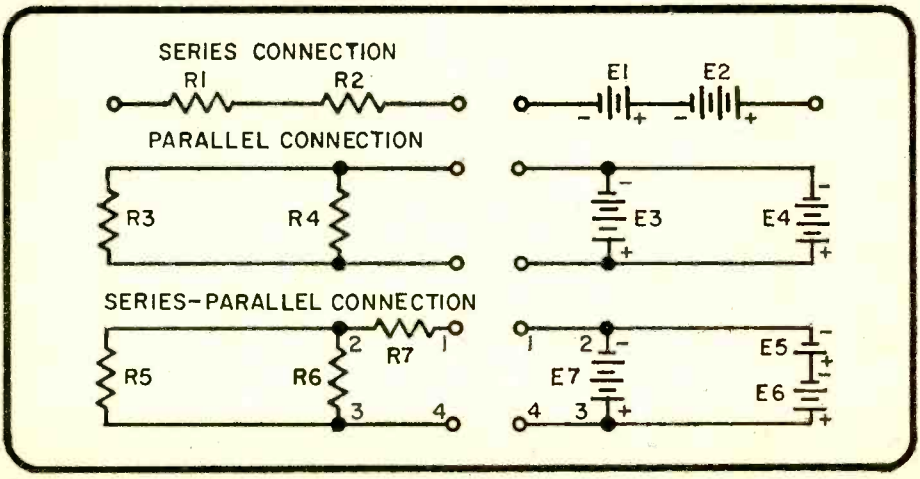
What you will learn. In this course you will learn the three basic ways resistors are connected together in electronic and electrical circuits. You will become familiar with the way voltage and current are distributed around series, parallel, and series-parallel resistance circuits. Important things you should know to measure voltages and currents in a resistance circuit are discussed along with techniques showing how you can determine the equivalent resistance of a complex circuit.

RESISTOR CONNECTIONS AND CIRCUITS

There are only three different ways in which electrical or electronic parts may be connected—*series, parallel,* and *series-parallel.*

The illustration shows the three different connections and also the accepted method for labeling components. R stands for resistor; E designates a voltage source. Numbers are used with the letters to identify a specific component.

THREE BASIC CIRCUIT CONNECTIONS



Series Connection

The first figure in the illustration shows components in series. A terminal of one component is connected to a terminal of the other. Since they are connected together in a line, R_1 is in series with R_2. Voltage sources may also be series-connected. E_1 is in series with E_2.

Parallel Connection

The second figure shows components connected in parallel. Each terminal of one component is connected to a terminal of the other. The connections are called *common terminal points.* R_3 is in parallel with R_4; E_3 is in parallel with E_4. In parallel, one component is connected *across* the other.

Series-Parallel Connection

As the third figure shows, series and parallel connections are combined to form a series-parallel arrangement. Two different combinations are illustrated. R_7 is in series with the parallel combination of R_5 and R_6. E_7 is in parallel with the series combination of E_5 and E_6.

Circuit Tracing

The method of determining the manner in which parts are connected within a circuit is called circuit tracing. Visualize how current would flow as you follow its path.

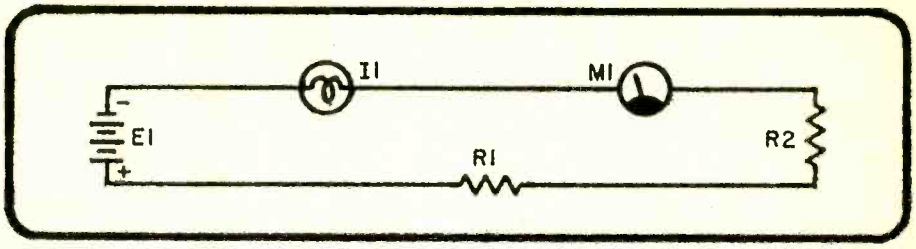
In the first figure, the same current that flows through R_1 must also flow through R_2. Current supplied by E_2 must flow through E_1 and add to the current generated by E_1. In the second figure, current is traced to one of the common terminal points. Here it must divide and flow through each leg, the name given to a parallel circuit path. Some of the current flows through R_3 and the rest through R_4, both currents joining again at the other terminal. Current from the E_3 and E_4 legs unite at one terminal and separate upon returning to the other terminal.

SERIES CIRCUITS

If all the components in a circuit are connected one after the other, it is called a *series circuit.* By circuit tracing, you can determine that in the circuit shown, the same current

that leaves E_1 flows through the lamp, the ammeter, R_2, R_1, and returns to E_1 again. Therefore, the circuit must be a series type.

MULTI-ELEMENT SERIES CIRCUIT



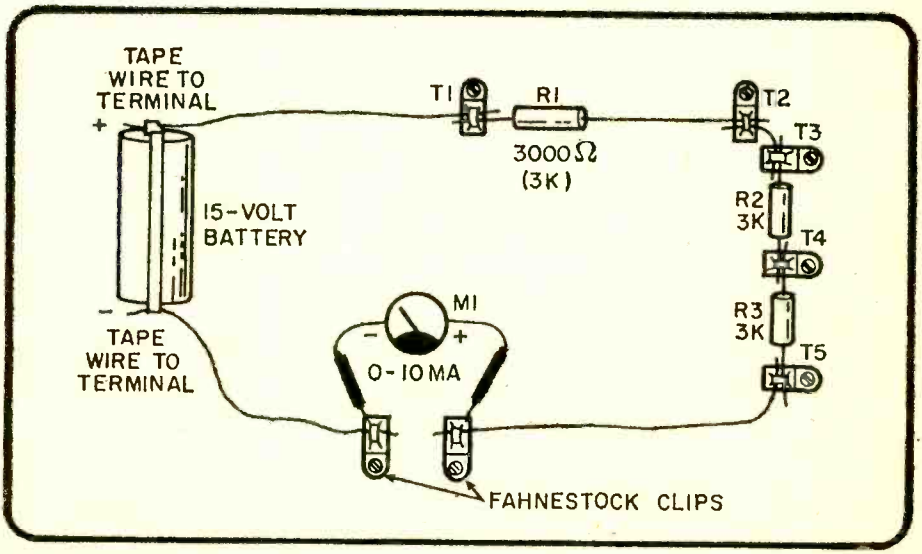
Current in a Series Circuit

It can be proved that the value of current remains the same in all parts of a series circuit by constructing the circuit shown in the next illustration. Fahnestock clips are used as terminal connections.

If the current is measured by connecting the ammeter as shown, the reading should be between 1.6 and 1.7 milliamps. This is the value of the current entering terminal 5.

Connecting the ammeter in series with the two resistors at terminal 4, another reading may be taken. Remember, an ammeter must *always be in series* with the circuit in which current is being measured. In this case, T4 is disconnected and each resistor terminal reconnected to one of the ammeter clips. The same results will be obtained at terminals T3, T2, and T1.

PICTORIAL OF A SERIES CIRCUIT



Resistance in a Series Circuit

Total resistance in a series circuit is equal to the *sum of the resistance* of its parts.

This is logical, because the total resistance in the circuit determines the amount of current allowed to flow with a given voltage source. Therefore, to find the total resistance in a circuit, add the values of the individual resistances.

In the circuit shown, the resistances are 3000 ohms each. Their sum is 9000 ohms. The ammeter also adds resistance in series. But since this resistance is normally less than 1 ohm, it adds so very little to the total that it can be disregarded.

QUESTIONS

Q1. In a series circuit, all of the parts are connected in - - - - - - .

Q2. R_1 and R_2 are connected in series. Their values are 3000 ohms and 1500 ohms, respectively. If current through R_1 is 2 milliamps, what is the value of current flowing through R_2?

Q3. Draw a schematic of the three resistors as they are connected in the above diagram. Show how an ohmmeter would be connected to read total re-resistance of the three.

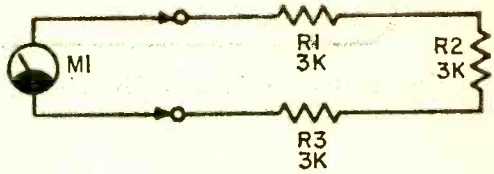
Q4. If the ohmmeter measures 9000 ohms, how much current will flow if the three resistances are connected across a 15-volt battery?

ANSWERS

A1. In a series circuit, all of the parts are connected in series.

A2. Current through R_2 is also 2 milliamps. (Current through all parts of a series circuit is the same).

A3.



A4. Current $= \frac{\text{voltage applied}}{\text{total resistance}} = \frac{9000}{15}$
$= 0.00167$ amp
(1.67 milliamps)

Voltage Distribution in a Series Circuit

The voltage of a source is distributed *across and within* any load connected to it. Though this is a simple statement, the concept is often misunderstood.

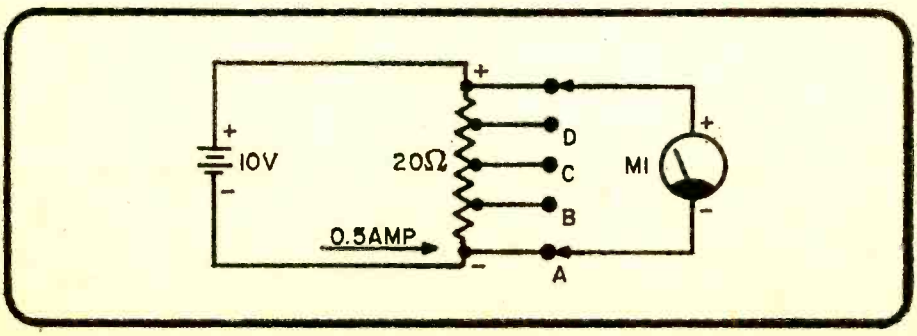
If a 20-ohm resistor is connected across a 10-volt source, as shown in the illustration, a voltmeter reading across the resistor will be 10 volts. This means that the voltage of the source is not only applied *across* the load, but it also exists *within* it.

The *taps* (connections) shown are equal distances apart. If the lower test probe is moved to tap B, the voltmeter will be across ¾ of the resistor. And ¾ of the total voltage is 7.5 volts. Half the resistance (between C and E) will result in a measurement of 5 volts. From D to E is ¼ of the resistance and ¼ of the voltage, or 2.5 volts.

Can voltage distribution be estimated without making the measurements? Yes, and the reason is based on the familiar relationship that exists between voltage, current, and resistance:

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}} \text{ or } I = \frac{E}{R}$$

SERIES CIRCUIT VOLTAGE DISTRIBUTION



If you do not know the value of voltage applied across a resistance of 20 ohms, but you do know the current through it is 0.5 amperes, how would you determine the voltage? You can find the value of voltage by reasoning that E/R must be a ratio that equals ½. Since R is 20,

E would have to be 10 volts. Or you can restate the relationship to read E = IR, meaning current multiplied by resistance. To prove that it is the same equality, ½ amp times 20 ohms does equal 10 volts.

Voltage developed across a resistance is termed an *IR drop*, or, substituting E for IR, it may be called a *voltage drop*. This does not indicate voltage has been lost. Instead, it identifies the amount of voltage existing between two points of a resistance when current is flowing.

The IR (or voltage) drop between points A and E in the illustration is 10 volts. IR equals 10 volts. What is the voltage (IR drop) between taps A and B? I is still 0.5 amp, but the value of R is different. It is ¼ of the total resistance or 5 ohms. Therefore, E = IR = 0.5 × 5 = 2.5 volts.

QUESTIONS

Q5. What is the value of voltage between taps A and C?

Q6. What is the voltage drop between taps B and E?

Q7. What is the IR drop between taps B and D?

Q8. The sum of the resistances in a series circuit is equal to the total ---------- of the load.

Q9. The sum of the ------- ----- in a series circuit is equal to the total voltage across the load.

ANSWERS

A5. 5 volts between taps A and C.

A6. 7.5 volts between taps B and E.

A7. 5 volts between taps B and D.

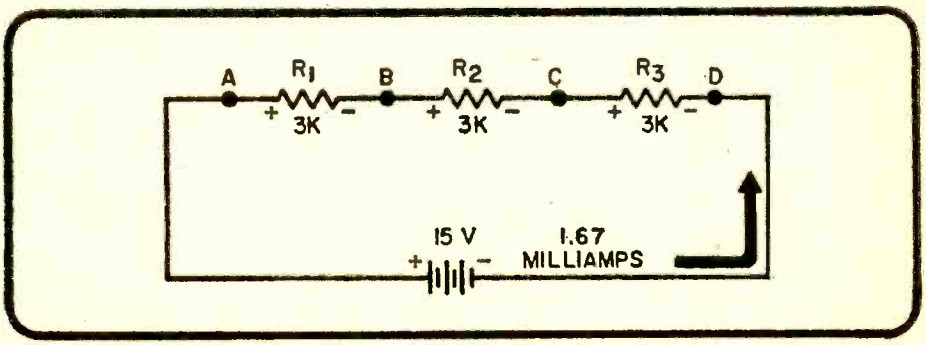
A8. The sum of the resistances in a series circuit is equal to the total resistance of the load.

A9. The sum of the voltage drops in a series circuit is equal to the total voltage across the load.

Example of Series Circuit Voltage

The schematic for three 3,000 ohm resistors and a 15-volt battery circuit can be drawn to look like the figure.

SERIES CIRCUIT SCHEMATIC



Voltage distribution principles are the same for this circuit as they were for the tapped resistor. Since the load contains three resistors of equal value, the voltage drop across each will be ⅓ of the source of voltage, or 5 volts. To prove this, multiply the resistance of one of the resistors times the current in the circuit to give the voltage. This voltage will not be exactly 5 volts because 1.67 milliamps was rounded off to the next highest whole number. If you make the measurements with a voltmeter, you will find the distribution principle correct by a reading of 5 volts.

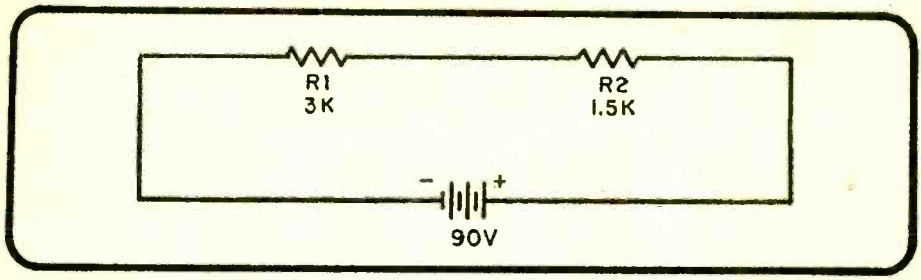
Note that each resistance is marked with polarity signs (minus and plus). The voltage across the resistor is just as real as that of the voltage source and, if the voltage is DC, the resistor has negative and positive terminals. When taking voltmeter readings, resistor polarity must be known. Circuit tracing is the best way to determine the polarity. The terminal that current enters is minus, and the one from which it leaves is plus.

Try the same reasoning on a series circuit containing resistors of unequal value.

R_1 is twice the value of R_2 in the above circuit. Both are in series across 90 volts. How

do you find the voltage drop across each resistor?

UNEQUAL RESISTORS IN SERIES



This can be done by either of the two methods discussed—determining proportional distribution across each resistor, or by using E = IR. By the proportion method it is necessary to determine what ratio (or fraction) one resistance is of the total.

$$\frac{R_1}{R\ (total)} = \frac{3{,}000}{4{,}500} = \frac{2}{3}$$

Two-thirds of 90 volts is 60 volts. So the drop across R_1 is 60 volts and across R_2, 30 volts. By the IR method, current must be determined first.

$$I = \frac{E\ (total)}{R\ (total)} = \frac{90}{4{,}500} = 0.02\ amp$$

Then, by using the IR relationship:

$$E = I \times R_2 = 0.02 \times 1{,}500 = 30\ volts$$

Since the two methods are based on the same voltage distribution principle, either method provides the correct answer.

QUESTIONS

Q10. The (left, right) end of R_1 is negative.

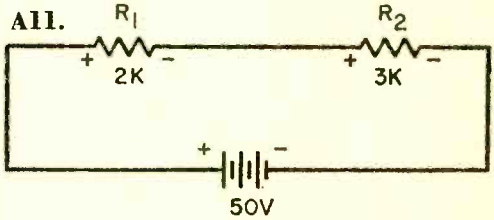
Q11. Draw a schematic of two resistances in series and supplied by 50 volts DC. R_1 is 2K and R_2 is 3K. Show all polarity marks.

Q12. What is the voltage drop across R_1?

ANSWERS

A10. The right end of R_1 is negative.

A11.



A12. Voltage across R_1 is 20 volts.

PARALLEL CIRCUITS

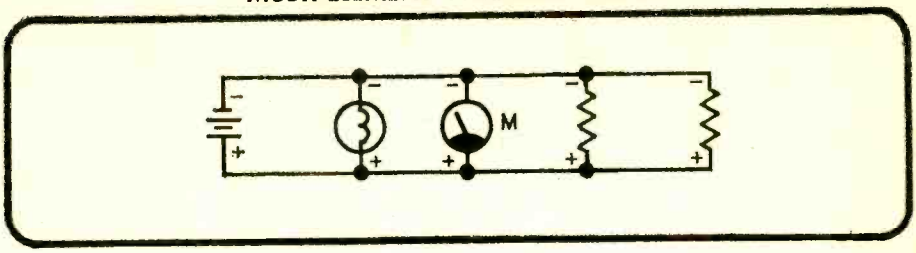
If all the components are connected across each other, the circuit is a *parallel circuit*. In the example shown, the components are all connected to the same terminal (a wire in this case) and are therefore in parallel.

Polarity across each component is determined by circuit tracing. The terminal that current enters is negative.

Voltage Distribution in a Parallel Circuit

Each component (the lamp, the voltmeter, and each resistor) is connected across the voltage source. Thus, the voltage drop across each part is the same value as the source. This is true even though the resistance of each component may be different.

MULTI-ELEMENT PARALLEL CIRCUIT

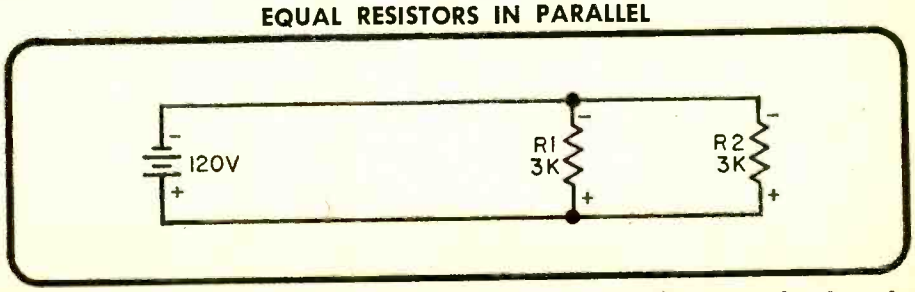


Current in a Parallel Circuit

Each component in a parallel circuit draws its own separate current. Each leg is connected directly to the voltage source, which means each leg can be considered as a separate circuit to determine its current.

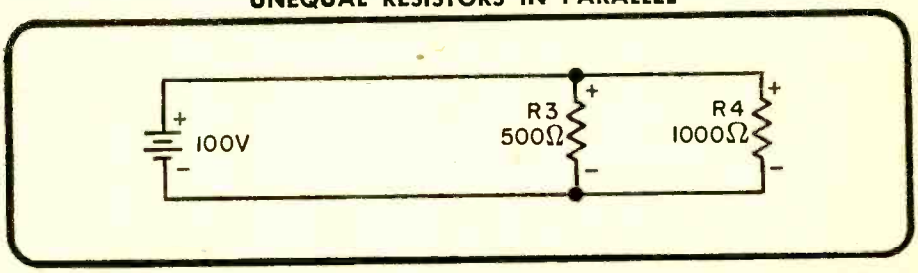
In the diagram, two equal resistors are shown as being in parallel across a single voltage source.

EQUAL RESISTORS IN PARALLEL



To find the current through R_1, divide the voltage across the resistor by the value of R_1. The result of this calculation is 0.04 amp. Since both resistances are equal and have the same voltage source, the current through R_2 must also be 0.04 amp. Both currents are supplied by the same voltage source, so the total current drawn must be 0.08 amp.

UNEQUAL RESISTORS IN PARALLEL



Using the same reasoning ($I = E/R$), it will be found that the current through R_3 in the above circuit is 0.2 amp. The current through R_4 is 0.1 amps. The total current is 0.3 amp.

QUESTIONS

Q13. In a parallel circuit, voltage across each leg is (the same as, different from) the voltage at the source.

Q14. In a series circuit, voltage across each resistor is (the same as, different from) the source voltage.

Q15. In a parallel circuit, total current is the (same as, sum of) currents in each leg.

ANSWERS

A13. In a parallel circuit, voltage across each leg is **the same as** the source.

A14. In a series circuit, voltage across each resistor is **different from** the source.

A15. In a parallel circuit, total current is **the sum of** currents in each leg.

Q16. In a series circuit, total current is the (same as, sum of) currents in each resistance.

A16. In a series circuit, total current is the same as currents in each resistance.

Q17. R_1 (20 ohms), R_2 (40 ohms), and R_3 (60 ohms) are in parallel across a 12-volt DC source. Draw the schematic.

A17.

Q18. Find the total current and the current in each leg.

A18. I in R_1 = 0.6 amp. I in R_2 = 0.3 amp. I in R_3 equals 0.2 amp. Total I = 1.1 amps.

Resistance in a Parallel Circuit

How would you find the total resistance in the parallel circuit you drew in A17 above?

At this point you have used two of the three arithmetic statements that express the relationship existing between voltage, current, and resistance. To find current:

$$I = \frac{E}{R}, \text{ or current} = \frac{\text{voltage}}{\text{resistance}}$$

To find voltage:

$$E = IR, \text{ or voltage} = \text{current} \times \text{resistance}$$

The third way the relationship can be stated is:

$$R = \frac{I}{E}, \text{ or resistance} = \frac{\text{voltage}}{\text{current}}$$

You know the total voltage across the circuit (12 volts), and you found the total current through the circuit (1.1 amps). What is the total resistance of the circuit? Using the resistance formula above, the answer is approximately 10.9 ohms.

As you suspected, total resistance is smaller than the smallest resistance in the parallel network. Total current is the sum of the parallel currents and is therefore an amount that can flow only if the total resistance is smaller than that in any of the legs.

Total resistance cannot be found by adding the values of the individual resistance. The sum would be a resistance much larger than any one of the resistances. This would mean the total current would be smaller than any of the leg currents. Obviously, such a solution cannot be correct. For those who like to work with numbers, total resistance can be obtained by adding reciprocals.

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \text{etc.}$$

The electrical wiring in your home consists of parallel circuits. This includes the ceiling fixtures, wall outlets, and whatever else is energized electrically. Each parallel circuit is fused. If you plug one too many appliances into a circuit, the fuse blows. You have just learned the reason why. You added one more resistive path that draws current. As a consequence, total current increased beyond the capacity of the fuse, and it performed its job.

Important Circuit Characteristics

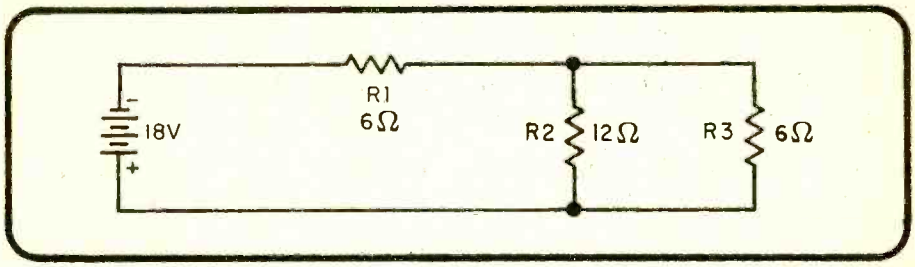
	Series Circuit	Parallel Circuit
Voltage	Divides across resistances	Same voltage across all resistances
Current Total	Same current through all resistances	Divides through each resistance
Total Resistance	Sum of all the individual resistances	Less than the smallest resistance

SERIES-PARALLEL CIRCUITS

A series-parallel circuit contains a combination of series- and parallel-connected components. The simplest example is the one shown.

The best way to work with a series-parallel circuit is to reduce all parallel combinations to an equivalent resistance. When this is done, the total current or the total resistance for the resulting series circuit can be readily found.

SIMPLE SERIES-PARALLEL CIRCUIT



In the example shown above, how would you find the total resistance? Think about it before you continue reading. Yes, you could do it with reciprocals, but there is another method that is more easily applied, even when the resistance values are difficult.

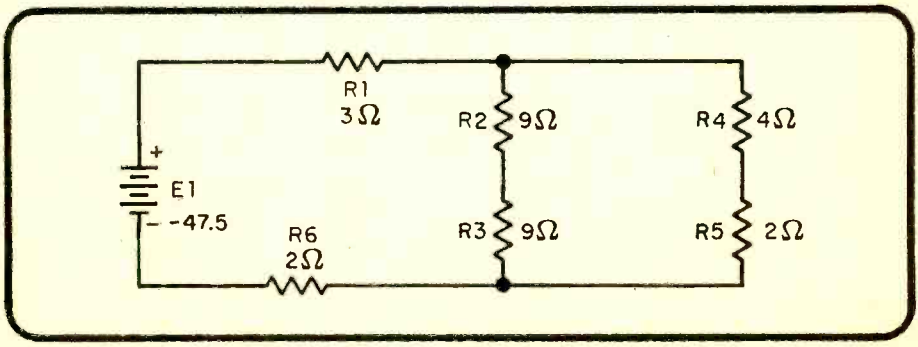
Cover all the circuit except for the parallel network. Apply a mythical voltage, the value of which is easily divisible by either resistance. Perform the $I = E/R$ division to find the mythical current flowing in each leg. Divide the sum of the currents into the mythical voltage to find the real total resistance. The following table uses three different voltages to show it will work with any assumed voltage.

Mythical Voltage	6 Volts	12 Volts	24 Volts
$I = E/R_2$ (12 ohms):	0.5 amp	1 amp	2 amps
$I = E/R_3$ (6 ohms):	1.0 amps	2 amps	4 amps
Total I is:	1.5 amps	3 amps	6 amps
$R = E/I$:	*4 ohms*	*4 ohms*	*4 ohms*

The total resistance (4 ohms) is the equivalent resistance of the parallel network. The 4 ohms is in series with 6 ohms for a total circuit resistance of 10 ohms (add resistances in a series circuit). The total circuit current (E/R) is 1.8 amps.

There are many different combinations of series-parallel circuits. One that is slightly more complex is shown. Some of the questions at the bottom of the page refer to this circuit.

COMPLEX SERIES-PARALLEL CIRCUIT



QUESTIONS

Q19. Current in the circuit flows through R_1 (before, after) it flows through the parallel network.

ANSWERS

A19. Current in the above circuit flows through R_1 after it flows through the parallel network.

Q20. Total series-parallel circuit resistance is readily solved by reducing parallel resistances to an equivalent ------ resistance.

A20. Total series-parallel circuit resistance is readily solved by reducing parallel resistances to an equivalent series resistance.

Q21. In a series circuit (voltage, current) divides among the resistances.

A21. In a series circuit voltage divides among the resistances.

Q22. In a parallel circuit (voltage, current) divides among the resistances.

A22. In a parallel circuit current divides among the resistances.

Q23. In a series circuit (voltage, current) is the same for all resistances.

A23. In a series circuit current is the same for all resistances.

Q24. In a parallel circuit (voltage, current) is the same for all resistances.

A24. In a parallel circuit voltage is the same for all resistances.

A Quick Review

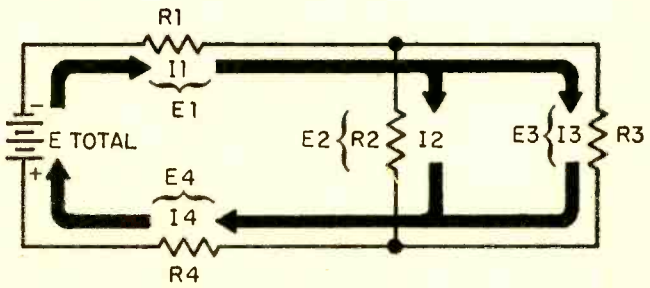
You have now accumulated quite a bit of experience working with the current-voltage-resistance relationship that exists in all DC circuits. This same relationship also holds true for any portion of a circuit.

You were guided very closely when solving for current, voltage, or resistance, so you may not recall or be aware of the care that must be tken in applying the three different arithmetic statements. For this reason, the necessary precautions are summarized.

1. The correct algebraic forms of the arithmetic statements are:

$$I = \frac{E}{R}, R = \frac{E}{I}, E = IR$$

2. When using any one of the three formulas, I must be expressed in amperes, E in volts, and R in ohms. When values appear with milli-, kilo-, mega-, or other prefixes, they must be converted to the basic units of amperes, volts, or ohms.
3. When using any one of the three formulas, values must be taken from that portion of the circuit on which you are working. Study this diagram for a few moments.



If you are solving for total current, you must use only the values that truly represent total voltage and total resistance. You cannot use E_1 (voltage across R_1) because it is *not* the *total* voltage. You cannot use the equivalent parallel resistance because it is *not* the *total* circuit resistance.

There is danger also in selecting incorrect values when seeking a solution for a portion of the circuit. If you are working with R_1, be sure the current you use is I_1 and the voltage is E_1 (volts *across* R_1).

Always label values to identify the circuit areas to which they belong (R_1, E_1, I_1, etc.).

OHM'S LAW

You probably have heard of or read about Ohm's law. Do you know what it is? Your answer should be yes. You have been working with it ($E = IR$; $I = E/R$; $R = E/I$) throughout this entire basic course!

QUESTION

A25. In the above circuit, E_2 is 6 volts and I_1 is 120 milliamps. What is the value of R_1?

ANSWER

A25. Your immediate answer should have been:
"There is not enough information available."

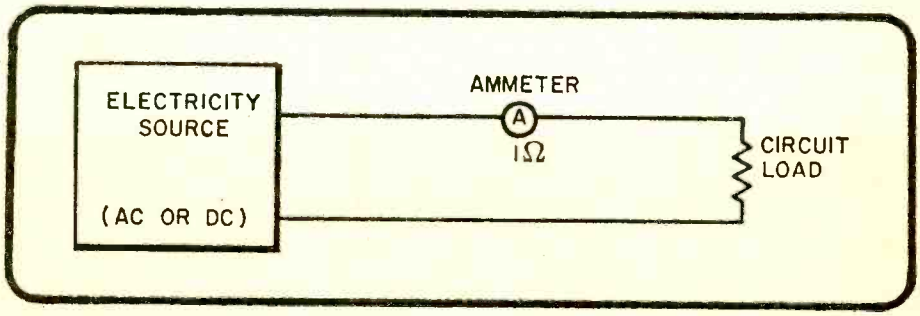
MEASURING WITH METERS

All meters have resistance between their terminals. When you connect a meter into or across a circuit, you add resistance to that circuit.

Ammeters

Ammeters are always connected in series with the circuit through which current is to be measured. As a result, the same current flows through the ammeter that flows through the circuit. The familiar connection is shown.

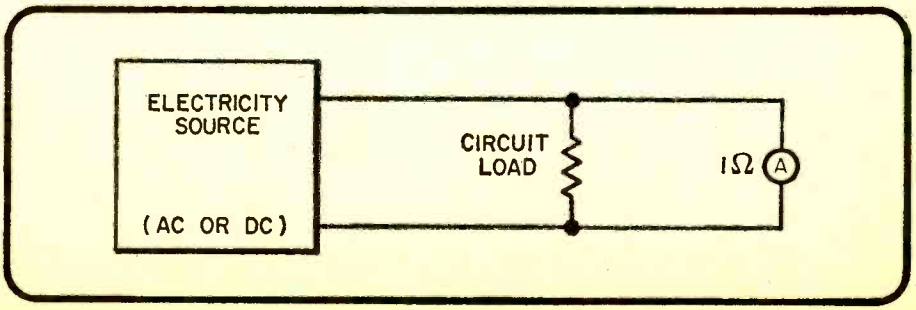
CORRECT AMMETER CONNECTION



The resistance of most ammeters is less than 1 ohm. Added in series with the load resistance, very little change is made to the total resistance. If the load were 10,000 ohms, for example, the new total resistance would be 10,001 ohms—hardly enough change to make a significant difference in the current. If the load were only 1 or 2 ohms, however, a difference would be noted. What would happen if an ammeter were connected in parallel?

You are right, it would be damaged. But do you know why? The full voltage of the source is applied across the 1-ohm resistance of the meter. Even if the source were only a 1.5-volt dry cell, more than an ampere of current would flow through the meter. Some meters are designed to handle that amount of current, but a multimeter is not. *(Turn to page 94)*

HOW TO WRECK AN AMMETER



EXPERTS AGREE
The TV of the future is here... in the Heathkit Digital-Design GR-2000 TV

"At **ELEMENTARY ELECTRONICS** they said: "The fact is, today's Heathkit GR-2000 is the color TV the rest of the industry will be making tomorrow... there is no other TV available at any price which incorporates what Heath has built into their latest color TV."

The **FAMILY HANDYMAN** reviewer put it this way: "The picture quality of the GR-2000 is flawless, natural tints, excellent definition, and pictures are steady as a rock. It's better than any this writer has ever seen."

POPULAR SCIENCE pointed out "more linear IC's, improved vertical sweep, regulators that prevent power supply shorts, and an industry first: the permanently tuned I.F. filter."

The **RADIO-ELECTRONICS** editors said the Heathkit Digital TV has "features that are not to be found in any other production color TV being sold in the U.S.:

"On-screen electronic digital channel readout ...numbers appear each time you switch channels or touch the RECALL button... *On-screen electronic digital clock*... an optional low cost feature... will display in 12- or 24-hour format... *Silent all-electronic tuning.* It's done with uhf and vhf varactor diode tuners ...*Touch-to-tune, reprogrammable, digital channel selection*... up to 16 channels, uhf or vhf... in whatever order you wish... there's no need to ever tune to an unused channel. *LC IF amplifier* with fixed ten-section *LC IF bandpass filter* in the IF strip... eliminates the need for critically adjusted traps for eliminating adjacent-channel and in-channel carrier beats. No IF alignment is needed ever. *Touch volume control*... when the remote control is used... touch switches raise or lower the volume in small steps."

POPULAR ELECTRONICS took a look at the 25-in. (diagonal) picture and said it "can only be described as superb. The Black (Negative) Matrix CRT, the tuner and IF strip, and the video amplifier provide a picture equal to that of many studio monitors..."

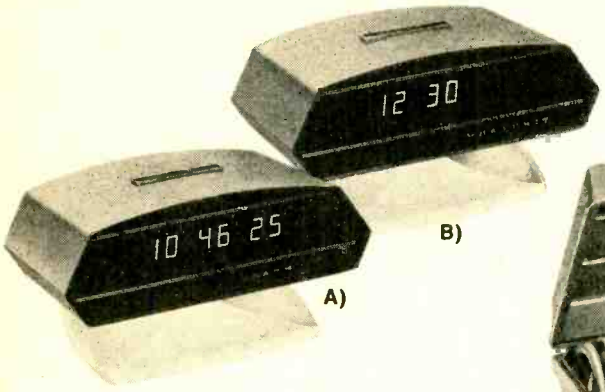
Furthermore, the Heathkit GR-2000 is an easier kit-form TV to build. **POPULAR ELECTRONICS** pointed out that "Each semiconductor has its own socket and there are 12 factory-fabricated interconnecting cables... The complete color adjustments can be performed in less than an hour."

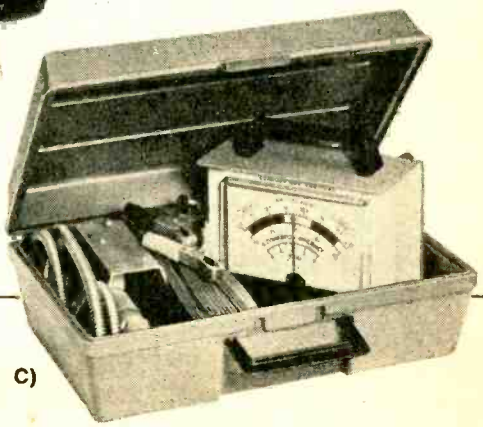
To sum up, **POPULAR ELECTRONICS** concluded its study by stating, "In our view, the color TV of the future is here — and Heath's GR-2000 is it!"

Why not see what the experts have seen? The Heathkit Digital Design Color TV — without question the most remarkable TV available today.

Mail order price for chassis and tube, $659.95. Remote Control, $89.95 mail order. Clock, $29.95 mail order. Cabinets start at $139.95. (Retail prices slightly higher)."

TOMORROW'S PRODUCTS are in kit-form today- with Heathkit electronics





(A) New Heathkit Digital Electronic Alarm Clock. Like no other clock you've ever owned ...with features as new as tomorrow! Wakes you with an electronic "beep" and shuts off at a touch — no fumbling for knobs or switches. And if the power goes off, you still get to work on time — the clock has its own emergency battery supply. Other features are a 24-hour alarm cycle with AM indicator light to aid in setting; 7-minute repeatable snooze cycle; 12 or 24-hour time format; automatic brightness control. Kit GC-1092A, 79.95*. Shipping weight, 5 lbs.

(B) New Heathkit Digital Electronic Calendar/ Clock. In this unique timepiece, we swapped the alarm feature for the date — and held the same low price featured in its alarm clock twin. Reads out the time in hours, minutes & seconds, with big orange digits. Plus, it gives you the month and day, either automatically for 2 seconds out of every 10, or anytime at the touch of an electronically activated control. It also features 12 or 24-hour time format, automatic brightness control, and built-in fail-safe reserve battery supply. Kit GC-1092D, 79.95*. Shipping weight, 5 lbs.

(C) New Heathkit Exhaust Gas Analyzer. A timely kit for the week-end mechanic and the professional alike. Checks exhaust gas of cars for pollution level and measures air/fuel mixture to help you tune for top economy. Also a great training aid in automotive mechanics classes for demonstrating results of proper anti-pollution system adjustments. Easy to assemble, simple to use. Kit CI-1080, 59.95*. Shipping weight, 6 lbs.

HEATHKIT ELECTRONIC CENTERS — Units of Schlumberger Products Corporation Retail prices slightly higher.

ARIZ.: Phoenix; CALIF.: Anaheim, El Cerrito, Los Angeles, Pomona, Redwood City, San Diego (La Mesa), Woodland Hills; COLO.: Denver; CONN.: Hartford (Avon); FLA.: Miami (Hialeah), Tampa; GA.: Atlanta; ILL.: Chicago, Downers Grove; IND.: Indianapolis; KANSAS: Kansas City (Mission); KY.: Louisville; LA.: New Orleans (Kenner); MD.: Baltimore, Rockville; MASS.: Boston (Wellesley); MICH.: Detroit; MINN.: Minneapolis (Hopkins); MO.: St. Louis; NEB.: Omaha; N.J.: Fair Lawn; N.Y.: Buffalo (Amherst), New York City, Jericho, L.I., Rochester, White Plains: OHIO: Cincinnati (Woodlawn), Cleveland, Columbus; PA.: Philadelphia, Pittsburgh; R.I.: Providence (Warwick); TEXAS: Dallas, Houston; WASH.: Seattle; WIS.: Milwaukee.

HEATH
Schlumberger

FREE 1975 HEATHKIT CATALOG
350 easy-to-build kits in all price ranges. Send for your free copy today!

Heath Company
Dept. 139-9
Benton Harbor, Michigan 49022

☐ Please send my free 1975 Heathkit Catalog.
☐ Enclosed is $_____, plus shipping.
Please send model(s)_____
Name_____
Address_____
City_____ State_____ Zip_____
Prices & specifications subject to change without notice.
*Mail order prices; F.O.B. factory CL-519

CIRCLE NO. 1 ON PAGE 17 OR 103

(Continued from page 89)

If an ammeter is connected to a wall outlet (115 volts AC) how much current would try to flow through the meter? More than 115 amps! However, when the current increased to 20 amps, the protective fuse in the house circuit would break the circuit. But the 20 amps would certainly damage the meter, and under ceratin conditions, the person holding the meter could be injured.

Voltmeters

Voltmeters are always connected in parallel with the component across which voltage is to be measured. As a result, the same voltage appears across the component and the meter. The internal resistance of a voltmeter is normally very high. The higher it is, the greater the meter accuracy.

Internal resistance of a voltmeter is given in terms of meter sensitivity (ohms per volt). Resistance varies with the range settings. To find the internal resistance, multiply the ohms/volt rating by the maximum number of volts in a range. With a 20,000 ohms/volt meter, the following resistances are obtained:

10-volt range: $10V \times 20{,}000\ \Omega/V = 200{,}000$ ohms
50-volt range: $50V \times 20{,}000\ \Omega/V = 1{,}000{,}000$ ohms
250-volt range: $250V \times 20{,}000\ \Omega/V = 5{,}000{,}000$ ohms

Corresponding resistances of a 5,000 ohms/volt meter are:

10-volt range: 50,000 ohms
50-volt range: 250,000 ohms
250-volt range: 1,250,000 ohms

The 20,000 ohms/volt meter is undoubtedly the more accurate meter. It will cost a few dollars more to attain this accuracy, but there will be times when you will be glad you paid extra for it.

WHAT YOU HAVE LEARNED

1. Resistors, or any other electrical/electronic component, have only three possible ways in which they can be connected—series, parallel, and series-parallel. These terms are also the names of the circuits in which they appear.
2. Algebraic and arithmetic statements of Ohm's law are used to determine I, E, or R in a circuit or a portion of a circuit.
3. In a series circuit:
   a. Total voltage is divided among the load resistances.
   b. Current is the same through all the resistances.
   c. Total resistance is the sum of all the resistances.
4. In a parallel circuit:
   a. Source voltage appears across all the resistances.
   b. Total current divides among the resistances.
   c. Total resistance is less than the smallest resistance.
5. Never connect an ammeter in parallel with a circuit.
6. Never connect a voltmeter in series with a circuit.
7. Never connect an ohmmeter to a circuit which is connected to a voltage source.

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.

DX Central Reporting

Continued from page 28

an application for a station on Guam, American territory in the Pacific Ocean. Things were stalled until last summer when the station "freeze" was lifted. On January 24th of this year, the FCC granted a construction permit for the Guam station, whose call letters will be KTWR.

Bandsweep. (Frequencies in kHz; times in GMT) **4820**—Still a good bet for most any DXer looking for a Central American station is *HRVC* in Tegucigalpa, Honduras. Signals are solid most every night and if you stick with it long enough you're bound to hear some English programming as well as Spanish . . . **4875**—Bolivia is not the easiest of the South American countries to hear. In fact, many of the stations in this landlocked nation are specially prized as DX targets by veteran DXers. The Bolivian best bet has to be *La Cruz del Sur* and the time to try is early-early-morning, say 0930-1030 . . . **5804**—An exotic station from the Arab world is *Radio Sana'a* broadcasting from the capital of Yemen. With luck you'll find it if you keep trying because of the off-beat frequency where it will stand out alone. But it's definitely not regular fare. Listen in around 0330 . . . **6195**—The turmoil in Chile early this year resulted in that country's first overseas shortwave service. *La Voz de Chile* has been reported broadcasting on 6195 during the evening hours, with some programs in English . . . **9360**—A good bet for beginning SWLs is Spain's *Radio Nacional de Espana,* which you should find operating in Spanish around 1940 . . . **9560**—As of this writing, *HCJB,* Quito, Ecuador, had rescheduled its popular "DX Partyline" program for 0130 Thursdays (remember that's Wednesday evening in North America!).

(Credits: Bob Zilmer, WI; Neal Perdue, TN; R.J Kosiomkowski, NY; Arthur Smith, AL; Jim Davis, CA; Solomon Wilson, PA; John Creamer, CO; Michael Ross, NY; North American SW Association, Box 8452, South Charleston, WV 25303)

Backtalk. On top of the stack of mail here at DX Central is a postcard from Eric Pomeroy of San Antonio, deep in the heart of Texas: "Thought you might be interested that I heard the *Israel Broadcasting Authority* from Jerusalem in English on 6195 at 0500. This should be a popular station. P.S. Your column is great!"

And thank you, Eric. Yes, IBA is much easier to hear these days now that the station has its full complement of four 300 kw transmitters operating. But IBA has been changing frequencies fast and furiously so any outlets I could list would be long outdated by the time you read this. You'll just have to scout around if you want to log Jerusalem.

Newscan

Continued from page 26

this speed, the deceleration force experienced by the Navy volunteer was 21.1G. Reports from the U.S. Navy flight surgeon and the test subject show that the volunteer had absolutely no injuries or pain of any kind.

Each test utilizing a human volunteer was preceded by tests using anthropomorphic dummies. The Navy test volunteers, all of whom were enlisted men, were under the supervision of Naval flight surgeons and physiologists. To assure the safety of the volunteers, each test was preceded by approval from a Medical Safety Committee.

Maybe they are not dummies after all.

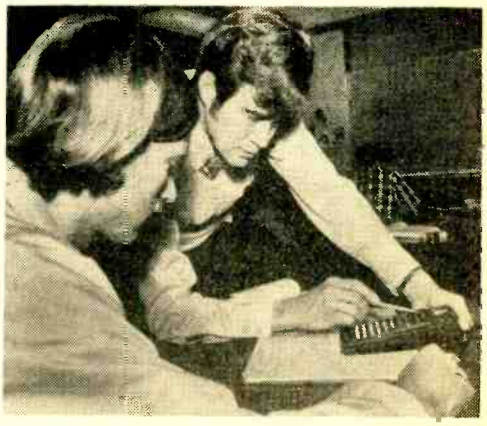
You Can Count on Them

Electronic pocket calculators in the classroom —an educational plus or minus?

This question has sparked a hot debate among academicians. Critics denounce the hand-held gadget as a debilitating crutch—a means of getting by without really learning much. They picture a generation of mathematical cripples, helpless to solve even simple problems without the "surrogate brain." Some have gone so far as to ban calculators from the classroom. Besides, detractors say, since not all students can afford calculators, why should those who can be allowed an unfair advantage?

Proponents, meanwhile, laud the device as a legitimate learning aid which actually increases understanding. But though the number

(Continued on page 97)



Mathematics department chairman Donald J. Albers goes over a problem using HP-45 pocket-sized scientific calculator with Menlo College student. Students learn more material at a faster clip through daily classroom use of pocket calculators.

LITERATURE LIBRARY

101. Kit builder? Like weird products? *EICO's* 1975 catalog takes care of both breeds of buyers at prices you will like.

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

103. See brochures on *Regency's* 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.

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

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

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. *EDI (Electronic Distributors)* has a catalog with an index of manufacturers' items literally from A to Z (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.

114. From *Olson* get their new, bargain-packaged 36-page, full-color tabloid (a new issue every 2 months). It contains their latest electronics parts, supplies, and hi-fi components. Pick up a copy at Olson stores coast-to-coast or send for a free copy today.

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

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).

119. Besides *Browning's* colorful leaflet on their Golden Eagle Mark III base station, their packet includes other surprises. The LTD is pictured in actual size on a card for you to test on your car's dash. Specifications are given for both the SST and LTD.

120. *Edmund Scientific's* new catalog contains over 4000 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. It's just off the press—*Lafayette's* all-new 1974 illustrated catalog packed with CB, hi-fi components, test equipment, tools, ham rigs, and more.

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.

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

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

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

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. *Heath's* new 1975 full-color catalog is a shopper's dream—chockful of kits and gadgets everyone would want to build and own.

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

Please arrange to have this literature whose numbers I have circled at right sent to me as soon as possible. I am enclosing 50¢ to cover handling. (No stamps, please). Allow 4 to 6 weeks for delivery.

☐ Indicate total number of booklets requested.

Sorry, only 10 circled items maximum.

S/074

101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170

Are you a subscriber to this magazine? Yes ☐ No ☐

51 ☐ Enter my subscription for 9 issues at $3.97 and bill me.

NAME _____

ADDRESS _____

CITY _____

STATE _____ **ZIP** _____

Not Valid After February 20, 1975

(Continued from page 95)

of advocates appears to be on the rise, rare is the educational institution that actively encourages classroom use of electronic calculators.

One that has is Menlo College, in Menlo Park, California, on the San Francisco Peninsula. Menlo's math and science professors feel so certain of the potential of pocket calculators as learning tools that last fall they equipped an entire classroom with them, revamped teaching methods and altered subject matter to match the capability of the calculators.

Today, after nearly a full academic year of use, the program is an unqualified success. In fact, in the coming year, Menlo will place greater curricular emphasis on the calculators, involving more number-oriented courses, more students, more teachers.

At present, six professors teaching nine mathematics, science, and business classes use the school's Computation Center. The Center is furnished with 20 Hewlett-Packard HP-45 pocket-sized scientific calculators, one to each student. About one-fourth of Menlo's 550 students use them in at least one class.

The pocket calculators help students understand the logic of problem solving while eliminating much of the drudgery of mathematics, according to Albers. "We're finding that through daily classroom use of the HP-45s, many students, especially the weaker ones, acquire a significantly faster and firmer grasp of what math is all about," he said.

Hey, Look Me Over

Continued from page 16

like a ratchet wrench—no need to remove and re-grip with each stroke. The self-adjusting Multi-Wrench grips at least three surfaces without rounding or damaging corners and grip increases as turning gets tougher. Excellent for removing or tightening damaged or rusted bolts that ordinary socket wrenches won't even fit. Made of high quality chrome vanadium tool steel polished heads, the Multi-Wrench is entirely chrome plated. 8½-in. long. Price: $9.10 postpaid. Write for 68-page catalog of *Hard-To-Find Tools*, Brookstone Company, 5121 Brookstone Bldg., Peterborough, NH 03458.

---

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.

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.

133. Get the new free catalog from *Howard W. Sams*. It describes 100's of books for hobbyists and technicians—books on projects, basic electronics and related subjects.

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.

136. *Leader's* catalog features "Instruments to Believe In." They have a complete line for industry, education and service, featuring oscilloscopes/vectorscopes, many generators, accessories, etc.

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. *Pearce-Simpson* has a booklet, "Citizens Band Radios & Scanners," which pictures and describes the various models in this line. A section on CB antennas is included.

139. For the latest information on CB transceivers by *Courier*, send for their literature.

140. Featured in *Siltronix's* brochure are single sideband/AM citizen band transceivers, pictured and described with extra features and specifications listed. VFO sliders for monitoring are pictured as well as export models of linear amplifiers.

141. *Lee Electronics Labs* has an inexpensive circuit analyzer, which is featured in this catalog.

142. Available from *Royce Electronics* is a 28-page, full-color catalog for CBers (base, mobile and handheld transceivers; accessories; and test instruments).

143. A set of Abraxas/4 speakers contains a rugged 12-inch long-throw woofer with a 22-oz. Alnico magnet, a 5-inch sealed-back rubber-damped midrange, and two 3-inch dome tweeters from *Designers Audio Products*.

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 CB'ers 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.

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

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

148. *American Trading Corp.* offers you two catalogs in 4-color. One features their Electronics 2000/Contact CB, pictured with descriptions and specifications. Their Monitor/Scanner, Surveyor Model 4H 4U, is featured in the second catalog.

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

150. For TV or communications towers, aluminum spells rugged strength. An 8-page brochure from *ASCOM* details 30 models to fit every need for CB, ham, commercial 2-way radio, or home/institutional installations.

151. For a complete audio accessory line-TV, tape, phono and radio for home and auto, send for *Audiotex* catalog FR 73-A.

152. Send for the new, free descriptive bulletin from *Finney Co.* It features the Finco line of VOM multitesters (and accessories) for electronics hobbyists and service technicians.

153. A full-color brochure on *Tennelec's* scanners is available. They have portables, 3 bands—12 channels and 3 bands—16 channels. Outstanding features and specifications of the tri-bands are listed.

Use Coupon on Left!

Kathi's CB Carousel

Continued from page 48

the rig is about as wide as a hand span and about 1-in. high. It has a low-clearance mobile mounting bracket and will fit snugly under a compact car's dash or air conditioner duct. These mini-rigs take up so little room there's no problem sliding across the seat when a girl's dressed for a heavy evening; even a long evening gown can slide past the rig without snagging.

Finally, I suggest the transceiver's power cable be spliced into the car's ignition system, or any wiring that's turned on by the ignition switch—such as the car radio's power lead. This way, the transceiver's power switch can be left permanently on. The transceiver will turn *on* and *off* with the ignition and accessory switch. To use the rig there will be no need to fumble for the controls at night. Just grab the mike, hit the PTT switch and you're on the air.

Costwise, the whole bit shouldn't run over $125 or so. Just figure it's part of Sis's (or Junior's) yearly gasoline bill. It might turn out to be the best "insurance protection" on your car and family.

For more information on the Antenna Specialists' "Big Momma" model M-410, circle No. 5 on the Reader Service Page.

Inside CB Xmitters

Continued from page 78

ficient bandwidth to pass one sideband, either the filter must be switched out of the circuit or the modulator's output must be routed around the filter so the entire AM signal—which is twice the bandwidth of and SSB signal—can be transmitted. Some SSB/AM transceivers have been seen which incorporate a separate high-level AM modulator such as used in standard AM rigs.

Don't Touch. The best tuning advice concerning modern solid state transceivers, whether AM or SSB, is *don't touch*! If the manufacturer doesn't provide a user adjustment control such as an antenna loading control, you will get optimum results with the factory tuning if you have a halfway decent antenna system. Actually, a high standing wave ratio, say, 3:1, can not only

SPECIAL INTRODUCTORY OFFER!

Now get ELEMENTARY ELECTRONICS sent to your home all year long for ONLY $2.67! Order Now and Save!

*** * * For beginner or expert EE is valuable * * ***

Written by experts—you get a practical understanding of IC circuits . . . semi-conductors . . . power supplies . . . networks . . . transistors . . . pulse circuitry, much more! Get general rules of electronics, develop trouble-shooting techniques, know how to calculate changing effects. TRY THIS NO-RISK SUBSCRIPTION OFFER TODAY!

PROJECTS IN EVERY ISSUE

•

CB RADIO

•

SHORT-WAVE

•

NEW PRODUCTS

•

BASIC ELECTRONICS COURSE

•

PRODUCT LAB TESTS

PUBLISHER'S DISCOUNT SAVINGS CERTIFICATE

Good for up to ***$2.78*** *off the newsstand price of* ***ELEMENTARY ELECTRONICS***

☐ Enter my trial subscription for 1 year (6 issues) of Elementary Electronics, for only $2.67. (regularly by subscription $3.95).

☐ I prefer 1½ years (9 issues) for $3.97 (on the newsstand $6.75).

☐ New Subscription ☐ Renewal Subscription

Name_____

(please print or type clearly)

Address_____

City_____ State_____ Zip_____

SEND NO MONEY, WE'LL BILL YOU LATER

You must seal (staple, scotch tape or glue) before mailing. Dept. P5020

FOLD HERE

Postage Will be Paid by Addressee

No Postage Stamp Necessary if Mailed in the United States

BUSINESS REPLY MAIL

First Class Permit No. 790 (Sec. 34.9 P. L. & R.) New York, N.Y.

ELEMENTARY ELECTRONICS

P.O. Box 2600

Greenwich, Connecticut 06830

Dept. P5020

CUT OUT AND MAIL TODAY!

reduce the power output through normal SWR losses, it can have such a drastic effect on the operating characteristics of a solid-state amplifier that the modulation turns to "mush." (This is not necessarily true of tube-type rigs which can absorb a high SWR without substantially affecting the modulation characteristics.)

The modern solid state rig delivers its maximum RF output and optimum talk power when working into a load impedance as close as possible to 50 ohms—meaning an SWR as close as possible to 1:1 (Yes, 1.3:1 or 1.5:1 is the same as 1:1, for CB use.) Because the antenna system directly controls the transmitter's performance, and because the antenna system is almost completely dependent on user installation and adjustment, as much time and effort as possible should go into securing the best possible antenna installation—no transmitter can be effective if you can't get the signal out. ■

FET Voltmeter

Continued from page 67

ticular range, the total resistance in *kilohms* between a tap on the divider (R10 to R20) and ground should be equal to 7500 divided by the range in volts. For example, on our meter a 75-volt range would result in a resistance of 100,000 ohms which is approximately the total of R17 through R20. If you want to use, say, 1.5, 15, and 150 volt ranges, you would omit R14 through R20 and select R10 to R13 as follows:

$$R13 = \frac{7500}{150} = 50 \text{ (50 kilohms)}$$

$$R12 + R13 = \frac{7500}{15} = 500 \text{ (500 kilohms)}$$

Since R12 and R13 together equal 500,000 ohms, and since R13 is 50,000 ohms, then R12 must be 450,000 ohms.

$$R11 + R12 + R13 = \frac{7500}{1.5}$$
$$= 5000 \text{ (5 megohms)}$$

therefore, R11 must be 4.5 megohms and R10 must be the difference between the above and the 20 megohms total. Therefore R10 equals 15 megohms.

Operation. Set switch S2 to *cal low ohms*

and turn the main power switch S1 *on*. Short the probes together and set the meter to zero with the *null* adjustment (R5). Open the probes and set the needle to the 1.35 volt mark on the meter with *cal* adjustment R4; repeat if necessary. Turn S2 to *volts*; you are now ready to measure voltages; select the range with S3.

To measure resistance, alternately short and open the probes on one of the resistance ranges and adjust the meter for zero ohms (leads shorted) and infinite resistance (leads open) with the two potentiometers. Adjustment on any resistance range should give satisfactory readings on other ranges. If you cannot calibrate the meter, check the batteries (with another voltmeter). The battery leads can be brought out to jacks for testing.

Initial Calibration. Set R4 (CAL) to max, R5 (NULL) to the center of its range, and the function switch to the VOLTS position. Then adjust R6 to indicate zero volts with the probes shorted together.

This article has provided you with some multimeter basics and an experimenter's example of a working FET voltmeter. You can simplify the design by making just a voltmeter, just an ohmmeter, or an abbreviated version of a volt-ohmmeter, if you wish. Use a simple basic meter 0 to 50μA and add your own scale, or find a surplus or used meter movement and design voltage ranges and "half-scale" ohmmeter ranges to match the printed scale. Any way you do it, an experimenter can get a feel for what's inside the widely used FET multimeter, and come up with a useful diagnostic tool to boot! ■

Bug Mother Nature

Continued from page 62

whenever I tested the amplifier out of its case.) Alternatively, you may find a place in the house that is hum free; make your tests there. With the amplifier completely enclosed in its case, there is absolutely no hum pickup problem.

When you are satisfied that the amplifier is stable and working properly, solder the short microphone cable to the input terminals and mount the amplifier in its case. You are now ready to set up the microphone for maximum gain. To do this, you will need a code practice oscillator or other source of audio signal and an AC voltmeter

INDEX TO ADVERTISERS

with a ten-volt range connected to the amplifier output.

Set the equipment up in a clear area. Enable the CPA and adjust the audio gain so that the voltmeter reads two volts or less. Next move the microphone cartridge towards and away from the center of the dish to find the microphone position giving the greatest output. Do not let the voltmeter reading go above three volts because overloading the amplifier will make it difficult to find the point of maximum gain. After finding the best position for the microphone, secure the rubber bands on the support rods with dabs of cement.

The parabolic snooper may be used in several ways. As a portable field instrument, just plug in a set of 2000-ohm earphones and be on your way through the woods. The unit will also work as a combination microphone-preamplifier with any amplifier or tape recorder. However, if you are using a speaker for monitoring outside noises, be sure to have sufficient acoustic isolation between the microphone and speaker, such as closed doors and windows. If you don't, all the world will know by your feedback howl that you are listening. When using the unit with an audio power amplifier it is best to run the gain quite high on the amplifier and adjust the system gain as needed with the preamp gain control.

Now you're ready for a new world of close up sound. ■

Fine Color Prints

Continued from page 43

filter in place before withdrawing the old one, switch the analyzer, and make the new meter reading. Repeat this for the third reading filter. You'll note that this procedure keeps bright white light from falling on the photocell between meter readings. If you want to change filters under room lights, make certain there are about five seconds of darkness between turning the room lights out and turning the enlarger on.

The whole bit might sound somewhat complicated, but after you've run through the procedure once or twice to get the hang of things it shouldn't take you more than a minute or so for a full color analysis of a new negative.

The Kodak Wratten filters needed are available from professional camera shops. For the construction project, color analyzer 2-in. or 3-in. Kodak Wratten filters Nos. 98 (blue), 99 (green), and 70 (red) are recommended. If

(Continued on page 104)

ELEMENTARY ELECTRONICS

READER SERVICE PAGE

To find out more about these coupons, turn to page 17.

SEPT./OCT. 1974 — Void after FEBRUARY 20, 1975

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

Please send literature for the numbers I have circled. I understand this is a free service.

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43					

We would like to know something about you. Please help us by placing an "X" in the appropriate boxes. Do you own a Class D CB transceiver? 44 ☐ Yes 45 ☐ No If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. 46 ☐ Base Station 47 ☐ Mobile Unit 48 ☐ Portable Do you use CB in your work? 49 ☐ Yes 50 ☐ No

51 ☐ Enter my subscription for 9 issues at $3.97 and bill me.

Name (print clearly) _____

Address _____

City _____ State _____ Zip Code _____

SEPT./OCT. 1974 — Void after FEBRUARY 20, 1975

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

Please send literature for the numbers I have circled. I understand this is a free service.

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43					

We would like to know something about you. Please help us by placing an "X" in the appropriate boxes. Do you own a Class D CB transceiver? 44 ☐ Yes 45 ☐ No If your answer is Yes, please check appropriate boxes below if you have one or more of the types indicated. 46 ☐ Base Station 47 ☐ Mobile Unit 48 ☐ Portable Do you use CB in your work? 49 ☐ Yes 50 ☐ No

51 ☐ Enter my subscription for 9 issues at $3.97 and bill me.

Name (print clearly) _____

Address _____

City _____ State _____ Zip Code _____

you have difficulty obtaining these specific filters you can make the following substitutions, though the analyzer's precision will be slightly reduced: 47B (blue), 61 (green), and 92 (red).

The Pro Shop. We could not close without some words on commercially processed color prints such as you might order from a drug-store or camera shop. Commercial color labs have as high (if not higher) a remake rate than the amateur if *quality* color prints are desired. As a general rule, it takes two tries to get a decent color print, so the hobbyist with a color analyzer is way ahead of the game because he can turn out, at worst, two *good* prints for each three first tries. The average is even higher than this as the hobbyist gets skilled in the use of a color analyzer.

Commercial labs come close to a hobbyist's results only when they are equipped with a video analyzer such as the Kodak Video Color Negative Analyzer Model 1-K; and Kodak only claims a 75%+ first try acceptance rate for their analyzer. The video analyzer is a 5-in. x 5-in. TV display. The operator views the color negative as a positive color TV image, and adjusts the TV's controls for proper color balance and brightness (saturation). The control settings are translated to the printing equipment's filter adjustments so that the final print is similar to the image displayed on the TV.

The video analyzer is a fast and easy way to get good color prints on the first try, but since video analyzers cost in the thousands, the color analyzer is the best thing going for the hobbyist. ■

Color Analyzer

Continued from page 40

should run out to the very edge of the knob skirt. If the calibrations don't run to the edge you won't be able to preset the controls with any reasonable degree of accuracy. Place a fine line or other indicator directly above each knob.

Checkout. Connect the photocells to the control unit and apply power. Don't worry if the meter pins at either end of the scale. Set switch S1 to the extreme clockwise position and adjust R2 through R5 until you find the control that changes the meter reading. Mark the switch and the control "C" for cyan. (We suggest you paint the cyan knob insert a blue-green. Also paint the other knobs the appropriate color.) Advance S1 one position clockwise, find the correct knob and label both "M" for magenta. Advance the switch another position clockwise, find the knob and label both "Y" for yellow. The last switch

position and knob is labeled "W" for white (white light exposure). Make certain the C, M, and Y controls are reading P2, the color comparator mounted under the lens.

Set S1 to any position, turn on bright room lights, and adjust the associated color control until the meter pins, or approaches full scale deflection. Make certain the control is adjusted for the maximum meter reading. Adjust trimmer control R6 so the meter pointer just pins (don't be afraid to piN thE meTER). Depending on the amount of light the meter pointer will pin right (for bright light) and left (for dark or very low light). This is normal, there will be no damage to the circuit or the meter. (Note: If you use a zero-center meter the pointer will barely pin on both sides.)

Install the Z-bracket under the lens. If your enlarger uses a filter holder under the lens insert a diffusion screen or glass, or a Beseler Light Integrator or similar ground glass in the filter holder. You are now ready to make color prints.

Complete instructions for using this color analyzer are also in this magazine. ■

Blackout

Continued from page 71

output to the new garage "outlet."

The Panel Box. Go down to the basement and look at your panel box. The oil burner should be on a separate circuit breaker. Mark this breaker in some way, say with a dab of red paint. Now locate the circuit breaker for your living room or hall lighting circuits; also mark this breaker. Similarly, mark the breaker for your refrigerator freezer. Now make certain that if you have 220 or 208 volt service the circuit breakers for the garage, oil burner, refrigerator, and lighting are all on the *same side* of the power line. Panel boxes generally have a schematic showing the relationship of each breaker position to each side of the power line.

When the appropriate breakers are marked and you are certain the "emergency circuits" all share the same side of the power line you're ready for a trial run.

Locate the master electric disconnect; this might be a large switch at the top of your panel box or a lever on the side of the box. Pull the master switch to disconnect the house from the utility service. Now switch off every single breaker, or loosen every fuse. Go out to the garage, move the portable generator out of the garage (into open air) and connect the generator to the "emergency" garage outlet. (Be absolutely certain every circuit is "pulled" in the panel box. You don't start a portable generator with the load connected.)

Start the generator, let it run for a few minutes so the speed stabilizes, and throw the generator feed switch (if so equipped) or the emergency circuit breaker you installed in the garage. Then go back down the basement and activate the garage, oil burner, and lighting circuit breakers in that order.

The generator will now feed emergency power to your home through the house wiring. In the summer, activate the refrigerator breaker instead of the oil burner. Unless you have one heck of a large power plant, don't try to run the heating system and the refrigerator/freezer at the same time. (Food will remain frozen for at least 24 hours if you don't open the freezer door, and besides, cutting down on the load reduces gas consumpton.)

When you know that commercial power is back on again, pull the garage circuit breaker in the main panel box first, then close the main power switch to restore connection to the utility power supply. Finally, go out to the garage and turn off your generator; then close the garage circuit breaker in the basement.

Be absolutely certain you do not connect to the utility power while your emergency generator is connected—that's looking for a heap of trouble.

Where the Money Is Saved. As you can see, by using the existing house wiring for the emergency power supply there is no expense other than the portable power plant and a few electrical accessories. That's where the real savings come from.

While not the most convenient system to use, you do save the cost of power circuit transfer wiring, hardware, and installation. And while you lose a few conveniences you've become accustomed to—like your electric coffee pot, toaster, and large screen TV—you will at least be warm and comfy in winter, and keep your food refrigerated in summer, while the local electric company thinks up five more reasons why they can't provide you with electric power for the next six hours. ■

CLASSIFIED Market Place

FOR BIGGER PROFITS! NEW CAREER OPPORTUNITIES!
READ AND REPLY TO THESE CLASSIFIED ADS

Classified Ads 95¢ per word, each insertion, minimum ad $15.00, payable in advance. For information on Classified ads—to be included in our next ELEMENTARY ELECTRONCIS —write to R. S. Wayner, Classified Ad Manager, 229 Park Ave. South, N. Y. 10003.

ADDITIONAL INCOME

SERIOUS PART TIMERS WANTED: $200.00 weekly possible. Complete wholesal. ers program $1.00 refundable on order. Alexander Enterprises, 1295 Beacon, Brookline, Mass. 02146.

WIN $1,000,000.00—$500,000.00—$250,-000.00 or Other Large Amounts in Oyimpic Lottery Canada, 17,000,000.00 Cash Tax Free Legal, Government Approved. Complete Information. To Enter Send Air Mail. For $2.50. Shon Company, P. O. Box 71-L, Station D, Montreal, Quebec, Canada H3K 3B9.

ANTIQUES, ART & CURIOS

OFFICIAL GUIDE TO ANTIQUES tells you at what price to buy and sell thousands of antiques. Send $4.98. Gregg's Gifts, 710 Doyle Street, Gadsden, AL 35903.

BIG MAIL

RECEIVE Amazing Mail Galore! Your name sent to over 200 firms. Send $2.00. Supreme Lists, Postal Box 10920, Parkville, MD. 21234.

BLUEPRINTS, PATTERNS & PLANS

DIAGRAMS, Servicing Information, Television-Radio. $1.95. Publications, 1760 Balsam, Highland Park, IL. 60035

EAVESDROPPER. Super Sensitive. Easily Built. Conversation, Wildlife. Complete plans $2.00. P.D. Associates, P. O. Box 8801, New Fairfield, Conn. 06810.

NEW CRAFT PRINT CATALOG—choose from over 100 great easy-to-build plans. Send $1.25 (completely refunded with your first order). BOAT BUILDER, (CP Div.) —229 Park Avenue South, New York, N.Y.

BOOKS & PERIODICALS

WIRETAPPING Expose! Your Privacy Invaded. Details $1.00 (Refundable). Don-Q, Box 548, Seattle, Washington 98111.

FREE LIST of books that are EXCITING. UNIQUE. UNUSUAL. Write today to: The J. J. Tallo Company, 525 North Irving Avenue, Scranton, Pennsylvania 18510.

HUGE Savings, Giant Catalog $3.00 refundable. Kegley, 51-B2 Chestnut Drive, Elkton, 21921.

BOOKS & PERIODICALS—Cont'd

COINS. Collect for Profit. Where to sell. List of valuable coins. Check your change. $1.00 refundable. Trademore, Dept.-114, 127 Oak Terrace, Akron, Ohio 44304.

BUSINESS OPPORTUNITIES

I made $40,000.00 Year by Mailorder! Help others make money! Start with $15.00—Free Proof! Torrey, Box 318-T, Ypsilanti, Michigan 48197.

MAKE Magnetic Signs, Big profits. Details. Universal, Lenora, Kansas 67645.

FREE Secret Book "2042 Unique, Proven Enterprises." Fabulous "Little Knowns" Work home! Haylings-E14, Carlsbad, California 92008.

1000% PROFIT Preserving Baby Shoes in Chinakote or Bronze. Free Literature. NBC-DG, Coral Springs, Florida 33065.

HERBALISM! The home gold mine! Free minicourse. Herbalism Institute-D. Box 968, Glendora, Ca. 91740.

HOW To Make Money Addressing, Mailing Envelopes. Offer Details 10¢ Lindbloom Services, 3636 Peterson, Chicago 60659.

ADDRESS Envelopes, $150.00 Weekly Possible. Details Send $1.00. Stamped Addressed Envelope. KeenJ, Box 9995DC, San Diego CA 92109.

NEW RECEIVE 100 Envelopes Daily! Each containing $1.00. Will send complete plan plus six formulas, only $1.00. Trade-7B81, 4122-32nd, San Diego, CA. 92104.

BECOME our Mail Order Distributor with $150 investment. Free brochure. Audit Controls, 30 Brookside Av., Fair Lawn, NJ 07410.

$100 WEEKLY possible! Mailing circulars for advertisers. Details. Rush stamped envelope. Service, Box 721-BC, Lynbrook, NY 11563.

IMMEDIATE Earnings stuffing envelopes. Beginner's Kit. $1.00 (refundable). Lewcard. Brea, CA. 92621.

FREE! Below Wholesale Catalog! Make Sensational Profits. Nedson-SM, R2-345S. Edgerton, WI 53534.

BUSINESS OPPORTUNITIES—Cont'd

HOW TO GET INTO TV SERVICE BUSINESS on a shoestring. 30 minute cassette and full report $9.95. Guaranteed and postpaid. Excellent income. Dahl Electronics, Box 758, Newcastle, WY 82701.

50 HOME BUSINESSES YOU CAN START ON $50.00 CAPITAL, $3.00. SATISFACTION GUARANTEED. Free Information. Pacific Sales (Harpers). 218 N. Harbin, Carson City, NV. 89701.

MAKE Money clipping newspaper items. $2.00—$10.00 each. Details free. Clippings, Box 10344-EE2B, Palo Alto, CA. 94303.

DO-IT-YOURSELF

DISCOVER how to avoid calling the serviceman. Save by servicing home equipment yourself. Send $1.25 for magazine. RADIO-TV REPAIR—229 Park Avenue South, New York, New York 10003.

EDUCATION & INSTRUCTION

"LOGIC newsletter, design and construction, sample copy, $1.00. Logic Newsletter. POB 252. Waldwick, N.J. 07463."

ACUPUNCTURE TRAINING Home Study Course! Tsang, Box 219W. Toronto, Canada M6M 4Z2.

BIG profits in publishing. Learn how. Details free. Stevenson Enterprises, 4808 Santa Monica Ave., San Diego, Ca. 92107.

COLLEGE DEGREES BY MAIL. Free Information. Write: Success Institute, 1435 North Belford, Dept. B9EE, Pasadena, Calif. 91104.

LEARN International Metric System. Soon to replace U.S. Standard Weights and Measures $2.98. Be Prepared. Wright Reports, 1959 S. Gilpin, Denver, CO. 80210.

INFORMATIVE BOOKLET—"How to Write a Classified Ad That Pulls." Includes certificate worth $2.00 towards a classified ad in this publication. Send $1.25 (includes postage) to R. S. Wayner, Davis Publications, Inc., Dept CL, 229 Park Avenue South, New York, NY 10003.

MORE

For Greater Classified Savings . . . Results . . . and Profits . . .

Place your ad in one of our SPECIAL COMBINATIONS: Business Group, Science & Mechanics, or Davis Combination. Each Combination is designed to give your ad the largest audience available For further information write to R. S. Wayner, Classified Ad Manager, Davis Publications, Inc. 229 Park Avenue South, New York, N.Y. 10003.

CLASSIFIED MARKET PLACE

(*Continued from page* 106)

EDUCATION & INSTRUCTION Cont'd

LEARN DESIGN TECHNIQUES. Electronics Monthly Newsletter. Digital, linear construction projects, design theory and procedures. Sample copy $1.00. VALLEY WEST, Box 2119, Sunnyvale, California 94087.

ELECTRICAL EQUIPMENT & SUPPLIES

TRANSFORMERS, quality Electronic Types also Electro-Mechanical assemblies. Burritt Manufacturing Co., P. O. Box #4, Spring City, PA. 19475.

FARMS, ACREAGE & REAL ESTATE

GOVERNMENT LANDS DIGEST. A Monthly review of government Real Estate offerings throughout the U.S.A. . . . Free subscription information! . . . DIGEST. Box 25561-DP, Seattle, Washington 98125.

GIFTS THAT PLEASE

FREE Jewelry Catalog. Everything Gift boxed. One modest price all items. Christmas buys for now. J. Van Emrik, 18325 A, Strathern, Reseda, CA. 91335.

BEST Reading in Mechanical Field—Science & Mechanics! $4.00 for year's subscription. Science & Mechanics, P.O. Box 2600, Greenwich, Conn. 06830.

HOME WORKSHOP SUPPLIES

25 WEEKEND BUILD-IT PROJECTS—Practical Designs for home/shop buffs who enjoy working with wood, tools, materials and techniques. Send $1.25 for your copy (includes postage) to Davis Publications, Inc., 229 Park Avenue South, New York, N.Y. 10003.

IDEA book for re-doing or adding to your kitchen and bath improvements. Send $1.25 to KITCHEN & BATH IMPROVEMENTS—229 Park Avenue South, New York, N.Y. 10003.

HYPNOTISM

HYPNOTIZE STRANGERS in 30 Seconds! Most powerful hypnotic device ever created! Complete easy instructions included. Guaranteed only $2.00. From: WORLD-30C9, 3047 University, San Diego, CA 92104.

INVENTIONS WANTED

WE either sell your invention or pay cash bonus. Write for details. Universal Inventions. 298-3 Marion, Ohio 43302.

FREE "DIRECTORY of 500 CORPORATIONS Seeking New Products." For information regarding development, sale, licensing of your invention, write for your FREE "INVENTOR'S KIT No. A-35." It tells how ideas become a reality! RAYMOND LEE ORGANIZATION, 230 Park Avenue, New York, NY 10017.

LOGIC

LOGIC NEWSLETTER. Design, Theory, Construction Sample copy $1.00. Logic Newsletter. POB 252, Waldwick, N.J. 07463.

MACHINERY, TOOLS & SUPPLIES

RIDING Lawnmowers—1974 model, 7 horsepower $209.00. Free brochure. Tomco, Box 72, Oak Grove, Missouri 64075.

MAGIC TRICKS, JOKER NOVELTIES & PUZZLES

WOW! Largest selection. Newest, best tricks, jokes. Giant 150 page catalog 25¢. Abracadabra-EE, Colonia, New Jersey 07067.

MAGNETS

TWENTY Disc, or ten bar magnets, $1.00. Magnets, Box 192-E, Randallstown, Maryland 21133.

MISCELLANEOUS

NEVER WON ANYTHING? Anyone can win Sweepstakes contests! Free details. Services, Box 644-SFJ, Des Moines, Iowa 50303.

LIFETIME INCOME! How? Send $1.00. Coil, P. O. Box 48056, Ft. Worth, TX. 76148.

HOW I'm collecting 5% interest on money I've already spent. $3.00. Herrick, Box 423W, Owosso, Michigan 58867.

MONEYMAKING OPPORTUNITIES

SILVER For $1.00 Ounce! Complete Report $5.00 (refundable). Harrolds Enterprises, Box 5307, Oakland, Calif. 94605.

MAKE MONEY! Sell your Photos. Report tells How, Where. Color Slide Market. Only $1.00. Treasure House, Dept. E. 708 East 192nd Street, New York, N.Y. 10040.

MAKE Your Classified Ad Pay. Get "How to Write A Classified Ad That Pulls." Includes certificate worth $2.00 towares a classified ad in this publication. Send $1.25 (includes postage) to R. S. Wayner, Science & Mechanics, Dept. CL 229 Park Avenue South, New York, N.Y. 10023.

OPTICAL GOODS—TELESCOPES

EYEGLASSES Wholesale—Free Catalog A-Z Optical Company, Box 175, Dept. 28 A, Bay Station, Brooklyn, N.Y. 11235.

PERSONAL

NEVER BEFORE SO MUCH for so little. Buy everything you'll ever need below wholesale! Full particulars FREE. Write today. Warner, Room CC-107-DL, 1512 Jarvis, Chicago, ILL. 60626.

CONDOMS! Three samples: $1. Twelve assorted samples: $3. Illustrated catalog free with every order. Choose from ALL nationally-advertised brands. Promptness and privacy assured. Money back guarantee. POPLAN, P. O. Box 2556-Dept. DCG-2a, Chapel Hill, N.C. 27514.

SINGLES? Widowed? Divorced? Nationwide introductions! Identity, Box 315-DC, Royal Oak, Michigan 48068.

JAPANESE introductions! Girls' photographs, descriptions, brochure, details, $1.00. INTER-PACIFIC, Box 304-SC, Birmingham, Michigan 48012.

BEAUTIFUL MEXICAN GIRLS Wanting American Boy-Friends. Details, Photos 25¢. World, Box 3876-SMC, San Diego, CA. 92103.

PERSONAL—Cont'd

DON'T DIE without a will! Blank will form protect your family. Only $2.00—Guaranteed! Order Today!! RuCuS Enterprises, Dept. 1C1 46 Cardwell St., Orangeville, Ontario L9W 2V6.

PHOTOGRAPHY—PHOTO FINISHING

SAVE HUNDREDS OF DOLLARS! ! ! Make your own S&M Densitometer. Send $3.00 for detailed drawings and instructions. A must for successful photography in your darkroom. Order direct from S & M Instruments, Dept. EE9, 229 Park Avenue South, New York, New York 10003.

RADIO & TELEVISION

TV TUBES 36¢ each. Send for Free 48 page color catalog. Cornell, 4217-W University, San Diego, California 92105.

"DISTANCE One Tuber" Handbook—50¢. 15 Distance one tube plans—25¢. Catalog 25¢, refundable. Laboratories, 1477-G, Garden Grove, California 92642.

99 EXCELLENT Ways to improve your TV Reception $5. Etco-DG, Box 741, Montreal "A", Canada.

ANTIQUE Radio Collectors: We have Schematics for most Radio's, from 1925 to 1948—Send $1.00 for list. Diagrams $2.50 each. Electronics Specialist Co., Box 213A, Rainier, Wash. 98576.

FREQUENCY RESEARCH. Highly detailed information, any two HF signals $1. Also, frequency lists. Comint, Box 45, Mentor, OH. 44060.

REMAILING SERVICE

CALIFORNIA Remails 20¢. Harrold, Box 5307, Oakland, CA. 94605.

SONGWRITERS

SELL Your Songs! Pros show you how! Music, Money, Marketing, everything! Nashville School, 708-S Berry Road, Nashville, Tenn. 37204.

STAMP COLLECTING

OLDER U.S. STAMPS. Surprisingly good approvals to adults only. Engle, Box 208C, Lowell, MI 49331.

TIPS FOR THE HOME, ETC.

PRACTICAL tips for home, garden and workshop are in "1001 How-To Ideas." Send $1.25 for your copy (includes postage), to 1001 How-To Ideas, 229 Park Avenue, South, New York, New York 10003.

TREASURE FINDERS—PROSPECTING EQUIPMENT

FREE FACT-FILLED CATALOG. World's largest line of metal detectors. Models as low as $79.50 and up. Two year Guarantee. Three factory locations. U.S. and Canada, plus over 1,000 dealers and 35 Service Centers from coast to coast. No finer instruments made at any price. Budget terms. Write: WHITE'S ELECTRONICS, INC., RM #399, 1011 PLEASANT VALLEY ROAD, SWEET HOME OREGON 97386.

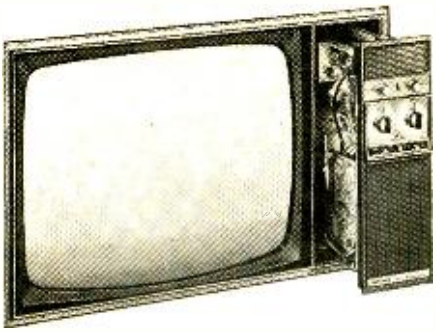
PLEASE Be sure to include your zip code when ordering merchandise from classified advertisements. You'll receive faster delivery.

YOU'LL MAKE MONEY

SAVE MONEY TOO— BY READING and ANSWERING THESE CLASSIFIED ADS

Let ICS mail you a FREE demonstration lesson without obligation... to prove that you can learn TV servicing at home.

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



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

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

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

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

This chassis with automatic fine tuning control is ideal for training purposes because it combines solid state devices with vacuum tubes to give you both kinds of practical experience. All parts carry Motorola's two year replacement guarantee!

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

Our free literature also describes the fully assembled test equipment you receive such as the Deluxe 5″ Solid State Oscilloscope, the tools and the learn-by-doing kits, all of the finest quality.

And we're going to tell you about eight other career opportunities in Electronics and the ICS Career Programs that can help prepare you for them. All you've got to do is mail the attached postpaid card or coupon—today!

ICS

International Correspondence Schools
Since 1890
School of Electronics
Scranton, Pa. 18515

Approved for Veterans' Training. Eligible Institution under the Guaranteed Student Loan Program. Accredited Member National Home Study Council. Canadian residents use coupon address for service from ICS Canadian, Ltd. In Hawaii: 931 University Ave., Honolulu, Hawaii 96814

ICS School of Electronics
International Correspondence Schools
Scranton, Pa. 18515

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

- ☐ Color TV Servicing & Repair
- ☐ Computer Maintenance
- ☐ CATV/MATV Technician
- ☐ Telephony
- ☐ Electrician
- ☐ FCC Licensing
- ☐ Communications/ Broadcasting
- ☐ Hi-Fi Sound Systems
- ☐ Industrial Electronics

AA762U

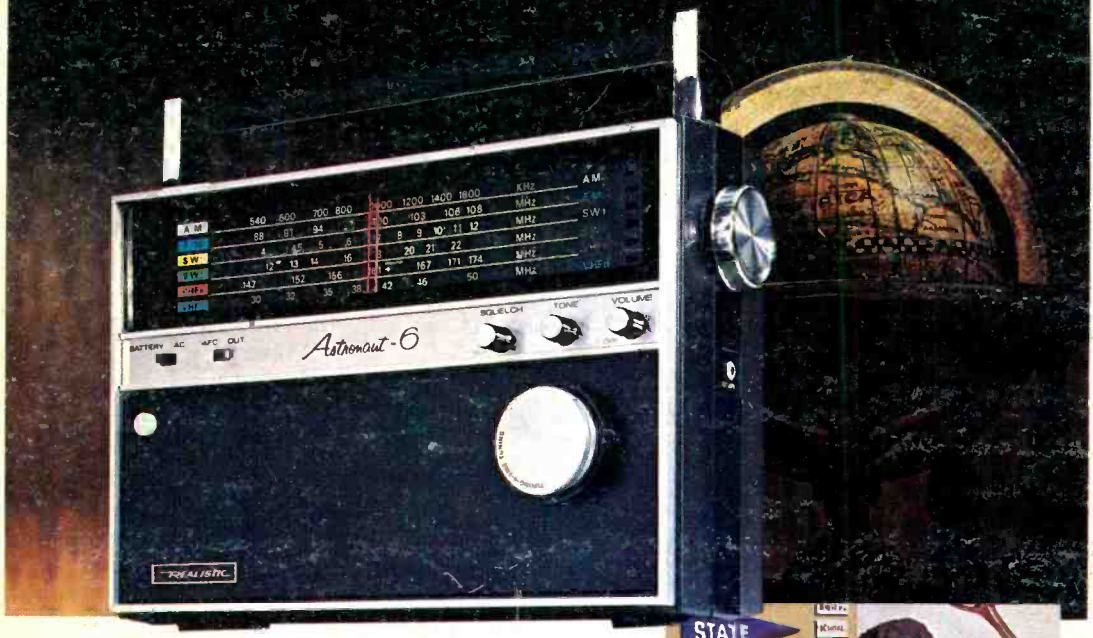
Name_____ Age_____

Address_____

City_____

State_____ Zip_____

The 6-band AM-FM-SW-VHF radio for the serious listener



Our famous Astronaut™-6 portable is more than 6 bands in name only —top performance on *every* band!

Many multiband portables work great on FM and AM, but aren't so hot on other bands. Our Astronaut-6 is great on *all* of its bands. Because it has a 3-gang, tuned RF circuit for superb FM reception plus a separate RF stage that really brings 'em in on shortwave and VHF. And—all-band fine tuning unscrambles close-together stations you'd normally miss. You'll hear true "worldwide" shortwave, exciting hometown police and emergency calls, and continuous weathercasts in many areas. Other big features: 4" speaker, ¼" headphone jack, squelch and tone controls, AFC off-on, dial light. Plays on AC or batteries, included. U. L. listed. Get #12-2060—tune in the world!

89.95

Your Worldwide Listening Post

Shortwave—5-12 and 12-22 MHz
VHF Hi and Low—30-50 and 152-174 MHz
FM—88-108 MHz AM—540-1600 kHz

REALISTIC® at Radio Shack®

OVER 2500 STORES • 2000 CITIES • 50 STATES

FREE! NEW 1975 CATALOG

Mail in coupon from one of our 3 other ads in this issue!

Retail prices may vary at individual stores. Prices and products may vary in Canada. #426

CIRCLE NO. 4 ON PAGE 17 OR 103