INFRARED SYSTEMS FOR WIRELESS STEREO

Popular Electronics®

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE OCTOBER 1977/$1.25

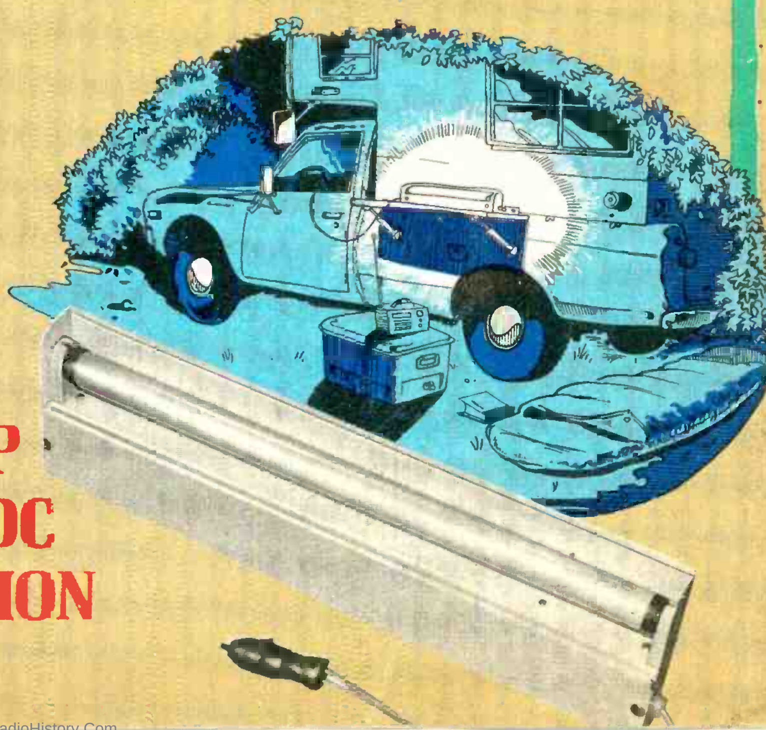
TELETYPEWRITER FUNDAMENTALS FOR COMPUTER HOBBYISTS, HAMS & SWL'ers

How To Design TTL Digital Systems

Build a Low-cost, High-sensitivity SWR Meter

TESTED THIS ISSUE:

Sony EL-5 Elcaset, Scott R376 AM/Stereo FM Receiver, Hy-Gain 2716 AM Mobile CB Transceiver



BUILD A FLUORESCENT LAMP FOR 12 VDC OPERATION

0 14024 14278 10
Popular Electronics

The Cobra 50XLR CB has it all. AM/FM Stereo. Cassette. And CB. All in one compact unit. All engineered to bring you the same loud and clear sound Cobra is famous for.

The remote mike houses the channel selector, squelch control, and channel indicator. So all you need for talking CB is right there in your hand. The cassette player features through the dial loading and four-way fader control.

Because they're only five inches deep, there's a Cobra in-dash radio to fit almost any car with little or no modification to the dash. This feature, plus the step-by-step Installation Manual and Universal Installation Kit makes them the easiest in-dash radios to install. And our Nationwide network of Authorized Service Centers makes them the easiest to service.

There are four Cobra in-dash models to choose from including AM/FM/Stereo/8-track/CB. But no matter which you choose you can be sure of getting the best sounding radio going. The ultimate car radio.

The Cobra.

Cobra®

Punches through loud and clear.

Cobra Communications Products
DYNASCAN CORPORATION
6460 W. Cortland St., Chicago, Illinois 60635
Write for color brochure
EXPORTERS: Empire • Plainview, N.Y. • CANADA: Atlas Electronics • Toronto
Subject to FCC type acceptance.

CIRCLE NO. 11 ON FREE INFORMATION CARD

THE ULTIMATE CAR RADIO.

Security is Mallory.

With Mallory Security Products on the job, intruders get the message loud and clear, anyplace, anytime. For the few dollars they cost, here are mighty effective ways to signal forced entry of a building, home, apartment, office, automobile.

Put the Mallory CA3 Intrusion Alarm in your living room, for instance. It'll easily pass for a radio or stereo tuner while transmitting a 20-foot ultrasonic wavelength field. One that will detect the slightest intruder movement and activate an alarm. This compact area-and-perimeter device comes with solid-state circuitry and big reliability. And a wide variety of indoor and outdoor warning accessories to choose from—bells, horns, sirens, rotating red lights, tape switches, many more.

For automobile security, install the Mallory ABA1 Car Alarm with entry sensing and instant siren alert for doors, hood and trunk. It comes as an easy-to-install kit, complete with switches, wire, keys, warning decals.

From any angle, Mallory Security Products mean protection. See your Mallory distributor. Or send for our Security Products Bulletin No. 9-654.

Mallory Distributor Products Company. A division of P. R. Mallory & Co. Inc., Box 1284, Indianapolis, Indiana 46206. (317) 856-3731.

Mallory CA3 Intrusion Alarm and ABA1 Car Alarm.

MALLORY

Capacitors • Controls • Fastening Devices • Resistors • Security Products • Semiconductors • Solderless Terminals • Switches

CIRCLE NO. 30 ON FREE INFORMATION CARD

SWTPC announces first dual minifloppy kit under $1,000

Now SWTPC offers complete best-buy computer system with $995 dual minifloppy, $500 video terminal/monitor, $395 4K computer.

$995 MF-68 Dual Minifloppy
You need dual drives to get full benefits from a minifloppy. So we waited to offer a floppy until we could give you a dependable dual system at the right price.

The MF-68 is a complete top-quality minifloppy for your SWTPC Computer. The kit has controller, chassis, cover, power supply, cables, assembly instructions, two highly reliable Shugart drives, and a diskette with the Floppy Disk Operating System (FDOS) and disk BASIC. (A floppy is no better than its operating system, and the MF-68 has one of the best available.) An optional $850 MF-6X kit expands the system to four drives.

$500 Terminal/Monitor
The CT-64 terminal kit offers these premium features: 64-character lines, upper/lower case letters, switchable control character printing, word highlighting, full cursor control, 110-1200 Baud serial interface, and many others. Separately the CT-64 is $325, the 12 MHz CT-VM monitor $175.

$395 4K 6800 Computer
The SWTPC 6800 comes complete with 4K memory, serial interface, power supply, chassis, famous Motorola MIKBUG® mini-operating system in read-only memory (ROM), and the most complete documentation with any computer kit. Our growing software library includes 4K and 8K BASIC (cassettes $4.95 and $9.95; paper tape $10.00 and $20.00). Extra memory, $100/4K or $250/8K.

Other SWTPC peripherals include $250 PR-40 Alphanumeric Line Printer (40 characters/line, 5 x 7 dot matrix, 75 line/minute speed, compatible with our 6800 computer and MITS/IMSAI); $79.50 AC-30 Cassette Interface System (writes/reads Kansas City standard tapes, controls two recorders, usable with other computers); and other peripherals now and to come.

Enclosed is:

_____ $1,990 for the full system shown above (MF-68 Minifloppy, CT-64 Terminal with CT-VM Monitor).
_____ $995 for the Dual Minifloppy
_____ $325 for the CT-64 Terminal
_____ $175 for the CT-VM Monitor
_____ $395 for the 4K 6800 Computer
_____ $250 for the PR-40 Line Printer
_____ $79.50 for AC-30 Cassette Inferface
_____ Additional 4K memory boards at $100
_____ Additional 8K memory boards at $250
_____ Or BAC # __________ Exp. Date _____
_____ Or MC # __________ Exp. Date _____

Name__________ Address__________
City__________ State _____ Zip_____

CIRCLE NO. 54 ON FREE INFORMATION CARD

SWTPC
Southwest Technical Products Corp.
219 W. Rhapsody, San Antonio, Texas 78216
London: Southwest Technical Products Co., Ltd.
Tokyo: Southwest Technical Products Corp./Japan

OCTOBER 1977

VOLUME 12, NUMBER 4

Popular Electronics®

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

Coming Next Month

BUILD AN AUDIO COMPANDER

ADD SYNTHESIZED SOUNDS TO ANY MODEL RAILROAD

HOW TO DRESS UP YOUR PROJECTS

PIRACY ON THE AIRWAVES

TEST REPORTS:
- Dual 1245 Automatic Turntable
- Burwen DNF 1201A Noise Reduction System
- Radio Shack TRC-449 CB Mobile Transceiver

Feature Articles

Construction Articles

Columns

Julian Hirsch Audio Reports

Electronic Product Test Reports

Departments

POPULAR ELECTRONICS, October 1977, Volume 12, Number 4, Published monthly at One Park Avenue, New York, NY 10016. One year subscription rate for U.S. $12.00; Possessions and Canada, $15.00; all other countries, $18.00 (cash orders only, payable in U.S. currency). Second Class postage paid at New York, NY and at additional mailing offices. Authorized as second class mail by the Post Office Department, Ottawa, Canada, and for payment of postage in cash.

POPULAR ELECTRONICS including ELECTRONICS WORLD, Trade Mark Registered. Indexed in the Reader's Guide to Periodical Literature.

Editorial correspondence: POPULAR ELECTRONICS, 1 Park Ave., New York, NY 10016. Editorial contributions must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models.

Forms 3579 and all subscription correspondence: POPULAR ELECTRONICS, Circulation Dept., P.O. Box 2774, Boulder, CO 80302. Please allow at least eight weeks for change of address. Include your old address, enclosing, if possible, an address label from a recent issue.

Popular Electronics®

ZIFF-DAVIS PUBLISHING COMPANY
Editorial and Executive Offices
One Park Avenue New York, New York 10016
212-725-3500
Hershel B. Sarbin, President
Philip Korsant, Executive Vice President
Furman Hebb, Executive Vice President
John R. Emery, Sr. Vice President, Finance and Treasurer
Phillip T Heffernan, Sr Vice President
Edward D Muhlfeld, Sr. Vice President, Sports Division
Philip Sine, Sr Vice President
Frank Pomerantz, Vice President, Creative Services
Arthur W. Butzow, Vice President, Production
Lawrence Sporn, Vice President, Circulation
George Morrissey, Vice President
Sydney H. Rogers, Vice President
Sidney Holtz, Vice President
Albert S Traina, Vice President
Paul H. Chook, Vice President
Edgar W Hopper, Vice President
Robert N. Bavier, Jr., Vice President
Charles B. Seton, Secretary

William Ziff, Chairman
W. Bradford Briggs, Vice Chairman

Midwestern Office
The Pattis Group, 4761 West Touhy Ave.,
Lincolnwood, Illinois 60646, 312 679-1100
Thomas Hockney, Michael Neri, Gerald E. Wolfe
Western Office
9025 Wilshire Boulevard, Beverly Hills, CA 90211
213-273-8050; BRadshaw 2-1161
Western Advertising Manager: Bud Dean
Japan James Yagi
Oji Palace Aoyama; 6-25, Minami Aoyama
6 Chome, Minato-Ku, Tokyo 407-1930/6821,
582-2851

Editorial

THE FUTURE OF HOME COMPUTERS

It has been almost three years since POPULAR ELECTRONICS introduced the first powerful, low-cost microcomputer mainframe. In this short time, many changes have taken place in the field. For example, then you could only buy a home computer by ordering it through the mail, sight unseen. Now there are many hundreds of retail computer stores where prospective buyers can observe computers in action and ask questions about their operation before making a purchase. Soon there will be even more such stores (in the thousands) with Radio Shack's and Heath's recent announcements of computer models joining the fold.

Other changes are evident, too. Whereas virtually every home computer purchased a few years ago was in kit form, sales of factory-assembled versions are growing. Moreover, we used to have just mainframes with separate peripherals; now we can buy single-board computers and mainframes incorporating terminals. For storing programs, the use of paper tape programs is giving way to audio cassette systems, with many a computer buff hoping for a floppy disc under his Christmas tree . . . BASIC in ROM is "in," if only because more and more electrical blackouts are anticipated . . . computer clubs are springing up all over the country as if they were fast-food operations.

Naturally, the question arises: "Where are non-commercial computers headed?" Undoubtedly, computers will one day reach the mass market; but when and where will they be merchandised? Here, views are divided.

Many people think computers will be sold by mass-market merchandisers, such as the large department stores. Supporting this view, a spokesman for Commodore Business Machines indicated that its personal computer (not yet available for sale) will indeed be sold by department stores, starting with the California division of R.H. Macy & Co. "In about five years or so, it'll be just like the calculator market is today," one computer hobbyist opined.

I don't agree.

Right now, we have virtually no true personal computer systems. Rather, we have a hobbyist and small-business market, as opposed to the appliance-type of computer. The field for the latter is bound to grow, of course. However, I don't believe that the *general public* is ready to plunk down $600 or more for a computer system that is largely based on playing games, doubling as a hand-held calculator, and maintaining the family checking account. It's a nice thought, but, in my view, an over-optimistic one. This is an area which will appeal to the hobbyist, who will take the time to learn what the machine can do, explore different ways in which to expand the computer's utility, join computer clubs, etc. This person is not the button pusher.

Furthermore, I cannot visualize computers being sold in great numbers in a general type of retail outlet where one cannot even get the attention of a clerk to pay a bill, let alone obtain counsel. It's the *specialist* store that will be best equipped to move computer merchandise in the foreseeable future. I draw a parallel here with stores that merchandise hi-fi components and photography equipment. Sure there are department stores that sell such equipment, but most of it is sold in specialty stores whose sales personnel can hold a customer's hand while he makes a buying decision and support him after the sale is made. And that's the computer or electronic retail store.

The mass appeal of computers to the public will likely take place when a terminal can be used in the home for a variety of pushbutton applications: shopping for and buying merchandise in various stores while sitting at home, selecting video presentations of material from newspapers and reference books in libraries, and so on. When this comes to pass (in the 1990's?), I'm confident that the terminals will be supplied initially by the "phone company" or IBM, rather than the comparatively small computer manufacturer. The latter is more likely to enter the competition after the former has established a major market by installing fibre optic cable lines to carry digital data, contracting with sellers, and offering the public a line of terminals for home use (with a monthly rental fee, of course).

Meanwhile, I anticipate the continued, burgeoning growth of the hobbyist and small business computer field for the next decade.

Art Salsberg

B&K-PRECISION's new 3½ digit DMM

For over two years, our competition has been trying to figure out how B&K-PRECISION could sell a full-feature 3-digit DMM for only $99.95. They've dissected it, analyzed it, and some even asked us how we did it. Well, they can start all over because we did it again!

B&K-PRECISION's new Model 2800 portable DMM features 3-1/2 digit display, auto-zeroing and 100% overrange reading for only $99.95. Basic DC accuracy is 1%. Twenty-two ranges read up to 1000 volts DC or AC, 1000mA and 10 megohms.

All ranges are well protected against overloads. Even if you should accidentally apply +1000VDC to the 2800 while switched to an ohms range, no instrument damage will result. All DC and AC voltage ranges are protected up to ±1000 volts DC or AC. The current ranges receive the double protection of diodes and a series fuse.

For accurate in-circuit resistance measurements, the 2800 measures with high– or low-power ohms ranges. At low-power ohms, less than 0.2 volt is developed across the measured resistance. To forward bias semiconductor junctions, the high-power ohms ranges develop about 2 volts.

B&K-PRECISION also has a full complement of optional accessories for the 2800. Accessories include a carrying case, wire tilt stand, AC adapter/charger, high-voltage probe, direct/isolation probe NiCad Batteries and 10-amp current shunt.

The B&K-PRECISION 2800 may be a mystery to our competitors, but for you—it takes all the mystery out of which DMM to buy.

See your local distributor for immediate delivery.

B·K PRECISION DYNASCAN CORPORATION

6460 West Cortland Avenue, Chicago, Illinois 60635 · 312/889-9087

In Canada: Atlas Electronics, Ontario · International Sales: Empire Exporters, Inc., 270 Newtown Road, Plainview, LI, NY 11803

CIRCLE NO. 9 ON FREE INFORMATION CARD

TEACHING DEVICE · ARCADE GAME · MUSICAL INSTRUMENT · HOME COMPUTER

Home Library Computer

The handsome and highly styled Bally Library Computer is made of high impact clear plastic and imitation walnut with gold trim. It measures 5" x 11" x 15" and weighs five pounds.

The new Bally Library Computer provides more entertainment and services than man has ever dreamed possible from a single consumer product.

This is the story of an incredible product. So incredible that we know of no future consumer product that will have such a far-reaching technological impact on society.

The Bally Library Computer is a small console unit that resembles a programmable TV game but whose computing capabilities resemble that of the IBM 5100 currently selling for $10,000. This calculating power and its present and future programs will provide more convenience and benefits than any other recent electronic product.

ELECTRONIC PRINTING CALCULATOR

Imagine the computer as a printing calculator with ten separate memories. You enter the data on the unit's keyboard, but instead of a paper tape, you use your TV screen to scroll out the answers similar to the credits on a movie screen. You can balance your checkbook and then double check your calculations by scrolling back to your first entry. By comparison, an electronic calculator with ten memories alone would cost what this entire computer costs—but there's much more.

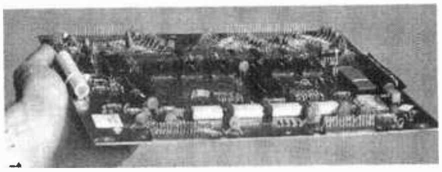
A CHALLENGING TEACHING TOOL

Your child inserts a cartridge in the Bally console. Three random math table problems are then flashed on your TV screen. Depending on the speed and accuracy with which those problems are answered, the Bally automatically programs the computer with your child's math level. Problems in addition, subtraction, multiplication and division are then flashed on the screen for the next three minutes, and the computer continually adjusts to a level slightly better than the math level indicated by the previous three answers. The math tables, therefore, remain a challenge no matter how good your child becomes. Psychologists, who were consulted by Bally, helped design the cassette. They stated that the cassette should stimulate math learning and improve grades.

On the same math cartridge is a two player game called Math Bingo. It adjusts to each player's ability so a parent can play against a child or two children can compete against each other at their own math levels—both with an equal opportunity to win. You first answer a math table problem similar to the first exercise; and with a pistol-grip pointer you move a square on your TV screen to the correct answer position on your TV bingo card. The game involves both math skill and dexterity. Each game is totally different since the bingo cards have a million different possibilities. Scoring is constantly displayed, and a typical game lasts approximately three minutes. You can play as many consecutive games as you wish. However, to start the score over, you press the reset button.

FUN AND ACTION ARCADE GAMES

Picture nine baseball players running out on your TV screen to the sounds of "Take Me Out to the Ball Game" as you step up to bat. That's the scene with Baseball, the arcade cartridge that plays two teams against each other with play so real that you hear all the music, sound effects and see all the action. There are walks, balls, and such realism that the pitcher covers first base when a ball is hit to right field—just like the real game. There are double plays, walks and errors—all part of nine innings of Baseball. On the same cartridge are several paddle ball games but with a new twist. Players can move the paddle, not only up or down like most TV games, but sideways and diagonally.



The Bally circuit board contains 34 integrated circuits including a Z80 microprocessor. This package represents more computing power in the hands of the consumer than was thought possible this early in the history of micro electronics. The mass production of these components and circuit board has made possible a quantum leap in lowering the cost of what normally would be a very expensive system.

Other popular arcade games include, Sea Wolf, Red Barron, Panzer Attack (similar to Tank) and dozens of games only previously available at arcades. These same games cost arcade owners up to $2,000 each.

MORE VALUE PER FEATURE

Let's quickly review the features—an electronic printing calculator with ten memories, a teaching machine that adjusts to your child's math level and an arcade center that replaces about $10,000 worth of electronic arcade games with just a few cartridges. Use any one of these features and you could justify buying this unit—but there's plenty more.

With all its sophistication, the Bally Library Computer was designed to keep current with advancing computer technology no matter how sophisticated the development. Bally has provisions in its present system for expansion modules. These devices will permit you to: 1) draw directly on your TV screen with an electronic wand in 32 different colors and eight shades of each color, 2) compose, record and playback music on an electronic synthesizer, 3) record your personal belongings and their value for security purposes and add or delete items while keeping the list in tact, 4) record all your phone numbers and then use the system to dial those numbers on your telephone, 5) play chess on the phone with another player and be able to see all the moves on your TV screen.

EXCELLENT BUSINESS TOOL

With these expansion modules, businessmen will be able to do all their bookkeeping functions, payroll, inventory control and billing. There will be printers, telephone modems and a variety of peripheral computer equipment that will turn your Bally Library Computer into a significant business tool. And, when used in your business, your Bally unit is depreciable like all your other capital equipment. Even large corporations can use the Bally for specific applications to avoid tying up their larger computer systems.

The Bally Library Computer will turn these incredible add-on features into reality in a planned program starting now. Each month, a new cartridge or accessory expanding the unit's capability will be announced. If you purchase your system from JS&A, you will be alerted to these new accessories by mail on a regular basis in advance of their availability and before any national announcement. You may then order the accessories directly.

Each new cartridge or accessory will offer you a new way to use your system—a way that would justify, by itself, the purchase of the entire system.

NOT JUST A TV GAME

Don't confuse the Bally Library Computer with the many inexpensive programmable TV games. The Bally computer is a powerful system using the Z80 microprocessor whose cost per byte (the measure of computer memory power) is even lower than a home computer. Yet it has 12,000 bytes of computer power in its most basic system and you are not just limited to teaching, music, entertainment or business applications. The Bally computer can be programmed to do anything any mini-computer can do. A programmable TV game at any price is (and will always be) just a programmable TV game. It cannot be expanded. The Bally Library Computer is actually a computer with a variety of expansion capabilities.

A COMPUTER IN EVERY HOME

This is the first time a full-scale computer has been offered to the consumer. The home hobbyist with his home computer started the revolution a few years ago. With the specific programs, software and accessories available from Bally, the age of affordable consumer computer ownership is here now.

INTERNAL TASK LIBRARY

The computer you buy now has within its 34 integrated circuits an internal library of over forty tasks that it performs. With such an extensive internal library, your computing power is already in the unit you buy. This also means that the Bally unit is a smart computer. (There are such things as dumb computers.) A smart computer can complete a function faster and more efficiently because it depends less on the data it gets and more on what it can already do.

SAFE FOR YOUR TV

The task library includes a built-in electronic timer which determines the end of a game or program by either score or elapsed time. It also times the arcade games and automatically turns off your unit and blanks out your screen if it is left on too long. Most TV set manufacturers have excluded sets that use TV games from warranty coverage because of the possible lines that appear on the screen from sets left on too long with the same picture. This is impossible with the Bally.

If you get a phone call in the middle of a game, you press the pause control which lets you freeze the action right in the middle of a play and blanks out the screen so you won't damage your picture tube.

The library has sound effects so that each arcade game is complete—from the sound of a baseball bat to that of a torpedo hitting a submarine. It has a math program capable of turning your unit into a scientific, statistical or engineering calculator with the addition of the appropriate cartridge. The library contains the capability of creating patterns on your TV screen, playing music, and accepting typewriter entries. It even has an index that displays everything in your library.

The cassette cartridges add between eight to thirty-two thousand additional bytes of computer power to the basic 12,000 byte system. The pistol grip arcade accessory can be used to play all the arcade games.

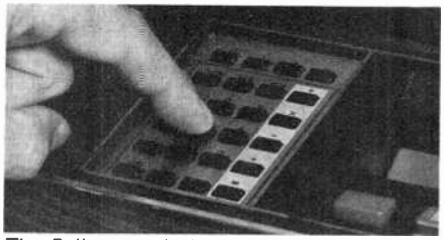
THE MAJOR BREAKTHROUGH IN BALLY'S COMPUTER

Its extensive internal library and the tremendous power in the computer are the big breakthroughs in the Bally unit. The internal computer has over 12,000 bytes with a minimum of 8,000 bytes in its cartridges. This puts more computer power in the hands of the consumer than six typical programmable TV games or an average hobbyist home computer. It has the computational capabilities of one $10,000 IBM 5100 computer, and each time you add a cassette cartridge you increase that capability.

Good resolution on your TV screen is one of the end effects of so much computer power. By comparison, the best programmable TV game image is projected on a screen composed of 64 dots wide by 64 dots deep or 4,096 total dots. The Bally unit is 160 by 100 or 16,000 dots—four times more—so the Bally image is sharper and has finer detail, better resolution, smoother motion, and clearer letters for math or text applications.

SIGNIFICANT EXPANSION MODULES

The most significant expansion accessory will be the dual magnetic tape decks with an alpha numeric (typewriter) keyboard. With this accessory package, which will cost under $500 and be introduced by JS&A next year, you can record data and software programs and do everything you can do on any mainframe computer system within the data storage capacity of the Bally unit.



The Bally console keyboard is used to select specific programs from each cassette.

The implications of this add-on module are mind-boggling. First, it adds an additional 16,000 bytes of memory to the powerful 12,000 already in the basic system. Secondly, it provides not only more power and features than are presently available in any home computer, but it contains peripherals that would normally cost thousands of dollars extra and are considered accessories on all other mini-computer systems. Thirdly, it uses the computer basic language which is easy to understand. And finally, each cassette tape in the system will contain an additional one quarter million bytes of storage capability. With the tape decks and keyboard, the consumer will now own the equivalent of an entire computer system complete with peripherals, storage and memory.

HIGH SPEED PRINTER

A quality high-speed printer will also be available next year. This will give you written records from your storage tapes. Store your most frequently called phone numbers, your income tax figures, your savings account deposits, the value of your stocks and bonds or a net worth statement. Then, when you need the information, press a button for a printed record.

DIAL-A-BARGAIN® ORDERING SYSTEM

Our technicians have programmed JS&A's main computer so you can use the Bally to access our computer directly when Bally's dual tape decks become available. With a special module and cassette, you will be able to 1) call our computer on our toll-free number, 2) place an order, and 3) find out when it will be shipped. Since you communicate directly with our computer, your order is processed immediately and can be shipped within a few hours after receipt. To do this, JS&A engineers developed a $100 hardware ordering package that will be sent free to those customers who order the basic unit this year.

THE BIG DIFFERENCE

When you order the Bally computer today, you are making an investment in the future. The basic unit you receive, without a single accessory, will provide more benefits than any other product of its kind in history.

When you buy an expensive product, you must be absolutely satisified that you get the service and a solid company standing behind your purchase for many years to come. The Bally Library Computer is backed by a substantial company, Bally—in business since 1931 and now the world's largest manufacturer of coin-operated amusement games. JS&A is America's largest single source of space-age consumer products and also a substantial company—further assurance that your investment is well protected.

A FRANK DISCUSSION OF SERVICE

The Bally unit is a solid-state computer with its electronics condensed on 34 integrated circuits—all hermetically sealed and all pre-tested for a lifetime of service. The Bally Computer is also self-diagnostic. We have developed a cartridge that lets the unit itself check every integrated circuit and every solid-state component and which displays any malfunction on your TV screen. Then all you do is send the circuit board or your entire unit to JS&A's service-by-mail center for prompt replacement. The cartridge will be sent free-of-charge only to JS&A customers after you receive your unit.

Please don't think service requirements are common. They're not. But we wanted to assure you that service was such an important consideration in the Bally design that the unit practically repairs itself.

COMPLETE AS IT ARRIVES

Each unit comes complete with four pistol grips for use with the arcade and teaching games, an AC adapter (batteries are not required), three free arcade games, the calculator program, its internal library of tasks, complete easy-to-understand instructions and a one year parts and 90 day labor limited warranty—all for only $299.95.

The arcade games include 1) Gun Fight, in which two cowboys shoot at each other around cactus, covered wagons and other obstacles, 2) Checkmate, a one to four player game in which you build walls around your opponent to win and, 3) Scribbling, a one to four player game that utilizes the pistol grip to droodle different designs on your TV screen (in color with a color set).

A keyboard lets you use your printing memory calculator and a special scroll button lets you scan your entries up or down to review or check your calculations. You may also order with your unit the Baseball and Paddle Games cartridge for $24.95 or the Math Table/Math Bingo cartridge for $19.95. A bulletin will accompany your unit listing all the other cartridges and accessories that are available or will be available in the near future.

We feel so positive about this product that we will 1) not charge you anything for postage and handling and 2) give you a 30 day extended trial period to prove that the Bally is everything you expected after reading this article. When you receive your unit, reconcile your checkbook with the calculator, let your child practice with the math programs or have your entire family play the arcade games. After you have used the system under your own conditions and have personally experienced its fun and benefits, then decide if you want to keep it. If not, return it within our 30 day extended trial period for a prompt and courteous refund. You can't lose.

JS&A is marketing a product that will not only greatly influence the future of the computer industry, but will dramatically add consumer conveniences never before dreamed possible. Order your Bally Library Computer, at no obligation, today.

Unit pending FCC approval—allow 4 weeks delivery.
Dial-A-Bargain is a registered trade mark of the JS&A National Sales Group.

JS&A® NATIONAL SALES GROUP
Dept. PE One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-9000
CALL TOLL-FREE.... 800 323-6400
In Illinois call .... (312) 498-6900

CIRCLE NO 25 ON FREE INFORMATION CARD

Learn to service Communications/CB equipment at home...with

NRI'S COMPLETE COMMUNICATIONS COURSE

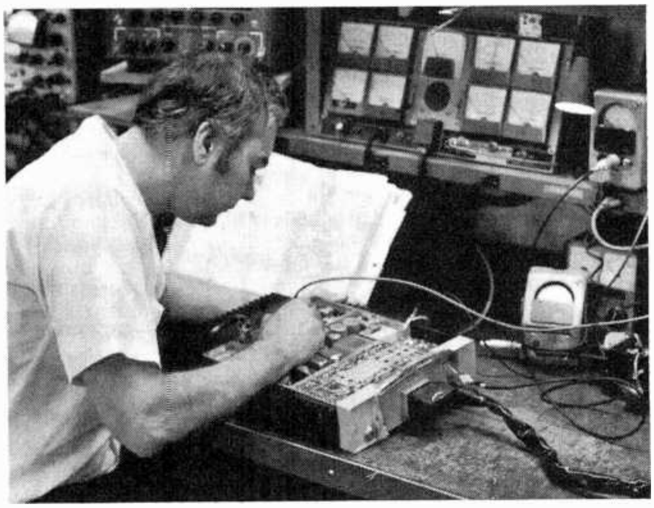
Learn design, installation and maintenance of commercial, amateur, or CB communications equipment.

The field of communications is bursting out all over. In Citizens Band alone, class D licenses grew from 1 to over 2.6 million in 1975, and the FCC projects about 15 million CB'ers in the U.S. by 1979. That means a lot of service and maintenance jobs . . . and NRI can train you at home to fill one of those openings. NRI's Complete Communications Course covers all types of two-way radio equipment (including CB), AM and FM

Transmission and Reception, Television Broadcasting, Microwave Systems, Radar Principles, Marine Electronics, Mobile Communications, and Aircraft Electronics. The course will also qualify you for a First Class Radio Telephone Commercial FCC License or you get your tuition back.

Learn on your own 400-channel digitally-synthesized VHF transceiver.

You will learn to service all types of communication equipment, with the one unit that is designed mechanically and electronically to train you for CB, Commercial and Amateur communications: a digitally-synthesized 400-channel VHF transceiver and AC power supply. This 2-meter unit gives you "Power-On" training. Then we help you get your FCC Amateur License with



special instruction so you can go on the air.

The complete course includes 48 lessons, 9 special reference texts, and 10 training kits. Included are: your own electronics Discovery Lab, Antenna Applications Lab, CMOS Frequency Counter, and an Optical Transmission System. You'll learn at home, progressing at your own speed, to your FCC license and into the communications field of your choice.

NEW CB SPECIALIST COURSE NOW OFFERED

NRI now offers a special course in CB Servicing. You get 37 lessons, 8 reference texts, your own CB Transceiver, AC power supply and multimeter . . . for hands-on training. Also included are 14 coaching units to make it easy to get your commercial radio telephone FCC license—enabling you to test, install, and service communications equipment.

Letters

EMERGENCY CALL SIGN "STANDARD"

In the May 1977 "CB Scene" it was stated that the PURAC was considering the 0911 number for an Emergency Call Sign. Within the past year, most single-sideband clubs in Ohio have adopted the Emergency Call Sign of 999, which is quickly being adopted throughout the U.S. On SSB, we use the "Q" signals, which many SSB clubs have adopted, to cut down on air time. (Q signals do not have an emergency call as is the case with the 10 Code.) I suggest that if an emergency call is made, it should coincide with one that has already been voluntarily adopted by CB'ers. *—Denton C. Rastall, President, USB, Willowick, OH*

COMPREHENSIVE, GENERAL, AND SPECIFIC

"FM Tuner Ratings and Measurement" by Julian Hirsch in the April 1977 issue was very informative. The article was comprehensive enough to be specific and general enough to be applied to just about any FM tuner available. After reading this article, I took a check, as suggested, of my tuner and compared the results I obtained to the results obtained from a test of a friend's FM tuner. I noted a substantial difference between the two sets of results. Finally, when playing the two tuners side by side, we could hear the difference. *Cary R. Patten, Northville, MI*

WORD SPACING IS VERY COMMON

I question the statement in "Morse Code Automatic Readout On a TV Screen" (May 1977) that "word spacing is rarely sent in Morse Code." After the original "Morse-A-Letter" project appeared in the January 1977 issue of Popular Electronics, I made my own interface that produces perfect word spaces. I send the parallel data out to my video terminal in RS-232 via a UART. I would have submitted a photo of a full "page" of a news broadcast that shows perfect word spacing were it not illegal. Except in the case of crude or unusual keying, I find word spacing is very common, even if it does occur naturally rather than intentionally. After all, any pause longer than a character will register as a word space. *—Joseph A. Maddox, Cincinnati, OH*

HOW ABOUT A TRANSLATION?

I enjoyed "How To Program Calculators for Fun and Games." However, the programs given are in Reverse Polish Notation (RPN) and not suitable directly for use with my algebraic-entry calculator. Needless to say, I had difficulty in trying to decipher and rewrite the programs. I hope that next time Popular Electronics publishes programs they are listed in a form that will make it easier to program any calculator. *—Marc Wester, Burlingame, CA*

We'll try.

ANOTHER COUNTING APPROACH

With reference to the June 1977 "Out Of Tune" for the "Westminster Clock" that appeared in the November 1976 issue, I had the same problem in getting *IC18* to count from 1 to 12 properly. It took me several weeks of learning about MOS to find the fault. In my studies, I learned about a different approach to use to get my clock working. To obtain a positive pulse to reset *IC18* at 1 o'clock, I connected *IC2*, pin 12, to the spare inverter in *IC5* (pins 12 and 13) and *IC5*, pin 11, to *IC18*, pin 15, and eliminated *C3* and *R9*. Pins 23 and 37 of *IC19* (output common source and unblanking, respectively) require a positive supply.

This was the best project yet. It made me learn something about CMOS.*—K.G. Burnett, Errington, B.C., Canada.*

MORSE CODE DETERRENT

I read the November 1976 Editorial with interest and would like to state that amateur radio operators should remember that they are

FREQ. OUT.

CSC's done it again.

Broken the price and performance barriers with new MAX-100. The multimode, professional portable frequency counter that gives you more range, visibility, accuracy, and versatility than any comparable unit at anywhere near its low, low price.

MAXimum performance. MAX-100 is a cinch to use. It gives you *continuous readings* from 20Hz to a *guaranteed 100MHz,* with 8-digit accuracy. Fast readings with 1/6-sec. update and 1-sec. sampling rate. Precise readings, derived from a crystal-controlled time base with 3ppm accuracy. High-sensitivity readings from signals as low as 30 mV, with diode overload protection up to 200V peaks.

Input signals over 100MHz automatically flash the most significant digit. And to indicate low-battery condition and extend remaining battery life, the *entire* display flashes at 1 Hz.

MAXimum versatility. Wherever and whenever you need accurate frequency readings, MAX can do the job. Use it with clip-lead cable supplied. Mini-whip antenna. Or low-loss in-line tap with UHF connectors. For AM or FM; CB, ham, business radio and R/C transmitter or receiver alignment. Monitoring audio and RF generators. Checking computer clocks and other digital circuits. Repair of depth sounders and fish spotters. Troubleshooting ultrasonic remote controls. For these, and hundreds of other applications, you'll find it indispensable.

MAXimum visibility. MAX-100 features a big, bright 0.6" multiplexed *8-digit* LED display, with leading-zero blanking. So you don't have to squint, or work up close. And, MAX's flip-up stand is *built-in.*

MAXimum flexibility. MAX-100 operates from *four* power sources, for use in lab or field. Internal alkaline or NiCad batteries. 110 or 220V with charger/eliminator. 12V with automobile cigarette-lighter adapter/charger. And external 7.2-10V supply.

MAXimum value. With all its impressive specs, you'd expect MAX to cost a lot more than a low $134.95, complete with clip-lead cable and applications/instruction manual. But that's another nice thing about MAX: though it's accurate enough for lab use, it's well within the reach of hobbyists' and CB-ers' budgets.

Try MAX for yourself at your CSC dealer—or contact us for full specs and your local dealer's name. Once you see how handy MAX is, you'll want to "freq out" too. With CSC.

Specifications.

Range: 20Hz to 100 MHz, guaranteed. **Gatetime:** 1 sec. **Resolution:** 1 Hz. **Accuracy:** ± 1 count + time base error. **Input Impedance:** 1 MΩ/56 pF. **Coupling:** AC. **Sine Wave Sensitivity:** 30 mVRMS @ 50 MHz. **Internal Time Base Frequency:** 3.579545 MHz crystal osc. **Setability:** ± 3 ppm @ 25°C. **Temp-Stability:** Better than 0.2 ppm/°C 0-50°C. **Max. Aging:** 10 ppm/year. **Display:** Eight .6" LED digits; anti-glare window. **Lead-zero blanking:** decimal point appears between 6th and 7th digit when input exceeds 1 MHz. **Overflow:** with signals over 99,999,999 Hz, most significant (left hand) digit flashes, allowing readings in excess of 100 MHz. **Display update:** 1/6-second plus 1 sec. gate time. **Low Battery Indicator:** When power supply falls below 6.6 VDC, all digits flash @ 1 Hz rate. Flashing display extends battery life. **Power:** 6 AA Alkaline or NiCad cells (internal); **External:** 110 or 220VAC Eliminator/charger; Auto cigarette lighter adapter; 7.2-10 VDC ext. supply; **Bat. Charging:** 12-14hr. **Size (HWD):** 1.75" x 5.63" x 7.75" (4.45 x 14.30 x 19.69 cm) **Weight:** Less than 1.5 lb. (0.68 kg) w/batteries. **Accessories Included:** Clip-lead input cable; manual.

CONTINENTAL SPECIALTIES CORPORATION

44 Kendall Street, Box 1942, New Haven, CT 06509
203-624-3103 TWX 710-465-1227
West Coast: 351 California St., San Francisco, CA 94104
415-421-8872 TWX 910-372-7992
MEXICO: ELPRO, S.A. Mexico City 5-23-30-04
CANADA: Len Finkler Ltd., Ontario

CIRCLE NO. 13 ON FREE INFORMATION CARD

an elite group by our choice, not theirs. I have worked in industrial electronics with hams and found them to be a good group of guys who know their electronics and their equipment very well. I, too, have been interested in ham radio, but I decided to pass on it because of the Morse Code requirement, which I do not understand and do not like. I feel the code requirement is a deterrent to highly qualified electronics technicians who simply can do without. Letting technicians into ham radio would be an enhancement, not a dilution.—*Gil Duddles, Princeton, IL.*

VALUABLE TEST INSTRUMENT

I recently built the "Automatic Diode Checker" featured in the June 1976 issue of POPULAR ELECTRONICS. It proved to be the most valuable test instrument I have ever seen. It is so simple and effective that I cannot help but wonder if the same principle could not be applied to the testing of transistors, inasmuch as they are basically a couple of diodes connected back-to-back. I service quite a few electronic photoflash units and since diodes and transistors are trouble spots in them, I know the diode tester will become an indispensable troubleshooting tool.—*Edward A. Bollinger, Satellite Beach, FL.*

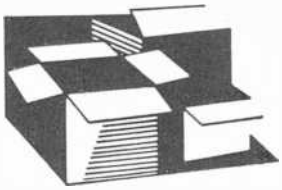
SOLAR CONTROLLER KIT

I read with interest "Build a Solar Controller" (July 1977), and while this device is suitable for actuating attic ventilators, it does have some deficiencies when used to control solar collection systems. Because the circuit provides no hysteresis, the system will cycle on and off at the same temperature difference between the sensors. Most solar controllers (or differential thermostats) are designed to turn on only when collector temperature exceeds the storage temperature by 20° F and then cycle off when this temperature difference falls to 3° F. This prevents rapid cycling of the system in early morning and late afternoon when only marginal solar energy is available, resulting in greater overall efficiency.

Our company offers a complete solar controller kit for less than $30. It includes the turn-on hysteresis, as well as freeze protection circuitry. This enables the controller to turn on the circulation system when the outside temperature falls to 36° F, thereby warming the collectors and preventing freezing when water is the circulating fluid.—*Charles Morton, Wind Sun Systems, 5209 Ave. H, Austin, TX 78751*

Out of Tune

In "How To Convert a 'Four Banger' For Stopwatch Functions" (August 1977), the identifications of IC2 and IC3 should be interchanged in the component installation diagram on page 57.



New Products

Additional information on new products covered in this section is available from the manufacturers. Either circle the item's code number on the Reader Service Card inside the back cover or write to the manufacturer at the address given.

DYNACO STEREO OCTAVE EQUALIZER

Dynaco's stereo octave equalizer, SE-10, has 10 slide controls for each channel, one control for each octave of frequency. Equalizer range is ±12dB from 30 Hz to 15 kHz. THD is said to be typically less than 0.01%, while hum and noise is rated 85 dB below two volts. The SE-10 has eight integrated circuits, two FET's, five transistors, and an IC-regulat-

ed power supply. A three-transistor circuit electronically prevents switch pops. Other features include independent channel gain control from −12 to +6 dB; low impedance (600 ohm) output; and 16 amplifiers in the four low-frequency sliders of both channels. An independent source/tape switch enables equalization of a second program. Factory assembled $349, kit $249.

CIRCLE NO 88 ON FREE INFORMATION CARD

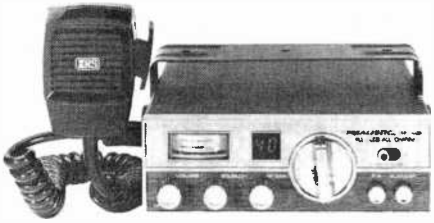
TAU EXPONENTIAL VCO AND VCF KITS

The Tau Systems Model 1050 vco kit features 1-volt/octave response over a full 10-octave range. Accuracy is claimed to be better than 1% over the range of 10 to 20,000 Hz. The vco generates up- and down-ramp and width-modulated pulse outputs of 10 volts peak-to-peak. The Model 1010 vcf kit offers a 24-dB octave response over the entire audio range, in addition to providing 10-octave exponential, 1-volt/octave control characteristics. The vcf has adjustable Q (resonance control) and can be made to generate what is claimed to be a very pure sine wave over the entire audio range. Both kits should be of particular interest to those involved in electronic music, artificial voicing, instrumentation, spectrum analysis, and sweep generation. Model 1050, $32.50; Model 1010, $47.00.

CIRCLE NO 89 ON FREE INFORMATION CARD

REALISTIC MOBILE CB AM TRANSCEIVER

Radio Shack has introduced the Realistic TRC-424 as its top-of-the-line 40-channel mobile. It features PLL circuitry, an automatic modulation gain control circuit for 100% modulation, and r-f power output of 4 W. Other



features include an r-f gain control, delta tuning switch, switchable noise blanker, LED digital readout, r-f/S meter, and PA capability. It operates on 12 V dc, positive or negative ground, and comes with mounting bracket and detachable mike. Measures 8½" × 6⅝" × 2 3/16" (21 × 17 × 6 cm). $169.95.

CIRCLE NO. 91 ON FREE INFORMATION CARD

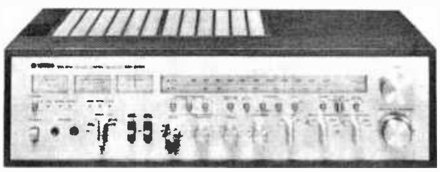
POLY 88 SYSTEM SIXTEEN COMPUTER

The POLY 88 System Sixteen from PolyMorphic Systems is a ready-to-run computer system that can be used to solve home finance problems, perform statistical analysis, and provide a host of challenging games. The 16k system features a high-speed video display and alphanumeric keyboard. Cassette tapes are used for permanent program storage. Programming is made simple by a BASIC software package. PLOT and TIME are unique features that rely on the video graphics and real-time clock. Other features include VERIFY that tells when a tape is good before another is loaded. Scientific functions, formatting options, and string capabilities are also included. $2250; kits start at $735.

CIRCLE NO. 92 ON FREE INFORMATION CARD

YAMAHA STEREO RECEIVER

The Model CR-2020 is Yamaha's top-of-the-line stereo receiver, rated at 100 watts/channel into 8 ohms at less than 0.1% THD, 20 to 20,000 Hz. Specifications include: 10 to 100,000 Hz ±2.5 dB audio frequency response; 35-45 dB stereo separation; 1.8 μV FM sensitivity; 1.0 dB capture ratio; 80 dB usable selectivity; 73 dB S/N; 30 to 15,000 Hz ±0.5 dB FM frequency response. Features include dual output power meters; signal and FM tuning meters; selectable turnover frequencies; bass, presence and treble tone



controls; selection of three pairs of speaker systems; Dolby FM selection; audio muting; FM blend switch; choice of phono input levels; and low and high filter switches. Dimensions: 21¼"W × 16 5/16"D × 6 9/16"H (540 × 415 × 167 mm). $700.

CIRCLE NO 93 ON FREE INFORMATION CARD

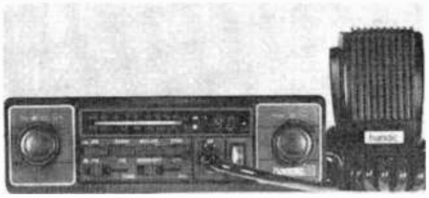
EV•GAME CB/AM/FM ANTENNA

"Breaker Beam" From EV•Game Inc. is a fully automatic, motor-driven CB/AM/FM antenna that is claimed to provide an exclusive "fail-safe" mast nesting function with ignition switch off. It also provides a transmit-actuated neon lamp that glows when the transmitter to which it is connected is keyed. The automatic fail-safe nesting action is said to ensure automatic retraction of the antenna mast into its housing mount as soon as the vehicle ignition or the transmitter/transceiver is turned off. The glowing neon lamp atop the antenna is easy to see by other CB'ers at night. The antenna extends to 40" (1 m) and has a loading coil on the fourth section of its five-section whip. The SWR is claimed to be extremely low, made possible with a fine-tuning, signal-splitting coupler that uses a CB tuning/trimmer capacitor. $79.00.

CIRCLE NO. 94 ON FREE INFORMATION CARD

HANDIC CB TRANSCEIVER/STEREO RADIO

Handic-USA's Model 240, is a 40-channel CB transceiver and AM/stereo FM receiver combination. The transceiver features PLL synthesizer, digital LED channel readout, r-f/S



meter, TX and RX indicator light, radio/CB select switch, standby/on/off switch for monitoring CB while listening to the radio, and anl. The radio has a tone control system, stereo balance control, AM/FM band select switch, and MPX/Mono switch. The entire unit is designed for in-dash installation. $259.95.

CIRCLE NO. 95 ON FREE INFORMATION CARD

WAWASEE CB FREQUENCY DISPLAY

The latest in Wawasee Electronics' line of CB accessories is a compact frequency counter, Model JB 1004 FC, that displays the operating frequency of CB and ham transceivers. It has a specified frequency range of from 100 Hz to 50 MHz, with a display accuracy of 100 Hz and a 50-mV sensitivity. Designed to be operated from 12-volt dc sources, the system's power requirements are said to be minimal because the leading zeroes of the 0.5" (12.7-mm) displays come on only when the

transceiver's microphone is keyed. Mounting is via Velcro-type "spots." The size of the counter is 4½"W × 3⅞"D × 1¾"H (11.4 × 9.8 × 4.4 cm). $99.95.

CIRCLE NO 96 ON FREE INFORMATION CARD

MULTICORE EMERGENCY SOLDER

Multicore Solders has introduced a new tape-like solder strip, called Emergency Solder, that requires only an ordinary match or candle flame to melt and form a solder joint. The Emergency Solder strip contains multiple cores of rosin flux, which is noncorrosive and can safely be used in electronic circuits. In use, the strips are loosely wrapped around the joint to be soldered and an open flame is moved back and forth until the solder flows into the joint. To solder sheet metal, the solder is placed either between or on the metal parts to be connected and heat from a candle or soldering gun is applied as the parts are held together. Available from Multicore Solders, Westbury, NY 11590.

AUDIOANALYST SPEAKER SYSTEM

Model M6 is one of a new group of speaker systems called PhaseMatrix TM introduced by Audioanalyst, Inc. It is an 8-ohm system that has a specified frequency response of 30 to 20,000 Hz ±3 dB and a maximum power handling capability of 150 watts. Minimum driving power is rated at 15 watts. The three-way speaker system has crossovers at 700 and 2000 Hz. It uses a 10" (25.4-cm) woofer,

4½" (11.4-cm) midrange driver, and 1" (2.54-cm) tweeter. The system is housed in a lacquer-finished walnut-veneer cabinet that measures 24⅜" × 13¾" × 11¾" (61.9 × 34.9 × 30 cm) and weighs 47 lb (21.3 kg). Behind the removable black fabric grille are three-position midrange and high-frequency controls that provide nine different contour setting combinations.

CIRCLE NO 97 ON FREE INFORMATION CARD

HF TRANSMITTER MONITOR

The Model WM-1000 by Communications Power, Inc. monitors transmitter performance in the 1.8-to-30-MHz frequency range. It contains three separate meters—an r-f wattmeter, an SWR meter, and a modulation level meter. The wattmeter reads either average or peak power output on 20-, 200-, and 1000-watt scales. Wattmeter operating mode (average or peak) and scale are selected by front-panel switches. The SWR and modulation meters have front-panel calibration controls and function with power levels of 1 to 1000 watts. The SWR meter employs a 30-dB directional coupler for improved accuracy at low SWR levels. Modulation level is measured by a full-wave circuit which functions over the full modulation wave form. The unit also features a built-in battery check circuit and automatic shut-off.

CIRCLE NO 98 ON FREE INFORMATION CARD

HEGEMEN PRE-PREAMP

Hegemen Input Probe (HIP) is a low-noise, wide-band preamplifier designed to mount next to a phonograph or tape deck. HIP is said to provide an audible increase in high-frequency detail, dynamic range, dimen-

sional perspective and a reduction in record surface noise. It works directly from either a tapehead or phonograph cartridge and is battery-powered to avoid hum pickup. Technical specifications include frequency response of 2 Hz to 350 kHz ±1dB, 0.1% harmonic distortion, 60 dB channel separation. Dimensions: 6" × 2⅝" × 1½" (15.5 × 6.5 × 3.7 cm), (battery pack) 5½" × 5" × 1½" (14 × 12.5 × 3.8 cm). $135.

CIRCLE NO 99 ON FREE INFORMATION CARD

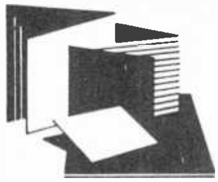
AVANTI CB BASE ANTENNA

The new Saturn antenna by Avanti Research and Development, Inc. is an omnidirectional base station antenna with switchable horizontal or vertical polarization. Overall height is 22' (6.7 m), radials measure 9' (2.7-m), and the antenna weighs 25 lb (11.3 kg). The Model AV-501 switchbox for remote polarization selection is included.

CIRCLE NO. 100 ON FREE INFORMATION CARD

CORRECTION

In the September issue, the price of the McKay Dymek DR-22 Receiver was incorrectly given as $2900. It should have been $995.



New Literature

CB ACCESSORIES CATALOG

The Magitran Co. offers an 8-page catalog of its line of citizens band radio accessories. Included in the listing are anti-theft alarm systems, an antenna matcher, power supply, power regulator-booster, receive signal booster/attenuator, remote/PA speakers, and a radio check monitor. Each piece of equipment is illustrated and technical specifications are provided. Address: The Magitran Co., 311 E. Park St., Moonachie, NJ 07074.

NBS SMOKE DETECTOR PAMPHLET

The Commerce Department's National Bureau of Standards is offering a guide to homeowners who are interested in purchasing a smoke detector. Titled "Smoke Detectors . . . What They Are and How They Work," the pamphlet describes the two types of smoke detectors; ionization chamber and photoelectric; and answers questions most commonly asked about selection and placement of the detectors in the home. Address: "Detectors," Consumer Information Center, Pueblo, CO 20234.

REPLACEMENT ANTENNAS CATALOG

Russell Industries has a six-page brochure illustrating its line of "Rubber Duckie" antenna replacements for 2-way communications and scanner applications. Categories include citizens band, uhf, vhf, ham and business band radios, and walkie talkies. Address: Russell Industries, 3069 Lawson Blvd., Oceanside, NY 11572.

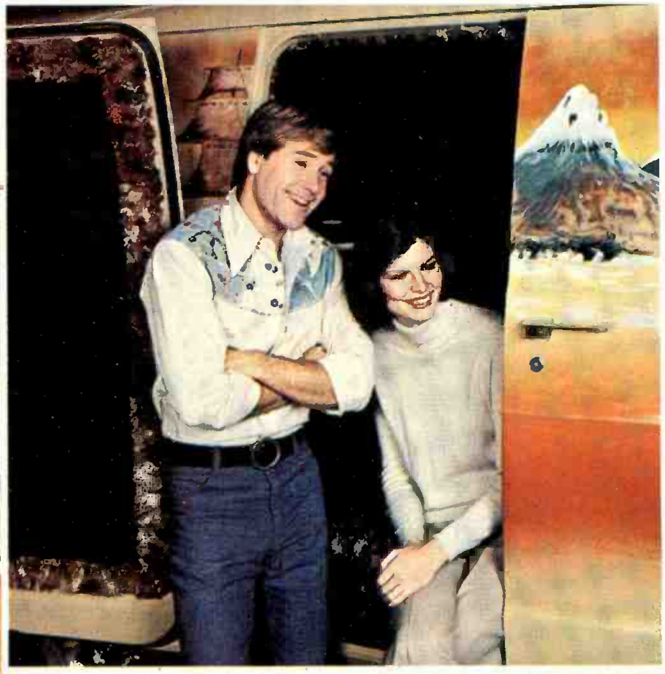
CHROME TAPE PAPER

A report on chromium dioxide cassette tape, "The Advent Chrome Paper," is available from Advent Corp. It discusses chromium dioxide tape, which was introduced in 1970, and compares it to other iron-oxide cassettes on the market. Address: Advent Corp., 195 Albany St., Cambridge, MA 02139.

SMALL-COMPUTER CATALOG

A 22-page Small Computer Catalog by Processor Technology describes the company's line of computers, computer systems, personality modules, software, memories, disk storage, interfaces and peripherals. Performance and application information is provided, with charts and illustrations. Address: Processor Technology Corp., 6200 Hollis St., Emeryville, CA 94608.

Go after the best of everything.



Don't settle for less. Especially when it comes to electronics training . . . because everything else in your life may depend on it. That's why you ought to pick CIE!

Stereo Scene

By Ralph Hodges

THE BIG JUNE TRIAL BALLOON

Well, it's come and gone—another June Consumer Electronics Show in Chicago. This year's JCES was marked by two developments of note. The first was a concession on the part of show management to the demands of audio exhibitors for listening facilities. Several floors of meeting rooms in the McCormick Inn (across the street from the McCormick Place convention center that formerly hosted the entire show) were made available, thus greatly expanding the scope and sprawl of the affair. Second, in what almost seemed a counter-concession, a number of prominent very-high-end audio manufacturers left their aeries in the renegade Bismarck Hotel (one of the few large hotels not affiliated with the show) and moved their exhibits closer to or actually into CES territory. (Not that this "sank" the Bismarck; the vacancies were promptly usurped by a whole new generation of little companies looking to make their marks.)

Both developments dramatize the new importance of audio—and, recently, high-end audio—to the show's well-being. More than ever, high-end was the big game at JCES, and almost everybody played.

The Heavy Hitters. If pure power grabs you, you will not be immune to the Marantz Model 2500, the show's most powerful receiver, with a continuous (FTC) rating of 250 watts per channel. This receiver also re-introduces Marantz's small front-panel scope, a popular feature on previous deluxe models from the company. The continuous-power rating of Hitachi's SR-2004 receiver is a "mere" 200 watts per channel. However, since the amplifier section operates in Hitachi's novel Class G, it is said to be entitled to a short-term ("music power," if you will) rating of 400 watts per channel. Several other receiver manufacturers are now crowding the 200-watt mark, such as Technics by Panasonic (with 165 watts) and Nikko (175 watts).

Where does this power escalation put separate basic amplifiers? Well, you can get up to 500 watts per channel with the Rotel RB-5000. This product, incorporating enough transformer iron to pose a serious threat to any sidewalk on which it may be dropped, has a glorious brutality to its appearance that devotees of high power will appreciate on sight.

Many of the other major manufacturers now seem inclined to eschew brute force for its own sake and adopt the "purist" attitude that characterizes the audiophile-oriented smaller companies. Pioneer, for example, which retains its credentials in the high-power club (its new SPEC 4 power amplifier is rated at 150 watts per channel), has chosen to lead this year with the M-22 Class-A power amplifier ($650) at 30 watts per channel. Onkyo's outlook on high-end equipment is similarly conservative, as exemplified by the P-303 preamplifier and M-505 power amplifier introduced earlier this year. Nikko established itself as a leader in Class-A power amplifiers some time ago. This year the company presents the Alpha V stereo power amplifier, featuring a healthy 100 watts per channel and a healthier price of $3,000.

Meantime, integrated amplifiers evolve in their own fascinating ways. Kenwood believes in isolated power supplies, and the new 90-watt-per-channel KA-9100 has three: one for each output section and a third for the preamplifier. Sansui believes in wide bandwidth—not necessarily for the preamplifier section, where it may cause trouble, but certainly for the power-output stages. The AU-717 ($450) and AU-517 ($370) pursue this philosophy.

The Innovators. Soundcraftsmen's major contribution to the show was a claim for a new mode of amplifier operation, "Class H." Like Class G, Class H employs two power-supply voltages for the output stage, the lower voltage being active most of the time and the higher voltage coming into use only on large waveform peaks. But Class H dispenses with Class G's two sets of output transistors and simply switches the supply voltages fed to one set. As in Class G, the object is to keep the output stage in the most efficient mode of operation possible, no matter what power level is being delivered to the load. Soundcraftsmen's initial Class-H offerings are the MA5002 power amplifier at 250 watts per channel, and a smaller Class-H power amplifier, the EA5003, with a built-in octave-band equalizer.

In the DL-2, Crown introduces the preamplifier it says it has always wanted to build. It is in three pieces: a power supply, a phono-preamplifier module designed to be located close to the record player, and a "switching module" (the DL-2 itself). This sports a complex-looking panel, with digital readouts of gain settings and a forest of controls. But inside, all is said to be simplicity itself, with none of the special control functions allowed to intrude on the signal path unless "enabled" by means of digital switching circuitry that operates high-quality relays.

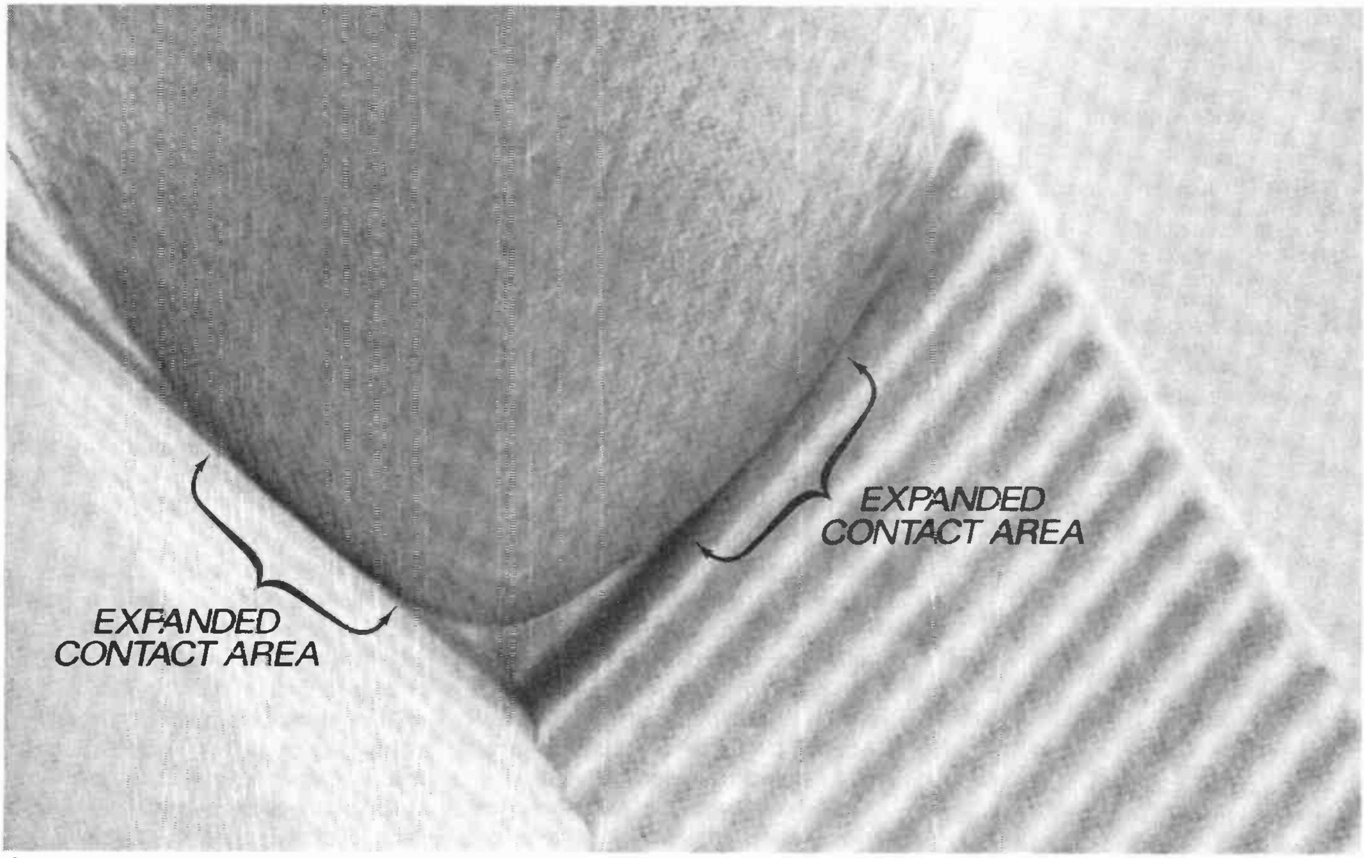
A digital-readout frequency-synthesyzing tuner is built in to the Setton RCS-X-1000 preamplifier/control center. The unit has throttle-like controls for gain and LED indicators for virtually everything. For remote control use, much of its circuitry is contained in a separate "black-box" module with generously long cable connection.

A little outboard air compressor is the key feature in the Infinity Black Widow "Air-Table." The Compressor floats the belt-driven platter on a compressed-air "bearing."

The Elaborators. While we're on the subject of turntables, you may recall ADC's digitally controlled Accutrac 4000. This year brings a changer version, the Accutrac +6, with the likable ability to return any records that have been "dropped" to the platter ("gently escorted" is a more accurate expression in this case) back up to the spindle-supported stack for another go-round. This is accomplished by punching appropriate buttons on the control panel (or on an ultrasonic remote controller), and the Accutrac +6 retains all the other automatic programmable features of the 4000.

In its MT-6225, Fisher has developed a new configuration for a direct-drive turntable motor. Its drive signal is de-

Better records are the result of better playback pick-ups



Scanning Electron Beam Microscope photo of Stereohedron Stylus; 2000 times magnification. Brackets point out wider contact area.

Enter the New Professional Calibration Standard, Stanton's 881S

Mike Reese of the famous Mastering Lab in Los Angeles says: "While maintaining the Calibration Standard, the 881S sets new levels for tracking and high frequency response. It's an audible improvement. We use the 881S exclusively for calibration and evaluation in our operation"

The recording engineer can only produce a product as good as his ability to analyze it. Such analysis is best accomplished through the use of a playback pick-up. Hence, better records are the result of better playback pick-up. Naturally, a calibrated pick-up is essential.

There is an additional dimension to Stanton's new Professional Calibration Standard cartridges. They are designed for maximum record protection. This requires a brand new tip shape, the Stereohedron®, which was developed not only for better sound characteristics but also the gentlest possible treatment of the record groove. This cartridge possesses a revolutionary new magnet made of an exotic rare earth compound which, because of its enormous power, is far smaller than ordinary magnets.

Stanton guarantees each 881S to meet the specifications within exacting limits. The most meaningful warranty possible, individual calibration test results, come packed with each unit.

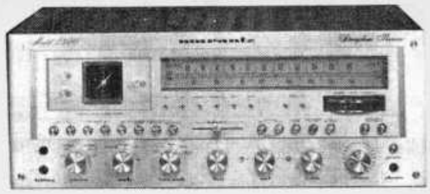
Whether your usage involves recording, broadcasting or home entertainment, your choice should be the choice of the professionals... the STANTON 881S.

STANTON

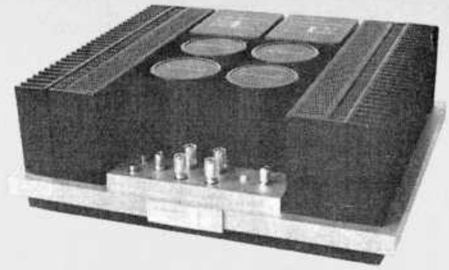
For further information write to Stanton Magnetics, Terminal Drive, Plainview, New York 11803

This new Stanton advertisement will appear in major consumer publications.

CIRCLE NO. 55 ON FREE INFORMATION CARD

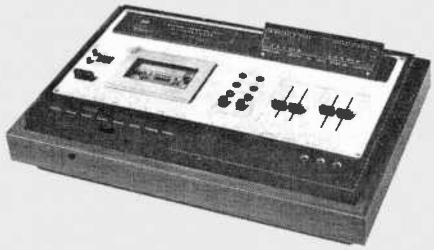


Marantz 2500 AM/Stereo FM Receiver is rated at 250 watts per channel.



Pioneer M-22 Power Amplifier is rated at 30 watts per channel.

Kenwood's KA-9100 Integrated DC Stereo Amplifier has three separate power supplies.



Model C-939 Cassette Deck from Dual has automatic reversing in both recording and playback.

rived from a 120-pole rotor (part of the platter) which amplitude-modulates a 60-kHz oscillator signal that passes through sensing coils in close proximity to the rotor. The back-EMF from the motor itself is routed through the motional-feedback circuit, where it is compared with a stable dc reference voltage.

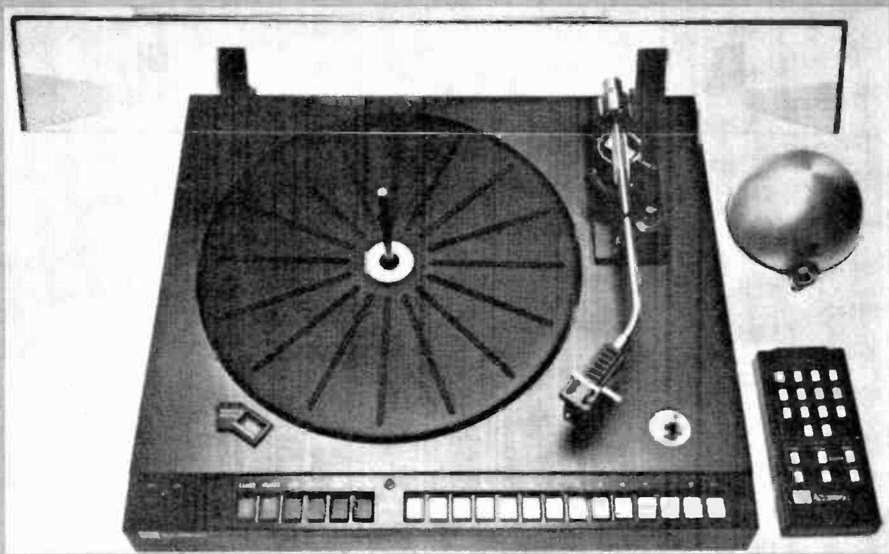
I'm personally glad to note some new developments in tonearms, prominent among which is the Technics EPA-100, offered on the new SL-1000 Mark II direct-drive turntable. The EPA-100 is a damped arm designed to accommodate itself to almost any cartridge. The arm has "dynamic damping" which not only dulls arm/cartridge resonance, but adjusts to match cartridge compliance. Very-low-mass arms continue to appear, the latest being the LMF from ADC, offered with and without detachable headshells. The LMF has a tapered carbon-fiber shaft and an appearance of high precision.

Dual's Model C-939 cassette deck offers automatic reversing in both recording and playback, and it introduces the erase head as a tape-editing feature. A unique control admits continuously variable erase current to the head, where it can be used to create fade-outs, fade-ins, or total obliteration of a previously recorded signal.

The Upstarts. With so many pursuing the serious-audiophile segment of the market, where does that leave the devotedly audiophile-oriented companies? More rarefied than ever. Threshold, which in its short history has established itself as one of the country's most prominent manufacturers of Class-A power amplifiers, introduced this year a preamplifier, the NS 10, with a response that extends to 5 MHz. The Van Alstine Model One preamplifier handily matched this feat by playing a color TV set through its circuits. While you recover from the shock of these revelations, you might want to contemplate the limited-bandwidth school of preamplifier design. The Apt Corporation's Holman Preamplifier will have nothing to do with ultrasonic or infrasonic signals. Tom Holman's arguments for eliminating out-of-band information are sophisticated and persuasive. Some would call his preamplifier radical for its inclusion of tone controls and other amenities that have been rapidly disappearing from such products.

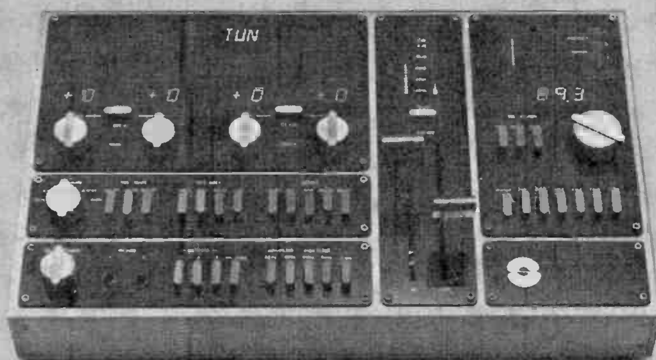
Vacuum tubes, until recently so beloved by the audiophile "fringe" for their alleged sonic superiority, are gradually passing away as more and more designers work out transistorized circuits that can suit their purposes. But the end of tubes is not here yet, as witness the remarkable Audionics BA-150 power amplifier with a transistorized front end and tube output stages. The chunky unit is rated at 200 watts per channel, which is very substantial. As for heat and its pernicious effect on tube life, this has been thwarted by "floating" bias and operating voltages that are under the benign governance of high-speed digital control circuitry. I expect this amplifier was a lot of fun to design.

The Indefatigables. The untiring



The Accutrac +6 Turntable has the automatic programmable features of its predecessor, the 4000, and also can be set to return a record to the stack on top of the spindle.

A digital-readout frequency-synthesyzing tuner is built in to the Setton RCS-X-1000 preamplifier/control center.



Crown's DL-2 preamplifier has a "switching module" with all of the controls and a phono-preamp module (right) to be located close to the record player.

search for perfection in phono cartridges continues, and you can now pay $325 for a Satin moving-coil cartridge with Shibata stylus and beryllium cantilever. The Satin cartridges remain the only moving-coil designs with user-replaceable styli, and among the few such designs with output sufficient to drive most phono preamplifiers without assistance from a transformer or intermediate gain stage. So far as I know, Satin commands the top price point in phono cartridges today, but others are not too far behind. The Model 9210SG from RAM Audio Systems, a strain-gauge pickup is $300 with the necessary external power supply. The Micro-Acoustic 530-mp is $200. And the Stanton 881S is $150.

Nor is there a lack of associated equipment for these new cartridges. The precision phono preamplifier for moving-coil and other pickups is now an established product. The Accuphase C-220 Stereo Disc Equalizer is designed to load and equalize any cartridge properly, supply gain that is immaculate in terms of noise and distortion, and balance the outputs of the two channels. A&E Technical Research offers a similar product, with elaborations that include a front-panel meter to read levels.

A year ago the manufacturers of the new sub-woofers were speaking out loudly for attention. Since then, several prophets have asked the question: "With a good sub-woofer, who needs a woofer?" And it's proved to be a good question. Audio enthusiasts around the country have been combining the phenomenally good (but bass-lacking) mini-speakers from ADS, Braun, and Visonik, among others, with sub-woofers from Janis, Dahlquist, etc., to produce full-range biamplified speaker systems for the home. They often sound as good as the best while costing little more than the mediocre. Janis has even devised an accessory to facilitate this—a stereo electronic crossover combined with a single-channel, 70-watt amplifier for the woofer. The phase relationship between the low- and high-frequency signals is continuously variable.

This year's new wave in four-channel sound will come from the Tate SQ decoder, now finally completed and encapsulated in three integrated circuits. The decoder boasts remarkable specifications, and the demonstration I heard left little doubt in my mind that many of the claims made for it are justified. The Tate people intend to offer the decoder to amplifier and receiver manufacturers, among which licensees are now being gathered. (Audionics has already announced its Tate decoder.)

The End. The end, obviously, is not yet in sight. More than anything else, this year's JCES was erected on shaky foundations laid down some years ago that have become much firmer in the intervening period. The serious audiophile is once more at the top of the heap, and his requirements are being elaborately—even extravagantly—catered to. In coming months this should lead to a vast proliferation of products that are claimed to "sound good." Ultimately, with luck, it will result in a whole community of products that "sound better." ◇

Para-Power

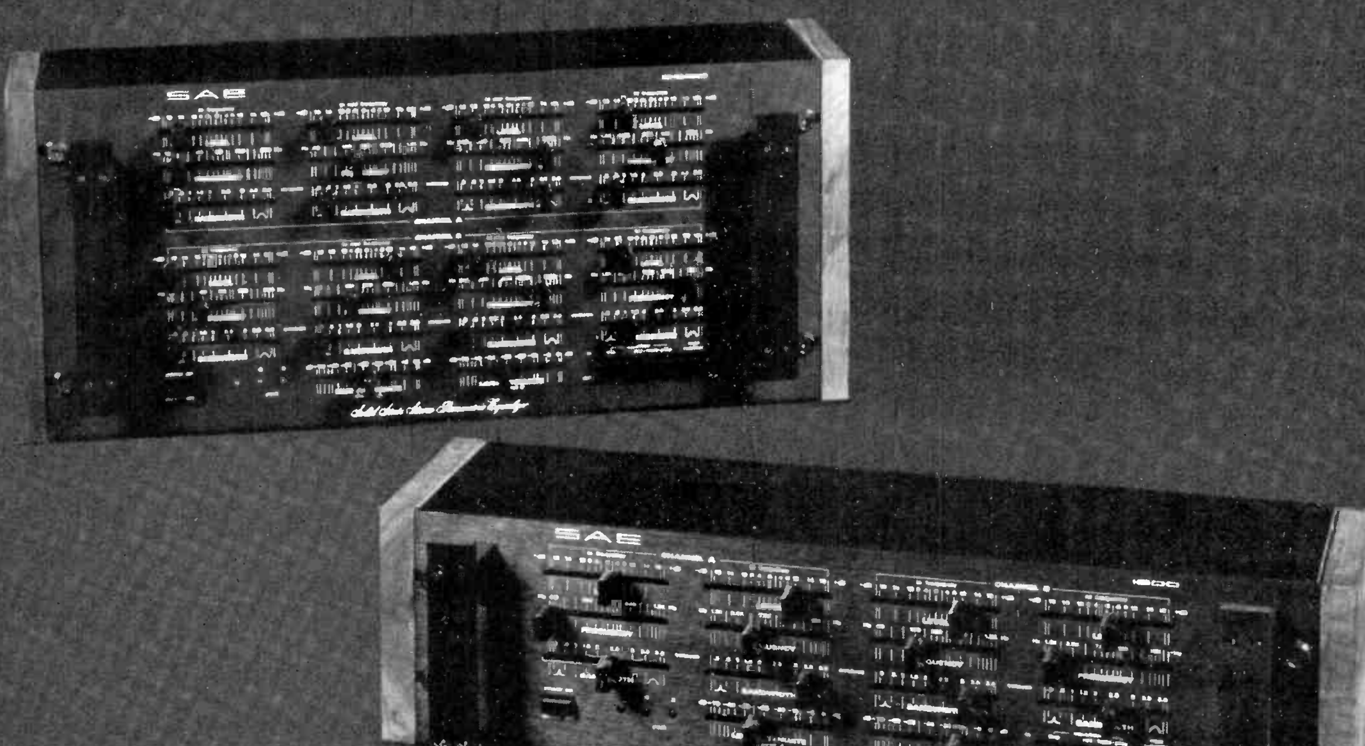
(Parametric Equalizers by SAE)

SAE has long been involved in the field of tone equalization. From our pioneering efforts in variable turn over tone controls to our more recent advancements in graphic equalizers, we have continually searched for and developed more flexible and responsive tone networks. From these efforts comes a new powerful tool in tone equalization — the Parametric Equalizer. Now you have the power of precise control.

Our 2800 Dual Four-Band and 1800 Dual Two-Band Parametrics offer you controls that not only cut and boost, but also vary the bandwidth and tune the center frequency of any segment of the audio range.

With this unique flexibility, any problem can be overcome precisely, and any effect created precisely.

With either of these equalizers, you have the power to correct any listening environment or overcome any listening problems that you are faced with. Whether you need a third octave notch filter, tailored bandwidth to resurrect a vocalist, or a tailored cut to bury an overbearing bass, the control flexibility of Parametric Equalizers can fill these needs and many more. And of course, as with all SAE products, they offer the highest in sonic performance and quality of construction.



only by SAE

Scientific Audio Electronics, Inc.
P.O. Box 60271 Terminal Annex, Los Angeles, CA 90060

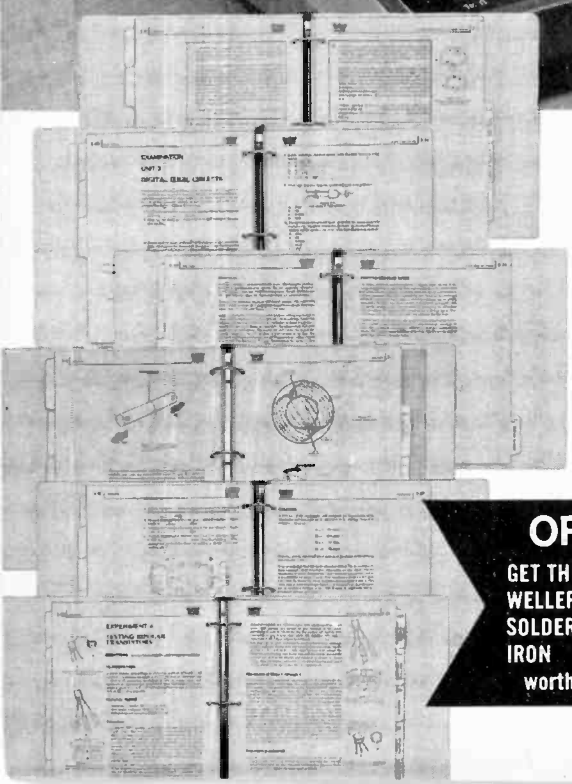
Learn electronics easier... with HEATHKIT®

MONEY-BACK GUARANTEE

We're so confident you will enjoy and benefit from these five courses, that if for any reason you are dissatisfied, we will refund the full purchase price of the course text material.

Unique Heathkit Electronics Courses are designed to provide you with a complete overview of basic and advanced electronics. You learn at your own pace, without pressure or deadlines, and all material is presented in a clear, logical, step-by-step fashion. It's the ideal, effective way to learn about electronics if you're a beginner, or to "brush up" on the latest techniques and theory.

Courses start as low as $39.95 (less trainer)



Thousands of people just like you have already learned electronics the easy Heathkit way — and you can, too. The secret is our efficient approach to self-learning with easy, step-by-step "programmed" instructions; audio records to introduce and reinforce key concepts; self-evaluation quizzes to test your understanding; and interesting experiments that let you learn the easy "hands-on" way. All you need is a record player, small tools and a VOM. The optional Heathkit experimenter/trainer is specifically designed to help you do the experiments in each course, and when you finish the course, you can use it to design and breadboard your own circuits. After completing each course, you can take the optional final exam (passing grade 70%) and receive both a Certificate of Achievement and Continuing Education Units, a nationally recognized way of acknowledging participation in non-credit adult education.

ORDER NOW—GET THESE BONUS SAVINGS!

GET THIS WELLER SOLDERING IRON worth $7.95 **FREE!** WITH YOUR ORDER — A 40-watt iron for easy kitbuilding

Buy Any Single Course with Trainer and — **SAVE $9.95**

Buy Courses 1 thru 4 with Trainer and — **SAVE $24.95**

Heath Company, Dept. 010-341 Benton Harbor, Michigan 49022

faster...at lower cost... Learn-at-home Courses!

COURSE 1: DC Electronics

An ideal introduction to electronics. Covers current, voltage, resistance, magnetism, Ohm's law, electrical measurements, DC circuits, inductance and capacitance. Discusses matter, atoms, current, flow, voltage rises and drops, series and parallel connections, magnetic fields, voltage dividers, network theorems, more. Includes text, records and 56 parts for 20 different experiments. Average completion time, 20 hours. 2.0 Continuing Education Units and certificate for passing optional final exam.

Course EE-3101 .... **39.95**

COURSE 2: AC Electronics

Provides an understanding of most commonly used circuits. Covers alternating current, AC measurements, capacitive and inductive circuits, transformers and tuned circuits. Discusses waveforms, period and frequency, meters, scopes, series and parallel circuits, RC filters, dividers, phase shifts, reactance, vectors, transformer theory and characteristics, series and parallel resonance, more. Includes text, records and 16 parts for 8 different experiments. Average completion time, 15 hours. 1.5 Continuing Education Units and certificate for passing optional final exam.

Course EE-3102 .... **39.95**

COURSE 3: Semiconductor Devices

Essential for understanding latest solid-state equipment. Covers fundamentals, diodes, zener diodes, special diodes, bipolar transistor operation and characteristics, FET's, thyristors, integrated circuits and optoelectronics. Discusses holes, current flow, N and P types, biasing, tunnels and varactors, PIN, IMPATT, gain, cutoff and leakage current, SCR's, bi-directional triodes, light sensitive and light emitting devices, more. Includes text, records and 27 parts for 11 different experiments. Average completion time, 30 hours. 3.0 Continuing Education Units and certificate for passing optional final exam.

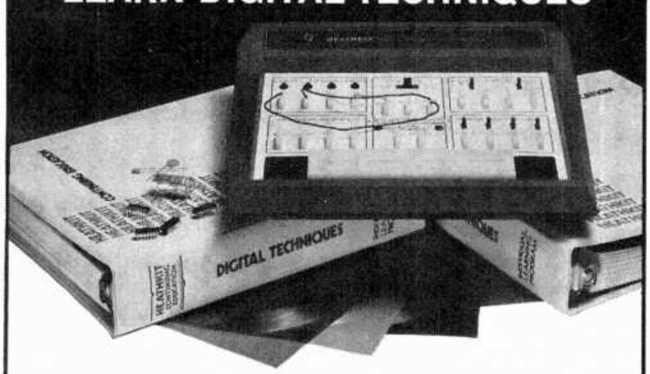
Course EE-3103 .... **39.95**

COURSE 4: Electronic Circuits

Outstanding explanations of basic circuits. Covers basic amplifiers, special purpose amplifiers, operational amplifiers, power supplies, oscillators, pulse circuits, modulation and demodulation. Discusses amplifier functions and configurations, class of operation, audio characteristics, video amplifiers, buffers, IF's, rectifiers, voltage multipliers, voltage regulation, basic oscillators, RC waveshaping, clipping, AM, FM and SSB, modulation fundamentals and more. Assumes knowledge of courses 1 through 3 or equivalent and requires an oscilloscope for some experiments. Includes text, records and over 110 parts for 18 different experiments. Average completion time, 30 hours. 3.0 Continuing Education Units and certificate for passing optional final exam.

Course EE-3104 .... **49.95**

LEARN DIGITAL TECHNIQUES



Our most advanced self-learning course prepares you for the world of computers and microprocessors, with particular emphasis on circuit design. Covers digital fundamentals, semiconductor devices for digital circuits, digital integrated circuits, Boolean algebra, flip-flops and registers, sequential logic circuits, combinational logic circuits, digital design and digital applications. Discusses TTL, ECL, CMOS, PMOS, NMOS; integrated circuits; SSI, MSI and LSI; ROM's, PLA's, microprocessors, computers and more. Assumes completion of Heathkit courses 1 through 4 above, or equivalent knowledge. The special digital techniques experimenter/trainer helps you perform all the experiments in the course, and when you complete the course, build and design your own circuits. Course includes text, records and 44 parts for 24 different experiments. Average completion time, 40 hours. 4.0 Continuing Education Units and a certificate for passing final exam.

ORDER DIGITAL TECHNIQUES PROGRAM AND TRAINER.... **$109.95**

HEATHKIT EXPERIMENTER/TRAINER

For use with Heathkit Electronics Courses 1 through 4 — helps you perform all the experiments quickly and easily. Has solderless breadboarding sockets, dual variable power supply for positive and negative voltages, sine and square wave signal source, center-tapped line transformer. After you complete the course, the trainer is ideal for experimenting and breadboarding with your own circuit designs.

Kit ET-3100 .... **$59.95**

HEATH IM-17 VOLT-OHM METER

All Electronic Learning Programs require a VOM to make electrical measurements. We suggest the Heath IM-17 as the ideal "all-purpose" unit. All solid state with FET input for better accuracy. Portable battery operation, zero and ohms adjust, accessory probe jack. Comes with DC polarity switch, three test leads; batteries not included. Easy 3 hour assembly.

ORDER KIT IM-17 .... **$32.95**

HEATH
Schlumberger

Order Form/Agreement

Heath Company, Dept. 010-341
Benton Harbor, Michigan 49022

Please send me items checked below and include FREE $7.95-value Weller Soldering Iron (GDP-1105).

☐ Send *one course* (checked below) *with the Experimenter/Trainer* (ET-3100) at the special price of only $89.95 plus $3.00 shipping and handling.
☐ DC (EE-3101) ☐ AC (EE-3102) ☐ Semiconductors (EE-3103)
☐ Send me the *Electronic Circuits* Course (EE-3104) *with the Experimenter/Trainer* (ET-3100) at the special price of only $99.95 plus $3.00 shipping and handling.
☐ Send *all four of the courses above* (EE-3101, 3102, 3103, 3104) with the Experimenter/Trainer at the special price of just $199.95 plus $4.50 shipping and handling.

In addition, please send the following *courses (less trainer):*
☐ DC (EE-3101) ☐ AC (EE-3102) ☐ Semiconductors (EE-3103) for just $39.95 plus $1.50 shipping and handling each.
☐ Electronics Circuits (EE-3104) for just $49.95 plus $1.50 shipping and handling.
☐ Send me the *Digital Techniques Course (EE-3201) with its Experimenter/Trainer* (ET-3200) for only $109.95 plus $3.00 shipping and handling.
☐ Also send me that IM-17 *VOM kit* for just $32.95 plus $1.50 shipping and handling.

Michigan residents add 4% sales tax.

I enclose ☐ check ☐ money order for $________; or, Charge to my:
☐ BankAmericard Acct. No.________________Exp. Date______
☐ Master Charge Acct. No.________________Exp. Date______
☐ If Master Charge, include Code No.________________

Signature: X________________________________
Name (please print)________________________________
ADDRESS________________________________
CITY________________STATE__________ZIP__________

Julian Hirsch Audio Reports

HIRSCH/HOUCK LABORATORIES

THE ELCASET HAS ARRIVED

MORE than a year ago, the Elcaset was announced to the high-fidelity audio world. Its name is derived from "large cassette," which is a fairly accurate description of this new tape format as far as its physical shape is concerned. Developed by a consortium of Japanese manufacturers—including Matsushita (Technics), Sony, and Teac—it is intended to bridge the gap between the standard cassette and the open-reel formats, with the convenience of the former and the performance of the latter. In addition, the Elcaset has a few advantages peculiar to itself. At present, all Elcaset tapes are made by Sony, but each of the participating manufacturers and some of their subsidiaries and affiliates produce their own competitive lines of tape decks based on their tapes.

The Elcaset itself is considerably larger than the conventional compact cassette. Resembling the cassette in general configuration, the Elcaset measures 6" × 4"D × ¾"H (15.2 × 10.1 × 1.9 cm), making it slightly larger than an 8-track tape cartridge pack. The Elcaset is loaded with standard ¼" (6.4-mm) tape, which can be recorded in four parallel tracks, two in each direction just as with the standard cassette. In addition, the Elcaset has provisions for recording two narrow control tracks between the pairs of signal tracks. These two extra tracks can be used for controlling slide projectors or for operating sophisticated signal processors when an Elcaset deck is used with devices designed to use the control feature.

At present, Elcasets are available in LC-60 and LC-90 versions. The two versions hold 30 and 45 minutes of program material on each side.

Unlike the standard cassette, with its 1⅞-inch/second (4.8-cm/s) tape speed, the Elcaset is designed to operate at 3¾ ips (9.5 cm/s). The combination of nearly double the tape width and double the tape speed gives the Elcaset a powerful advantage over the standard compact cassette in its freedom from high-frequency tape saturation (which is perhaps the most serious fundamental limitation of cassettes). Another unique feature of the Elcaset is that the tape is withdrawn from the cassette housing and passed over fixed heads in the tape deck, just as in an open-reel tape deck. This makes possible almost any type of head configuration. This contrasts sharply with the standard cassette, which requires the heads to be moved to make contact with the tape within the cassette housing and where a third head can be used only by exercising considerable design ingenuity.

The Elcaset housing contains a number of notches and holes that give it a potential capability for almost totally automatic selection of operating parameters. For example, three types of Elcaset have been announced or are contemplated, each with a different formulation that requires its own particular bias and equalization adjustments. Type I tape is a low-noise ferric-oxide type that is currently used in Sony's SLH. Type II is Sony Ferrichrome (FeCr), while Type III is a chromium-dioxide formulation. Holes near one corner of the Elcaset's housing can identify the type of tape contained in the Elcaset so that, in a tape deck equipped to make use of this feature, the bias and equalization could automatically be selected as the tape is inserted. Other breakout tabs similar to those used for standard cassettes for recording lockouts are used for switching in Dolby noise reduction system decoders when a tape has been Dolbyized.

Like the cassette, the Elcaset can be made to prevent accidental recording over a piece of tape whose contents are to be preserved. Instead of breaking out a tab, however, one moves a slide near one corner of the Elcaset housing to its safety position. If it is desired to rerecord over a protected portion of tape, the slide can easily be returned to its original, or "unprotected," position. (The Elcaset's design makes accidental movement of the slide impossible.)

The internal tape reels are locked in place when the Elcaset is removed from the recorder to prevent the creation of tape slack in shipping and handling. Hinged protectors minimize the likelihood of the tape being pulled from the housing accidentally. When the Elcaset is inserted into the tape deck, the hinged protectors move aside to allow the tape to be withdrawn and brought into contact with the tape heads. From then on, tape handling is completely automatic as the deck's controls are operated.

(Audio Test Reports start on page 34.)

The first complete low-cost microcomputer system for home, business or education!

Radio Shack TRS-80

The TRS-80 is for people who want to use a computer now — without the delay, work and problems of building one. The system is fully wired, tested and U.L. listed — ready for you to plug in and use! Program it to handle your personal finances, small business accounting, teaching functions, kitchen computations, innumerable games — and use Radio Shack's expanding line of prepared programs on cassettes. The Z80-based system comes with 4K read/write memory and Radio Shack Level-I BASIC stored in read-only memory. Memory expandable to 62K bytes. Includes CPU, memory, keyboard, display, power supply, cassette data recorder, 300-page manual, 2-game cassette program. Designed and built in USA by Radio Shack. Only 599.95.

Includes everything you need to start using it immediately!

Clip and Mail Coupon Today!

Mail to: Radio Shack, Dept. TRS-80
205 N.W. 7th St., Ft. Worth, TX 76101

C003

Send me more data on the TRS-80 microcomputer

- **Description of applications, software and peripherals available through Radio Shack • Owners' newsletter**
- **Price list • List of stocking stores and dealers**

NAME ______________________ APT. NO. ______

ADDRESS ______________________

CITY ______________ STATE ________ ZIP ________

SOLD ONLY WHERE YOU SEE THIS SIGN:

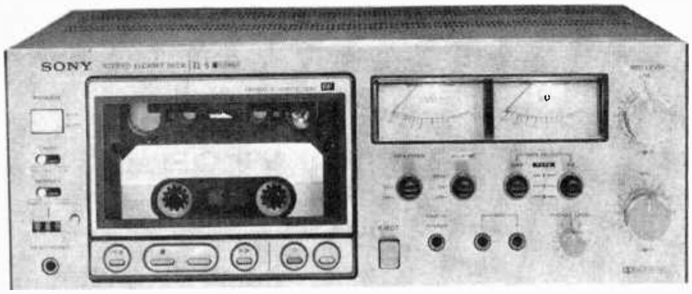
Radio Shack®

A TANDY COMPANY • FORT WORTH, TEXAS 76102
OVER 6000 LOCATIONS IN NINE COUNTRIES

Price may vary at individual stores and dealers

SONY MODEL EL-5 ELCASET TAPE DECK

Offers the convenience of a tape cartridge with performance of open reel.



HIRSCH-HOUCK LABS REPORT

In physical appearance, the Sony Model EL-5 Elcaset deck resembles a front-loading cassette deck. The Model EL-5 is a relatively simple, basic deck, with no automatic parameter selection features. It uses a two-head configuration with a combined recording and playback head. (Although the Elcaset design makes three-head transports a practicality, the EL-5 uses only two heads, but Sony does make another model that offers the three-head feature.)

The Model EL-5 measures 17"W × 12 5/8"D × 6 3/4"H (43 × 32 × 17 cm) and weighs 23 lb (10.5 kg). Its nationally advertised value is $599.50.

General Description. The Elcaset loads into the Model EL-5 vertically in a transparent hinged door that is opened by pressing an EJECT button. Below the door are light-touch pushbuttons that control the transport functions through solenoids and include rewind, fast forward, play, record, and pause functions. Colored symbols above the buttons glow to indicate the operating mode of the deck. A logic system allows the buttons to be operated in any sequence without damaging the tape.

To the left of the Elcaset door is a pushbutton POWER switch, and two three-position levers that control the TIMER and MEMORY functions. The TIMER switch can be used to start the deck with an external clock timer in the power line, in either the recording or the playback mode. The MEMORY circuit can be set to stop the tape in rewind when the counter returns to 000, or to go into PLAY automatically at that point if desired. Below the MEMORY switch are the index counter and its reset button and a headphone jack for low-impedance phones.

Across the upper right of the panel are two large illuminated VU meters and a red REC light. Below these are four lever switches, two of which separately control the recording bias and equalization for the three types of Elcaset tape. A third switch controls the Dolby system, with an extra position for recording Dolby FM broadcasts. In the DOLBY FM mode, the tuner's deemphasis time constant is changed to the required 25 μs, and the recording level is set by a pair of controls in the rear of the machine so that the Dolby level tone transmitted by some FM stations gives a 0-dB meter reading on the EL-5. The signal is recorded in its Dolbyized form, and the recorder's Dolby circuits are placed in the playback path, where it is monitored with the correct frequency response and noise level, and heard in that form when subsequently played through the recorder with its Dolby system on. The fourth switch turns on the MPX filter that removes the 19-kHz pilot carrier from signals being recorded with Dolby.

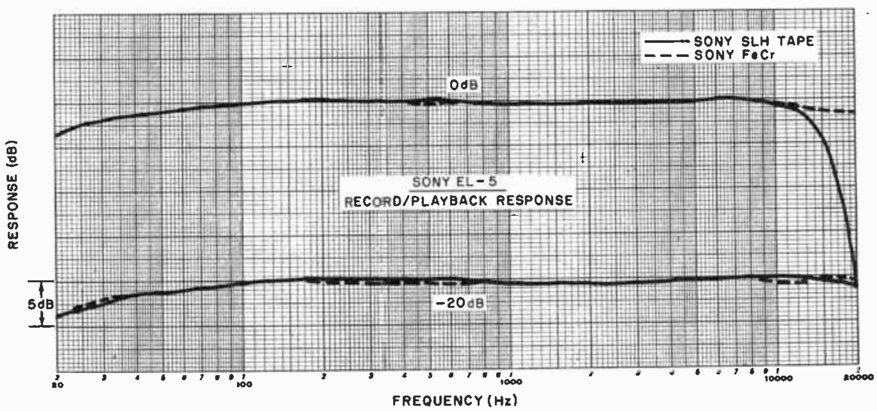
At the right of the panel are concentric recording level controls for the LINE and MIC inputs, which can be mixed. Across the bottom of the panel are the two microphone jacks, a stereo LINE input jack that replaces the normal LINE jacks on the rear apron when a plug is inserted, and a small knob that controls the playback level through the headphone jack.

The rear panel contains the LINE input and output jacks, a LEVEL adjustment for the LINE outputs, two FM CAL level controls, a socket for an optional REMOTE CONTROL accessory, and one switched and one unswitched accessory outlet.

Laboratory Measurements. The Model EL-5 Elcaset deck we tested came with a prerecorded demonstration tape and samples of Type I and Type II blank Elcasets. (Type III is not yet available.) Since there are no standard test tapes as yet for the Elcaset, we made all our measurements by recording and playing back the same tape.

With the Type I (Sony SLH) tape, the record/playback frequency response at a −20-dB level was within ±0.5 dB from 60 to 20,500 Hz. It was down 4 dB at 20 and 22,400 Hz. At a 0-dB recording level, the playback output dropped rapidly above 10,000 Hz, due to tape saturation. The superior high-frequency qualities of Type II (FeCr) tape were dramatically demonstrated by its frequency response, which was within ±0.5 dB from 60 to 24,000 Hz at −20 dB, down 4 dB at 20 and 26,200 Hz. Even at 0 dB, the Type II tape revealed little evidence of tape saturation, with a response within ±2 dB from 20 to 21,500 Hz. The MPX filter, which operates only during recording and had no effect up to 15,000 Hz, cut the 19,000-Hz response by at least 25 dB.

To reach a 0-dB recording level, a LINE input of 56 mV or a MIC input of 0.145 mV was needed. The resulting playback level was about 650 mV. The microphone preamplifier overloaded at a 70-mV input. The superior tape headroom of the Elcaset format was further demonstrated by very low distortion at a 0-dB recording level of only 0.08% with Type I and 0.28% with Type II tape. To reach a 3% playback distortion level, we had to record the tapes at +10 and +12 dB, respectively. The unweighted S/N



Record/playback response for two kinds of tape at 0 and −20 dB.

ratio, without Dolby, was 47.5 dB with Type I and 50 dB with Type II. With the Dolby system switched in, and using the CCIR weighting recommended by Dolby Laboratories, the S/N figures were improved to 67.7 and 70.5 dB. Through the microphone inputs, at maximum gain, the noise increased by 8.5 dB. The Dolby circuits tracked closely between recording and playback modes. The Dolby system changed the overall record/playback frequency response by no more than 1 dB at levels from −20 to −40 dB.

The unweighted rms wow and flutter was only 0.07%. An LC-60 Elcaset was moved from end to end in the fast speeds in about 76 seconds. The VU meters were slower in their response than a true VU meter. They reached 65% to 70% of their steady-state readings on 0.3-second tone bursts. The headphone volume was good with 8-ohm phones but was rather low with 200-ohm phones.

User Comment. There can be no doubt that the Elcaset, especially with the Type II (FeCr) tape, is a vastly superior medium to the compact cassette, especially with respect to high-frequency recording headroom. It is not inferior to cassettes in *any* of its performance characteristics. This is not surprising, given the Elcaset's 3 3/4 ips and 1/4-inch tape. A more dramatic contrast is that it matches the performance of the many open-reel decks that operate at 7 1/2 ips. Of course, much of the credit for this must go to the FeCr tape, which is not generally available for open-reel machines (nor are such decks, with the exception of one or two Sony models, equipped to use FeCr tape).

Judged solely on its own merits, the Elcaset, even in the modestly priced Model EL-5 deck appears to be a no-compromise high-fidelity recording medium for the home recordist. Used with extreme care, only the best cassette recorders can approach the overall performance of the Elcaset, and this is possible only by careful control of recording levels. (Such machines, incidentally, are considerably more epensive than the model EL-5.)

We found the Model EL-5 to be a very easy deck to use, too. The absence of a third head for monitoring caused us some concern at first, but we soon found that the entire recording process was so noncritical that there was little need to monitor while recording.

The Elcaset is as easy to handle as a regular cassette (perhaps easier, due to its larger size). Presumably, it could be spliced and edited like open-reel tape, although we would have misgivings about withdrawing any substantial amount of the tape from an Elcaset housing.

Like most people closely involved with high-fidelity matters, we have given considerable thought to the place of the Elcaset in the hi-fi picture. Our first reaction to its announcement was one of skepticism. After all, who needs a "better" cassette? Having lived with the Model EL-5 for some time, we appreciate how much of a "better cassette" it really is. The Type II Elcaset (and probably the Type III, when it becomes available), is really a full equivalent of 7 1/2-ips open-reel tape in sheer quality. In contrast to the clumsiness of handling open-reel tape, the Elcaset offers all the convenience of use that has helped make the compact cassette so popular. Further, the Elcaset recorder is closer in size and weight to a cassette deck than to the open-reel machine. We understand, too, that the Elcaset tapes will be priced comparably to open-reel tapes.

One should be aware that, for dubbing most phonograph records and FM broadcasts, the Elcaset does not offer any quality advantage over the compact cassette. Only when the dynamic range of cassettes is inadequate or marginal, as in the case of almost all "live" recording, does the Elcaset clearly demonstrate its superiority. There are no commercially recorded Elcasets on the market, and we would not expect any significant number to be produced. The Elcaset is strictly for the "do it yourself" tape enthusiast who does not intend to do much editing but wants the convenience of a tape cartridge with the performance quality of an open-reel tape deck.

H.H. SCOTT MODEL R376 STEREO RECEIVER

More receiver than modest specifications imply.

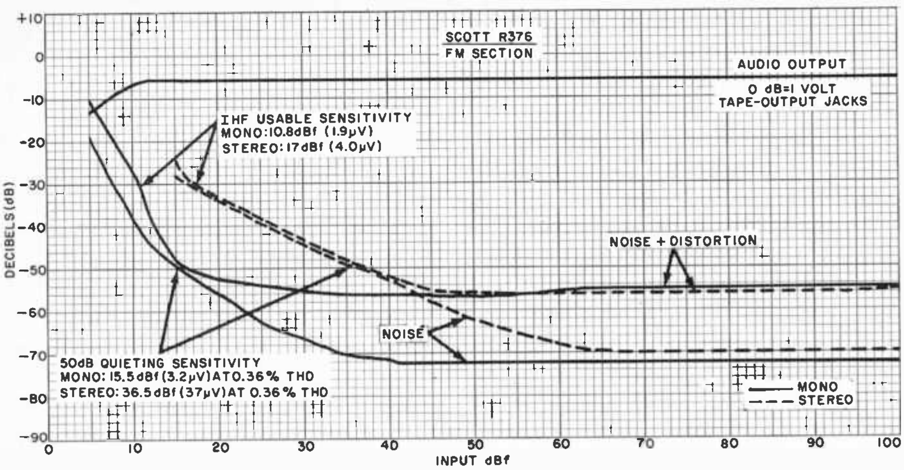
HIRSCH-HOUCK LABS REPORT

The Model R376 AM/stereo FM receiver, which heads the current line from H.H. Scott, is rated to deliver 75 watts/channel into 8-ohm loads at less than 0.2% THD. Manufactured in Japan to Scott's specifications, this receiver features contemporary styling with a distinct European touch in its panel markings.

The satin-finished silver-colored front panel has a large, clear glass window, behind which is a similarly finished dial scale, tilted slightly back for better visibility. Above the dial scales are five colored lights that indicate which input has been selected and separate tuning meters for relative signal strength on AM and FM and center-channel tuning on the latter.

The receiver is supplied with a walnut finished wooden cabinet. It measures 19 3/8"W × 15 7/8"D × 5 3/4"H (49 × 40 × 14.4 cm) and weighs 30.8 lb (14 kg). Price is $549.95.

General Description. The input SELECTOR switch has positions for AM and FM tuners, magnetic PHONO cartridge, dynamic MIC (through a jack on the front panel), and high-level AUX program source. The BASS, MIDRANGE and TREBLE controls each have 11 detented positions. The POWER/SPEAKERS switch can be set to connect to the amplifier, ei-



Noise and sensitivity curves for FM section of receiver.

ther, both, or neither of two pairs of speaker systems.

The VOLUME and BALANCE controls are concentric. The VOLUME control has 41 detented positions, while the BALANCE control is a standard potentiometer with a detented center position. A pushbutton switch activates the LOUDNESS compensation that works with the VOLUME CONTROL. Two other pushbuttons are used to switch in and out the LOW and HIGH audio FILTERS. Pushbuttons also switch in and out the FM MUTING and select STEREO/MONO modes.

The only remaining controls are the large TUNING knob and two three-position lever switches for the tape recording functions. One of the switches for the tape recording functions is a COPY switch that cross-connects two tape decks for dubbing from either machine to the other. The other switch is labelled MONITOR and is used for connecting either the selected source or the playback output from either tape deck to the receiver's audio amplifiers.

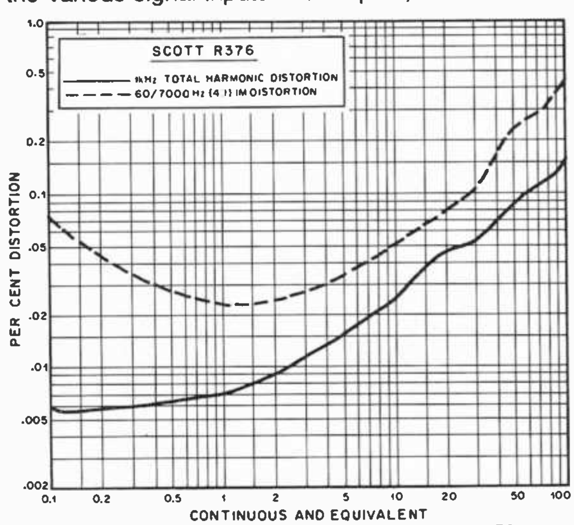
On the rear apron are phono jacks for the various signal inputs and outputs, a DIN socket that duplicates the TAPE 1 functions, and insulated spring clips for the speaker connections. Binding posts are used for the antenna connections, and there is a hinged AM ferrite-rod antenna. Slide switches are provided for selecting 25-, 50-, or 75-μs FM deemphasis time constants and high and low sensitivities to accommodate high- and low-output phono cartridges. One of the two accessory ac outlets on the rear apron is switchable.

Laboratory Measurements. Although the rear apron of the receiver became quite hot during the one-hour preconditioning period at one-third rated power and subsequent tests, the rest of the receiver's exterior remained cool. Driving 8-ohm loads with both channels at 1000 Hz, the output clipped at 109 watts/channel. Into 4 and 16 ohms the clipping power was 96 and 75 watts, respectively.

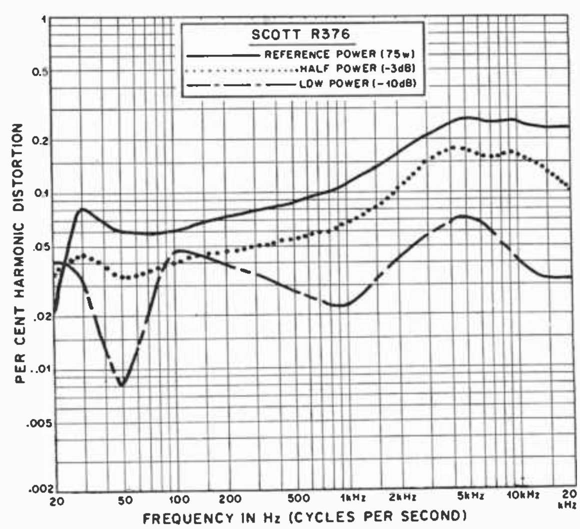
The 1000-Hz THD was very low at all usable power levels. It increased smoothly from 0.006% at 0.1 watt to 0.11% at the rated 75 watts and to 0.16% at 100 watts. The IM distortion was less than 0.075% from 0.1 to 20 watts output and increased to about 0.3% at 75 watts and to 0.42% at 100 watts. At the rated 75-watt output into 8 ohms, the THD was typically between 0.06% and 0.1% from 20 to 1000 Hz. It rose to 0.27% at 5000 Hz, after which it remained at about 0.27% all the way up to 20,000 Hz. At lower power levels, the shape of the distortion curve was similar, but the values were considerably lower. (At 7.5 watts output, distortion was under 0.07% from 20 to 20,000 Hz.)

To develop a reference output of 10 watts, a high-level input of 50 mV or a phono input of 0.82 mV (1.9 mV with the lower input sensitivity switch setting) was required. The S/N was roughly the same for all inputs at about 72 dB, referred to 10 watts. The phono overload input was a very safe 130 mV (290 mV with the lower sensitivity setting).

The bass tone control had the usual sliding turnover frequency characteristics. It varied from about 100 to 700 Hz as the control was moved from its center position. The treble response curves were "hinged" at about 1000 Hz. The midrange control affected most of the audible range, its maximum effect being between 1000 and 2000 Hz. The maximum range of this control was about ± 6 dB, making it unlikely to produce bizarre effects if used incautiously. The filters had the highly desirable (and rare) 12-dB/octave slopes, although Scott does not mention this in the specifications. The −3-dB response frequencies of the filters were 120 and 3700 Hz. The loudness compensation boosted both low and high frequencies at reduced volume control settings. The RIAA phono equalization was very accurate, within ± 0.5 dB of the extended ideal characteristic from 20 to 20,000 Hz. The interaction



Total harmonic distortion and 60/7000-Hz distortion.



Harmonic distortion at three power levels.

You're looking at the world's best-designed tonearm.

This is a Dual tonearm. It can make a big difference in the way your records sound. And how long they last.

The four-point gyroscopic gimbal is widely acknowledged to be the finest suspension system for a tonearm. It pivots the tonearm precisely where the vertical and horizontal axes intersect. The arm remains perfectly balanced in all planes of movement.

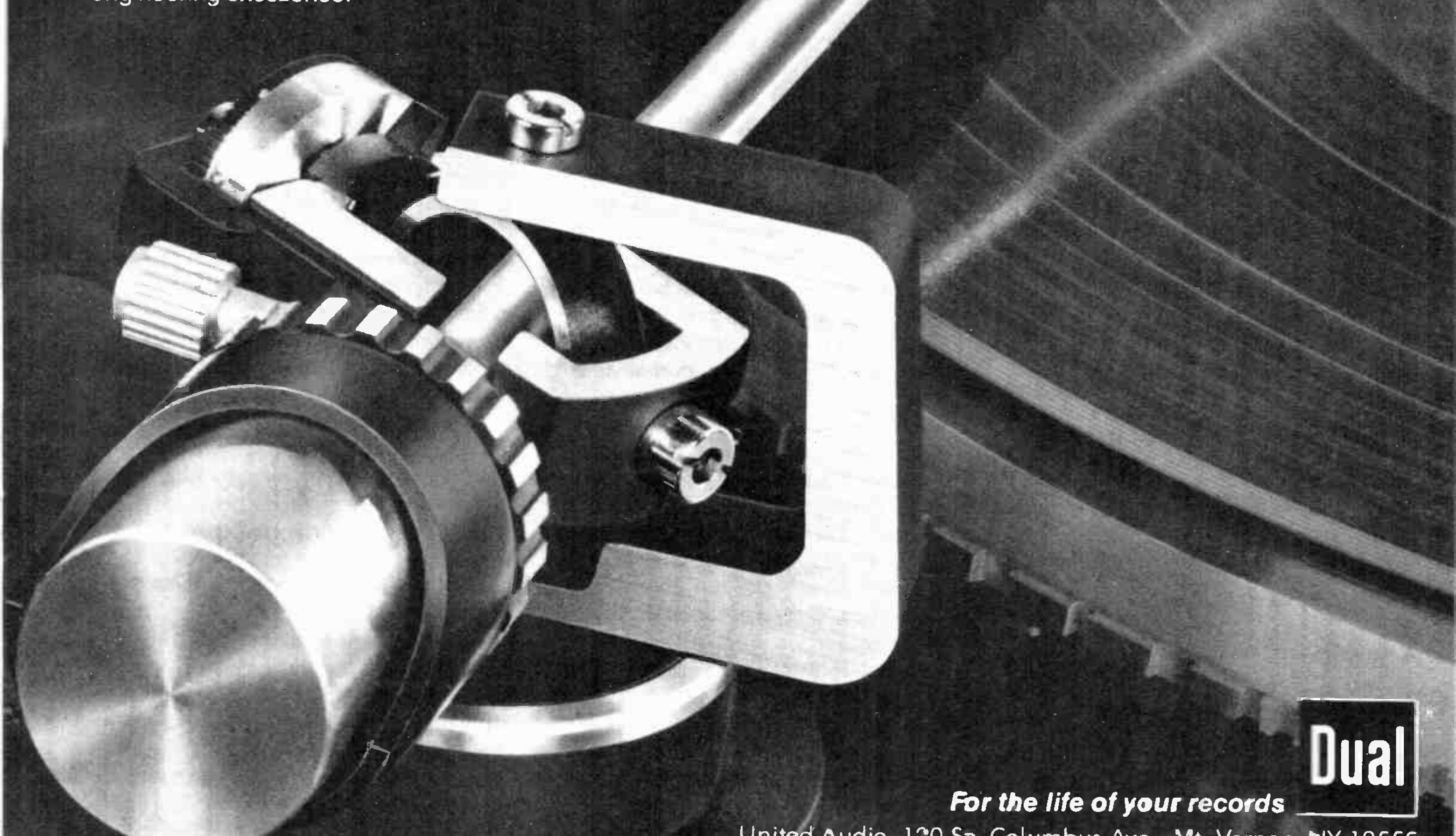
Further, the straight-line tubular design achieves the shortest distance between pivot and stylus. That's basic geometry. Curving the tonearm adds mass, decreases rigidity and makes the arm prone to lateral imbalance.

The vernier counterbalance permits you to balance the tonearm with micrometer-like precision. Tracking force is applied so that the stylus remains perpendicular to the record, even if the chassis is not level.

All this serves to establish and maintain the correct cartridge-to-groove relationship. So the stylus can trace the rapidly changing undulations of the groove walls freely, precisely and with the lowest practical force. In short, flawless tracking.

Despite the advantages of the gimbal-mounted tonearm, you won't find many around. But now, you will find one on every Dual turntable. Even our lowest-priced model, the new, fully automatic 1237.*

It's one more example of Dual's total commitment to engineering excellence.



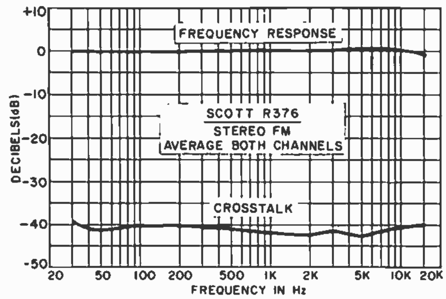
Dual

For the life of your records

United Audio, 120 So. Columbus Ave., Mt. Vernon, NY 10553

*Less than $135. Other Duals to $400. Actual resale prices are determined individually by, and at the sole discretion of authorized Dual dealers.

CIRCLE NO. 4 ON FREE INFORMATION CARD



Frequency and crosstalk averaged for both channels.

with phono cartridge inductance was slight, producing a drop of about 1 dB in response between 10 and 20 kHz.

The FM tuner section generally met or surpassed its specifications, within normal measurement tolerances. The IHF usable sensitivity was 10.8 dBf (1.9 μV) in mono and 17 dBf (4 μV) in stereo. The 50-dB quieting sensitivity was 15.5 dBf (3.2 μV) in mono and 36 dBf (37 μV) in stereo, both with only 0.36% THD. The distortion at 65 dBf (1000 μV) input was 0.19% in mono and 0.16% in stereo, and the respective S/N figures were 72 and 69.5 dB. In stereo, the THD at 65 dBf with a L − R modulating signal was 0.45% at 100 Hz. It was a very low 0.075% at 1000 Hz, 0.08% at 6000 Hz.

The FM frequency response was flat within ±0.5 dB from 30 to 15,000 Hz, yet the 19-kHz pilot carrier was suppressed to a barely measurable −85 dB. This implies either an unusually effective low-pass filter or some form of pilot cancellation circuitry in the multiplex section. There was no mention of such special features in the instruction manual, and no schematic was included, so we can only conjecture as to how this remarkable performance was achieved. The stereo channel separation was equally impressive, almost perfectly uniform at 39 to 42.5 dB from 30 to 15,000 Hz, and practically the same in both channels. This type of performance suggests the use of a phase-locked-loop (PLL) stereo demodulator, but there is no specific information on that subject.

Other FM performance specifications were generally of the same caliber. The capture ratio was 0.8 dB at 45 dBf and 1 dB at 65 dBf. AM rejection was an acceptable 56 dB at 45 dBf, improving to a very good 70 dB at 65 dBf input. The image rejection was 78.5 dB, and alternate channel selectivity was identical above and below the receiver's center frequency, measuring 72.3 dB. Adjacent-channel selectivity was 4.9 dB. The factory settings of the muting and stereo thresholds were identical, at 12 dBf (2.2 μV).

In view of Scott's former reputation for exceptional AM tuner quality, we were somewhat disappointed to find that the AM section of the Model R376 was very ordinary in its frequency response. The response was down 6 dB at 3000 Hz, although it was maintained at full level down to 20 Hz.

User Comment. The performance specifications of the Model R376, whether published by Scott or the results of our measurements, leave no doubt that this is a fine receiver. As often occurs, the bare measurements do not adequately define the true quality of a product. For example, instead of the distortion remaining low until the amplifier clips abruptly and the distortion rises rapidly, in this receiver, the distortion increases so gradually that the clipping point is not at all obvious from the distortion measurements. This soft clipping characteristic is recognized as being the best way for an amplifier to overload, since it does not tend to produce very-high-order harmonics that are unpleasant to the ear. In spite of its rather modest (by today's standards) 75-watt power rating, the Model R376 could fairly be described as a 100- or 110-watt receiver. It will deliver that much power without sounding unpleasant. (Its distortion is almost all second- and third-harmonic.)

The real quality of the FM tuner section may not be apparent to anyone who has not made measurements on a number of tuners. In almost every case, one must make allowances for departures from ideal performance, so that the tuning is adjusted for minimum distortion rather than for a center indication on the tuning meter. One also expects the tuning setting for minimum distortion or maximum separation to be quite critical (and not necessarily the same). Also, virtually all i-f response characteristics are asymmetrical so that selectivity measured above and below the set frequency will be different, requiring the two values to be averaged to obtain a final figure. These conditions are so "normal" that the IHF measurement standard defines the methods necessary to derive numerical results from sometimes ambiguous measurements.

All of this leads us to the fact that the FM tuner in the Model R376 had both minimum distortion and maximum separation at the same tuning point, which happened to coincide with a center meter indication. Tuning was not critical, which means the average user should have no difficulty realizing the same kind of performance we measured. The FM muting was both positive and noise-free.

Although it probably has little to do with actual performance (except as an indicator of how well the receiver is put together), we noted that the flywheel tuning mechanism would cover the entire band with one spin of the knob.

The receiver's top-notch electrical performance was unfortunately not completely matched by its human engineering aspects. If we seem to be nit-picking here, it is only because of the contrast between the two. For example, the antenna terminals are too close together and are smooth (non-knurled) binding posts, creating difficulty in connecting the antenna. This was in sharp contrast to the excellent speaker connectors. In another area, the unusually long (9 1/4 inch) dial scale should have made accurate tuning a simple matter, but the dial markings at 1-MHz intervals would require a degree of care in interpolation to set the tuning to a known frequency within the required 200-kHz accuracy.

Aside from these minor criticisms, we found the Model R376 to be a thoroughly enjoyable receiver to use. Its sound is faultless and its appearance and "feel" are what one would expect from a company's top receiver. And as we discovered, the R376 is more receiver than its modest specifications imply.

CIRCLE NO. 102 ON FREE INFORMATION CARD

SHURE MODEL 516EQ MICROPHONE

Has four built-in equalizer filters centered on 190, 560, 1650, and 4950 Hz.

HIRSCH-HOUCK LABS REPORT

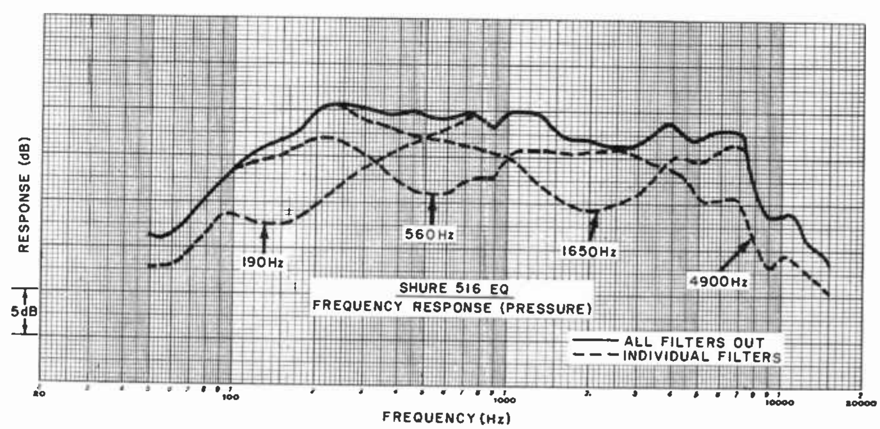
A "flat" microphone frequency response is not always ideal for making a live tape recording. The placement of the microphone relative to the performers, the acoustic properties of the room, and one's personal taste, among other factors, may make it desirable to modify the overall frequency response. ("Graphic equalizers," so popular among amateur recordists, are often used for this purpose.) There are many situations that call for equalization in which one does not have access to a graphic equalizer or its equivalent. Shure's Model 516EQ "E-Qualidyne" microphone is a novel and effective answer to that problem for the amateur tape recording enthusiast.

This unidirectional (cardioid) dynamic microphone has a nominal rated impedance of 150 ohms. It is compatible with microphone inputs having rated impedances between 25 and 3000 ohms, which encompasses the majority of home-type open-reel or cassette recorders. The 1000-Hz output level, for one microbar of pressure, is rated at −81 dBV, or 0.09 millivolts. A three-pin male connector in the tapered end of the microphone's body mates with the furnished cable or any other cable fitted with a Cannon XL, Switchcraft A3, or equivalent plug. The cable supplied with the microphone is 4.6 meters (15 feet) long, and has a metal-bodied 6.3 mm (¼ inch) phone plug at its free end. A 36" (0.91-m) adapter cable is supplied so that the microphone can be used with recorders equipped with miniature phone jacks for their microphone inputs.

The novelty of the Model 516EQ lies in its integral four-band equalizer that is controlled by four tiny switches recessed into the body of the microphone. Each switch introduces a broad response notch, nominally 6 dB deep, with center frequencies of 190, 560, 1650, and 4950 Hz. The 16 possible combinations of switch settings permits the response of the microphone to be tailored for a wide variety of circumstances. The instruction leaflet shows typical response curves for each of the switch combinations and describes the sonic effect of each.

The Shure 516EQ is supplied in a rugged plastic storage case, with signal cable, mini-plug adapter, wind screen, and swivel adapter for stand mounting. For stereo recording, one can buy the Model 516EQ-PR that contains two complete Model 516EQ systems in a single carrying case. The price of the Shure Model 516EQ is $75.

Laboratory Measurements. A rigorous measurement of microphone frequency response requires elaborate and specialized test facilities. Fortunately, it is also possible to make less exact measurements that show the microphone's effective response and how it compares to other microphones measured in the same manner. We use the same basic setup employed for speaker system testing. A speaker system, driven from the swept frequency output of a General Radio response plotter, is used as a sound source. First, the output of the speaker is plotted through our calibrated laboratory microphone at a distance of about 15" (38.1 cm) from the grille and on the central axis of the drivers. Then the test microphone is substituted for the reference microphone, making sure that both are positioned identically relative to the speaker. The swept measurement is



Frequency response (pressure) with all filters out and with individual filters in.

repeated on the same chart paper. The frequency response of the reference microphone is known (and is flat within better than 1 dB to beyond 10,000 Hz), so the difference between the two curves is taken as the response of the test mike.

The curve we obtained in this manner from the Shure Model 516EQ microphone (with all four filters OUT) has less high-frequency emphasis than was shown on Shure's "typical response" curves, but it was otherwise fairly similar. It was flat within ± 3 dB from 110 to 7500 Hz, dropped about 9 dB in the 9000-to-11,000-Hz range, and fell more rapidly at higher frequencies. The low-frequency response followed Shure's curve closely, rolling off below 200 Hz to −13 dB in the 50-to-60-Hz range.

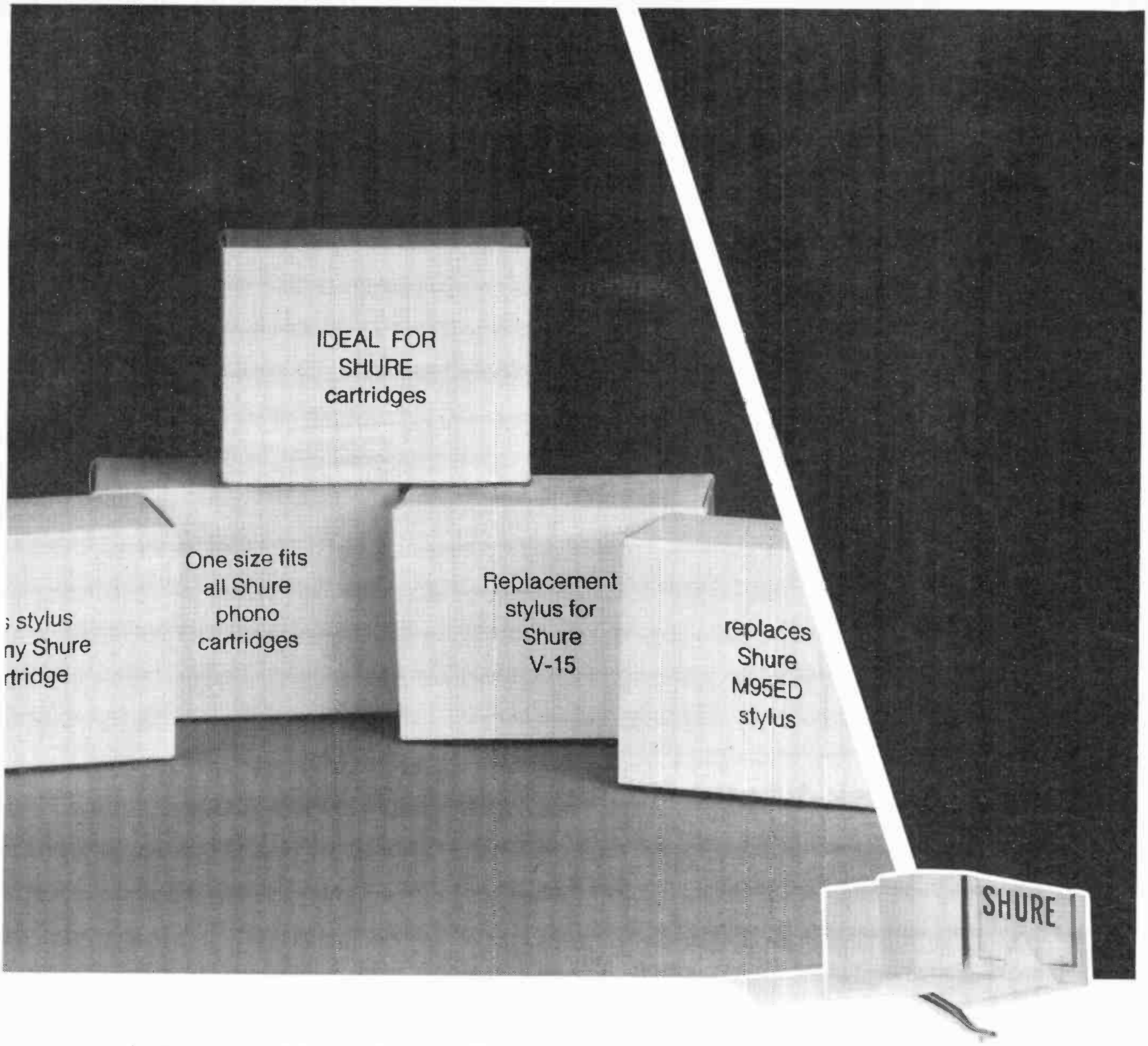
We repeated the response measurements using the filters, one at a time, and plotted the effect of each filter on the same coordinates used for the equalized response curve. Each filter had the specified effect, although the attenuation was usually closer to 8 or 10 dB than the nominal 6 dB, which will vary with load impedance. (We used a high-impedance load in our tests).

User Comment. The effect of the filters on the sound of the microphone can best be judged by making a recording (of one's own voice, for example), using all possible combinations of switch settings. We would suggest that one keep a small screwdriver or a pencil handy for operating the equalizer switches.

It was soon apparent that the microphone can be adjusted to sound like almost anything from a nasal constricted "telephone" sound to an excellent wide-range response very close to that of our calibrated capacitor microphone. We did not use the microphone in the field for live recordings, but our experience with it suggests that the built-in equalizers should be able to cope with many of the acoustic problems one might encounter.

This is one of the least expensive microphones we have seen whose sound quality is reasonably well matched to that of a modern cassette deck. Other microphones may come closer to utilizing the full capability of such a recorder, but they will probably cost more than the Model 516EQ and will not have its equalizing ability. Although we could not make meaningful measurements of the sensitivity of the Model 516EQ, its output was compatible with the requirements of several good cassette decks with which it was used.

CIRCLE NO. 103 ON FREE INFORMATION CARD



Needle in the hi-fi haystack.

Even we were astounded at how difficult it is to find an adequate other-brand replacement stylus for a Shure cartridge. We recently purchased 241 random styli that were not manufactured by Shure, but were being sold as replacements for our cartridges. Only ONE of these 241 styli could pass the same basic production line performance tests that ALL genuine Shure styli must pass. But don't simply accept what we say here. Send for the documented test results we've compiled for you in data booklet #AL548. Insist on a genuine Shure stylus so that your cartridge will retain its original performance capability–and at the same time protect your records.

Shure Brothers Inc.
222 Hartrey Ave.,
Evanston, IL 60204
In Canada:
A. C. Simmonds & Sons Limited

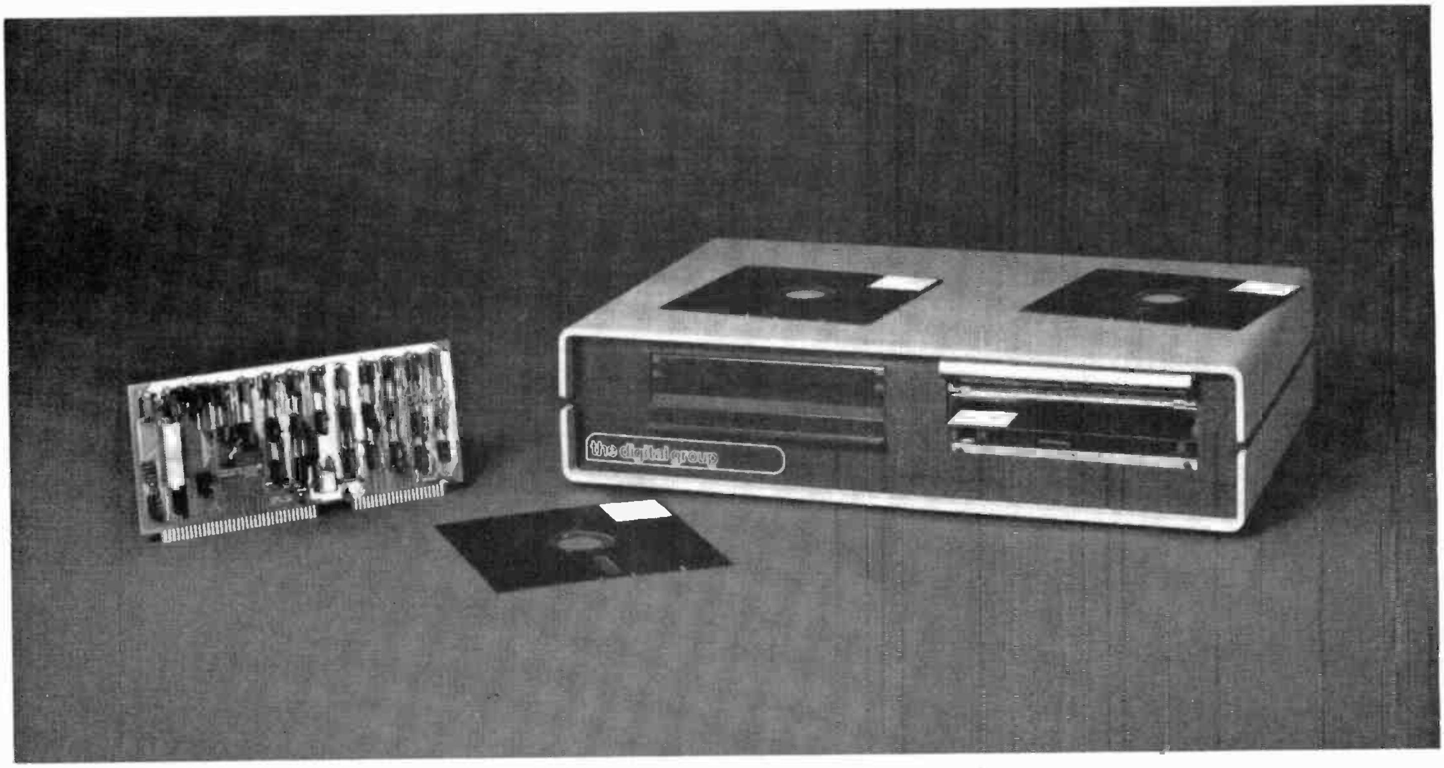
TECHNICORNER
The criteria for these tests involved the eight standard production line inspections used for all Shure styli: Visual and mechanical inspection, tip configuration, trackability, vertical drift, 1,000 Hz output level measurement, channel separation at 1,000 Hz, channel separation at 10,000 Hz, and frequency response.
Only genuine Shure styli have the name SHURE on the stylus grip and the words "This Stereo Dynetic® stylus is precision manufactured by Shure Brothers Inc." on the box.

® SHURE

Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

CIRCLE NO 52 ON FREE INFORMATION CARD

NOW, DISKS TOO!



(And they're **Disk**-tinctly Digital Group.)

With the addition of our all-new Disk Subsystem, the Digital Group becomes the only manufacturer of microprocessors to offer you a real choice. Tape or disk. Or both. Whatever *you* want.

We spent a lot of time designing and testing our new Disk Subsystem, and it shows in the result. The Subsystem is highly flexible. . . gives you direct access to data. . . and completes your Digital Group System.

Here's what the Disk Subsystem consists of:

Disk Interface Card--provides the electrical interface between the disk drives and the computer.

Disk Power Supply--provides all power required for up to 2 drives.

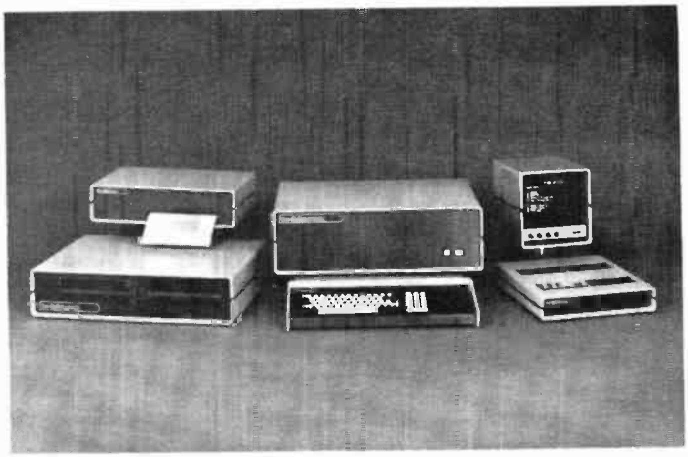
Disk Cabinet and Cables--cabinets provide housing for 1 to 2 drives plus the power supply; assembled cabling is provided for connection between all system components.

Disk Drives--the Digital Group Disk Subsystem supports standard 8" floppy disk drives from a number of manufacturers. Drives can be mixed, and in addition, mini-floppy drives are available for the function of a disk at minimum cost.

Documentation and Software--the Digital Group's standard documentation includes construction guides, maintenance manual, theory of operation and other useful information to help you get the fullest value from your new Disk Subsystem. And there's also software to provide initial support.

The price? Low. It's become a tradition with the Digital Group to offer you high-quality, state-of-the-art equipment at the lowest possible prices. Our new Disk Subsystem is no exception.

For only $745, you can get a standard 8" floppy drive and an interface card. A complete single-drive Disk Subsystem with interface, power supply, cabinet, and cables is as low as $995.

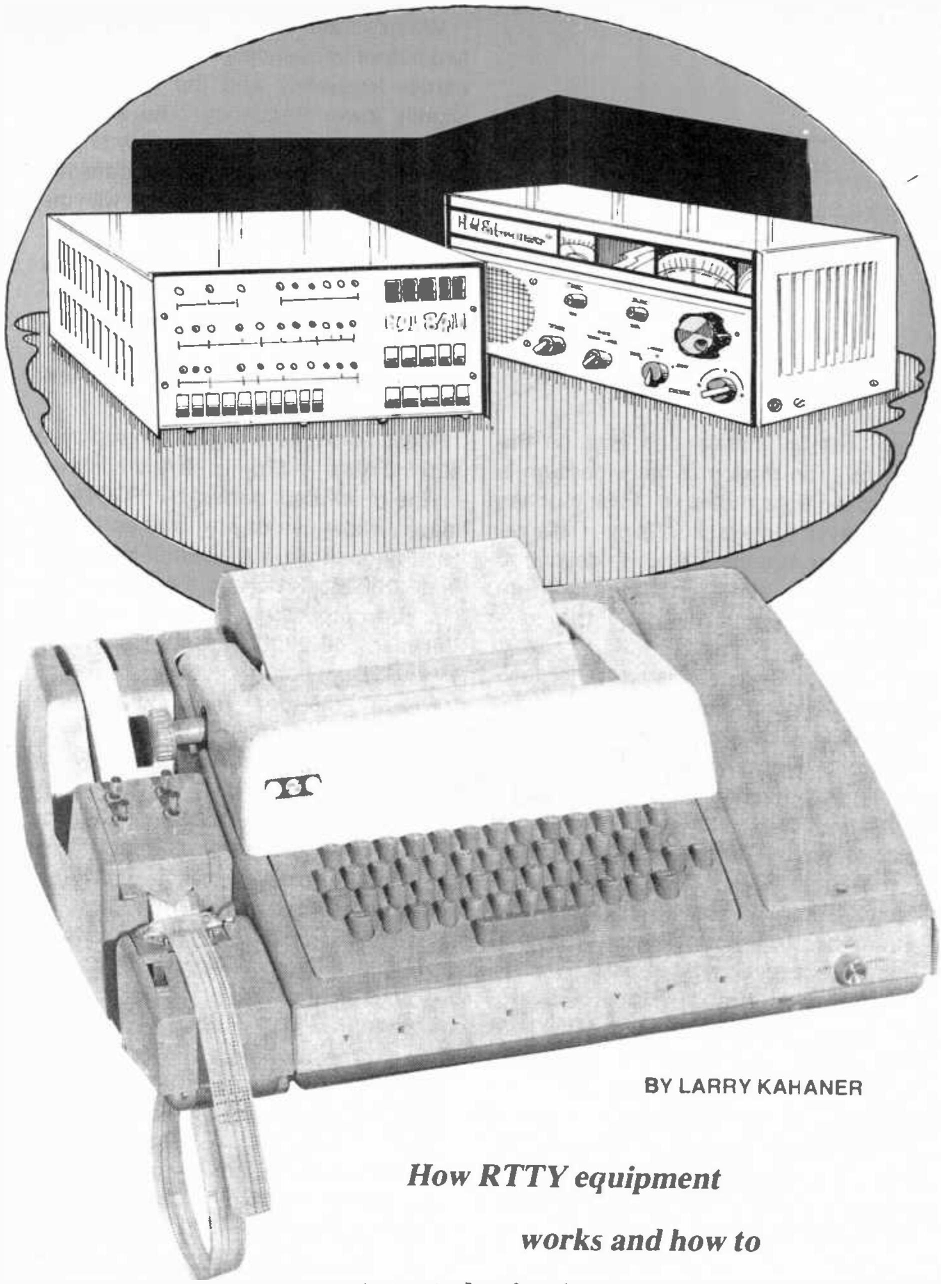


Now the Digital Group system is really complete. If you don't own it all yet, take another longing look. In addition to our CPU, keyboard and video monitor, you can add an impact printer and the cassette storage system. All in our beautifully coordinated custom cabinets. All unmistakably Digital Group.

The Digital Group now has disks. And a lot more. Why not find out about all of our exciting products? Simply call or write today for direct information. From the Digital Group.

the digital group Inc.

box 6528 denver, colorado 80206 (303) 777-7133



BY LARRY KAHANER

How RTTY equipment works and how to get started using it.

TELETYPEWRITER FUNDAMENTALS FOR HAMS, SWL'ers & COMPUTER HOBBYISTS

HAVE you ever wondered about those strange "deedle-deedle" signals on the shortwave bands? They are actually radioteletype (RTTY) transmissions. You can receive them using your communication receiver and readily available teletypewriter equipment. In this article, we will cover the basics of radioteletype and detail how to set up an RTTY listening post at home.

The Teletype Code. All teletypewriters, whether they communicate by radio or land-line links, "talk" to each other in a language called Baudot, or five-level code. Each character (letter, numeral, punctuation mark) in the Baudot code is uniquely defined by a sequence of five time slots, or *elements*, each of which contains a *mark* or a *space*. For example, the letter A is "mark-mark-space-space-space." When the teletypewriter is operating at 60 wpm (words per minute), each mark or space is exactly 22 milliseconds (ms) long.

A sixth slot is added to the basic five-level code to act as a "flag" that indicates the end of a character. To make this stop flag stand out from the others, its interval is 31 ms instead of 22 ms. Still another time slot is placed at the beginning of each character to give the teletypewriter time to prepare itself for a new character. This is the "start" slot. The 31-ms stop slot contains a mark, while the 22-ms start slot contains a space. A complete character, therefore, consists of seven slots, six 22-ms intervals and one 31-ms interval for a total of 163 ms (see Fig. 1).

The Equipment. A complete station for transmitting and receiving radioteletype signals is shown in Fig. 2. The transmitter and receiver are of conventional "communication" design. The teletypewriter is a combination keyboard/printer. On transmit, the keyboard drives a keyer that, in turn, modulates the transmitter. On receive, signals are coupled from the communication receiv-

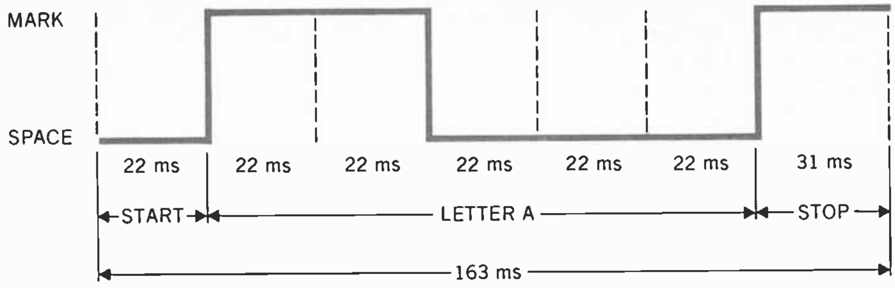


Fig. 1. Waveform showing the pulse sequences that make up the letter "A".

er to the demodulator or terminal unit (TU), which drives the printer.

Now let us examine each component in the system in detail:

Keyboard. A mechanical teletypewriter keyboard resembles the keyboard on a conventional typewriter, but its operation is quite different. When a key is operated, it selects mechanical levers that produce mark and space pulses that correspond to the key's character. Also, there are no lower-case letters—all are capitals. To type punctuation marks, the SHIFT key is pressed first, followed by operation of a key that corresponds to the character you wish to type.

The diagram in Fig. 3 illustrates how one keyboard might work. Each key has a notched lever, which when pressed down can touch five "fingers" that will be either depressed or not, depending upon the notch positions of the lever.

After the key is pressed and the mark and space levers have moved accordingly, a wiper arm sweeps across the mark levers but cannot touch the space levers. An electrical connection is made between the wiper arm and mark fingers, but no current can flow on the spaces. The motion of the wiper arm is controlled by a motor so that it touches each lever for exactly 22 ms. This results in the five-element code described above. Start and stop commands are generated automatically by the keyboard.

The above process is typical of keyboard operation, but it is not absolute. There are variations in keyboard design from one teletypewriter to another. The latest generation of teletypewriters, however, uses electronic instead of electromechanical means for generating the Baudot code. Digital matrix keyboards with clock-controlled digital IC's that generate precisely timed code elements have recently become common.

Transmitter Keying. Dc pulses produced by the keyboard drive a keyer that, in turn, modulates the transmitter. Most often used is frequency shift keying (FSK), a form of frequency modulation. Transmission of FSK signals allows the use of FM demodulation techniques so that there is some discrimination against noise.

When a transmitter is FSK modulated, two output frequencies result, one at the carrier frequency and the other at a slightly lower frequency. The simplest way to accomplish the frequency shift is to add more capacitance to the transmitter's vfo tank circuit or in parallel with the oscillating crystal. In practice, the dc pulses from the keyboard control a relay or solid-state switch that rapidly connects and disconnects the additional capacitor. Hence, the transmitted frequency varies in step with a character's mark and space code.

Most commercial systems employ a 425-Hz shift. A 170-Hz shift is common on the hf amateur bands, but FCC regulations allow use of any shift up to 900 Hz. For example, if the carrier frequency is 15.000000 MHz and the shift is 425 Hz, the output frequency will alternate between 15.000000 and 14.999575 MHz. By convention, the space is the lower and the mark the higher frequency. In this example, marks appear at 15.000000 MHz and spaces appear at 14.999575 MHz.

Receiving FSK. A bfo (beat frequency oscillator) is commonly used for CW reception. The bfo generates a signal that beats against the incoming CW signal to produce an audible tone. If the frequency of the bfo's output is variable, the frequency of the audible tone can be changed. In RTTY communication, signals are received as in ordinary CW, but the bfo is tuned to provide 1275- and 1700-Hz tones, which are 425 Hz apart.

The reason for using 1275- and 1700-Hz tones is that a terminal can demodulate only one pair of frequencies at a time. This pair was chosen by TU

The new breed of teleprinter equipment: Morse and RTTY keyboard (left), demodulator (right bottom), video display unit (right top) and video monitor (top center). Courtesy HAL Corporation.

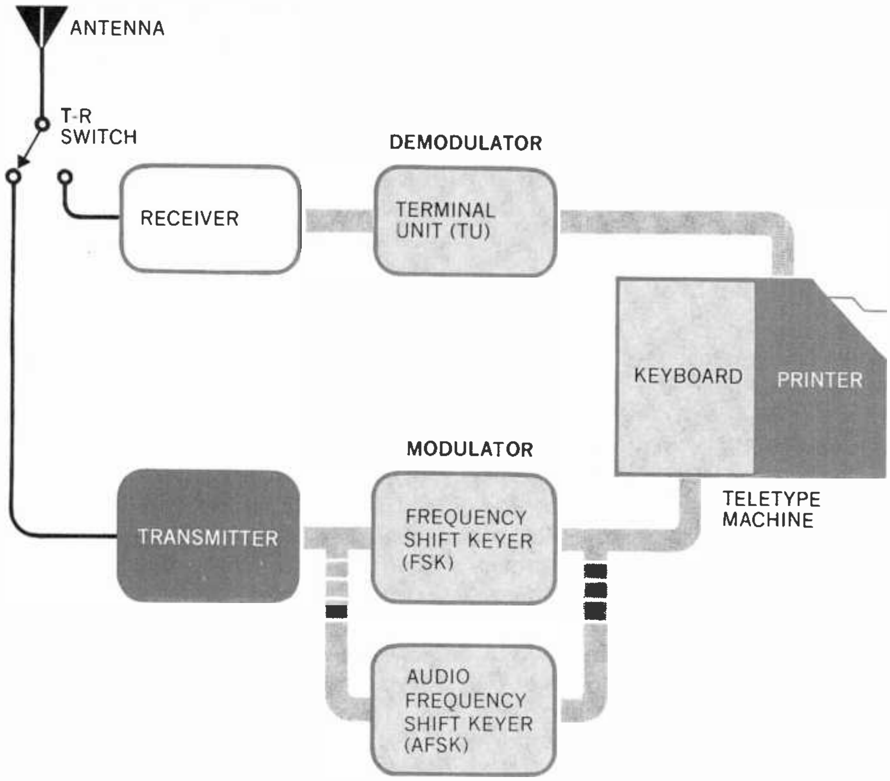


Fig. 2. Block diagram of the equipment in a complete RTTY station.

manufacturers for demodulation of a 425-Hz shift. (However, you can adjust the bfo or the main tuning knob if the bfo is fixed to produce any pair of tones your TU can demodulate.) Other shifts and tone pairs used in RTTY communication are listed in Table I.

An RTTY terminal unit looks and acts like an FM receiver, but it accepts audio signals. Called an *audio TU*, its block diagram is shown in Fig. 4. The limiter accepts the audio outputs of the receiver and amplifies and clips them to keep the signal level fairly constant. Mark and space filters remove any extraneous signal content. The two filtered tones are converted into dc pulses by the audio discriminator. Any ripple on the dc pulses is smoothed by the low-pass filter. The dc pulses are then applied to the keyer, which uses them to generate commands for the printer's magnets.

AFSK. Another method of keying is audio-frequency shift keying, or AFSK. It produces a result similar to FSK but is derived in a different manner. Two audio tones, separated by the frequency shift, modulate an AM or an SBB transmitter. The low-distortion sine-wave tones are applied to the transmitter's microphone input.

If the output from the transmitter is conventional AM, no bfo is required in the receiver. The detected envelope is coupled to the TU from the receiver's audio output. If, on the other hand, SSB equipment is used, the receiver must be carefully tuned for the correct output frequencies and allowances must be made in the transmitter for a 100% duty cycle. As in FSK, the two tones commonly used are 1275 and 1700 Hz.

The Printer. Although printer design varies from one machine to another, the following description is representative of printer operation. A simplified printer is shown in Fig. 5. The selector magnet is energized by each mark pulse. This closes the relay that corresponds to a moving cam connected to each mark and space lever. At the proper time, the cam either pulls down or does not affect the lever. Each lever is connected to a bar with many notches, which are placed at different intervals along the bar.

In the illustration shown in Fig. 5, the first, third, and fifth levers are pulled by the cam. The other levers remain in their original positions. After a character is completed (all five pulses received), one set of notches lines up directly under the appropriate character's striker. (Strikers are in a row, as in a regular typewriter.) When the stop pulse is received, a hammer hits all strikers, but only the one with the lined-up notches moves and imprints the paper. After the strike occurs, the bars and their notches return to their original positions.

The new teletypewriter printers literally do not print at all. They are actually special types of TV receivers that process the dc pulses and apply control signals to form letters on-screen. The advantages of screen printers are that they are quiet, clean, and have no moving

TABLE I—STANDARD SHIFTS AND TONE PAIRS (Hz)

Shift	170	425	850
Space	1275	1275	1275
Mark	1445	1700	2125

OTHER PAIRS IN USE

Space	2125	2125	2125
Mark	2295	2550	2975

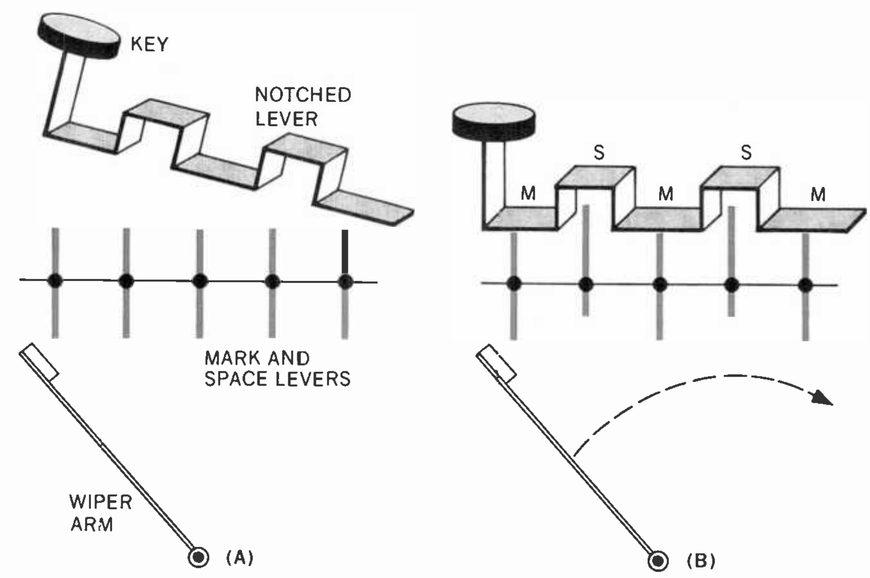


Fig. 3. Simplified diagram shows how key depresses levers at (B).

parts to wear out. Some screen printers have memories that allow storage and playback of messages. These "glass teletypewriters" cannot produce "hard" copy on paper; for this, you must use a regular teletypewriter printer.

Some teletypewriters have perforators that punch holes in 1" (25.4-mm) wide paper tape. The holes in the tape correspond to character codes. Tapes can be made from either an incoming signal or from a message typed on the machine's keyboard. To play back the message, you feed the tape through a tape reader called a transmitter-distributer (TD). The teletypewriter then prints the message. You can also transmit taped messages over the air.

The most commonly used speed is 60 wpm, but stations also transmit at 66, 75, and 100 wpm. To receive different speeds, no changes need be made in the terminal unit, but the printer must be altered. Printers rely on gears to set the speed. Changing gears allows the machine to print at different speeds. TV teletypewriters usually accommodate many speeds with just the turn of a switch.

The number of words per minute tells you only part of the printer's story because each speed requires different slot lengths. A slot for 60-wpm copy is not the same length as one at 100 wpm. So, another word—"baud"—was invented to take slot length into account. The baud is a measure of the rate at which data is sent and is defined as a rate of one pulse (of the shortest duration used in the system) per second. The baud rate is calculated by finding the reciprocal of the shortest slot length. For 60 wpm, the shortest length is 22 ms or 0.022 s; the baud rate is 1/0.022 = 45.5 baud. Other baud rates are detailed in Table II.

When printer gears are changed, the baud rate is altered. The printer's magnets sweep the levers in step with the length of each pulse and, hence, the baud rate.

Equipment Considerations. Any good communication receiver can be used for receiving RTTY. Due to the small, critical frequency shift, however, stability is essential. If your receiver's CW filter bandwidth is 400 Hz, it will probably be suitable for shifts up to 425 Hz. It might not work well with wider shifts, such as 850 Hz, especially if signals are weak. Of course, the SSB filter can be used if the received shift is too great for the CW filter.

Your choice of TU's hinges on your needs and your budget. (Sources of teletypewriter gear are listed in Table III.) One inexpensive approach is to build your own TU. A simple two-chip TU can be built for less than $20. Alternatively, you might decide that a more sophisticated demodulator with built-in oscilloscope tuning indicator and sharp filtering and a choice of shifts fills your needs. Plans for many different TU's can be found in published literature.

If you prefer not to build your own TU, you can buy factory assembled units. Some features to look for here are a choice of shifts, reverse/normal switching, filtering, tuning indicator, baud-rate selection, adequate loop current for the printer magnets, and selectivity.

Most RTTY enthusiasts buy "surplus" printer/keyboard combinations. After these machines are used commercially, surplus dealers buy, recondition, and resell them. Old teletypewriters are rugged and, if properly reconditioned, should last a long time. Prices range from $50 to $250, depending on model, age, and condition. New machines are quite expensive and can cost as much as $2000.

You might wish to buy a video monitor instead of a mechanical printer. (Of course, you can modify an old TV receiver for use as a monitor.) A video monitor requires the use of a visual display unit (VDU), which converts the dc pulses from a TU into a form suitable for onscreen display. VDU's cost $350 to $600. You can however, build your own VDU from plans that have been published in the literature.

If you are a computer hobbyist, consider using your existing monitor and VDU. Be aware, of course, that computers use ASCII, an eight-level computer code, rather than the five-level Baudot code used in RTTY. Baudot signals must be converted to ASCII before reaching the VDU. Baudot-to-ASCII converters are commercially available, or you can make one yourself.

Making Connections. If you buy a teletypewriter, be sure you get the manual, because it contains the machine's wiring diagram and color code. Each machine is wired differently. Bear in mind that, in spite of the jungle of wires inside the teletypewriter, only six wires are necessary for RTTY operation. Two are for the motor, two for the printer magnets, and two for the keyboard. Once you locate the appropriate wires, the hookup necessary to put the tele-

TABLE II—RATES AND SLOTS

Bauds	Words/Min.	Millisec./ Pulse
45	60	22.0
50	66	20.0
57	75	17.57
74	100	13.47
100	132	10.0

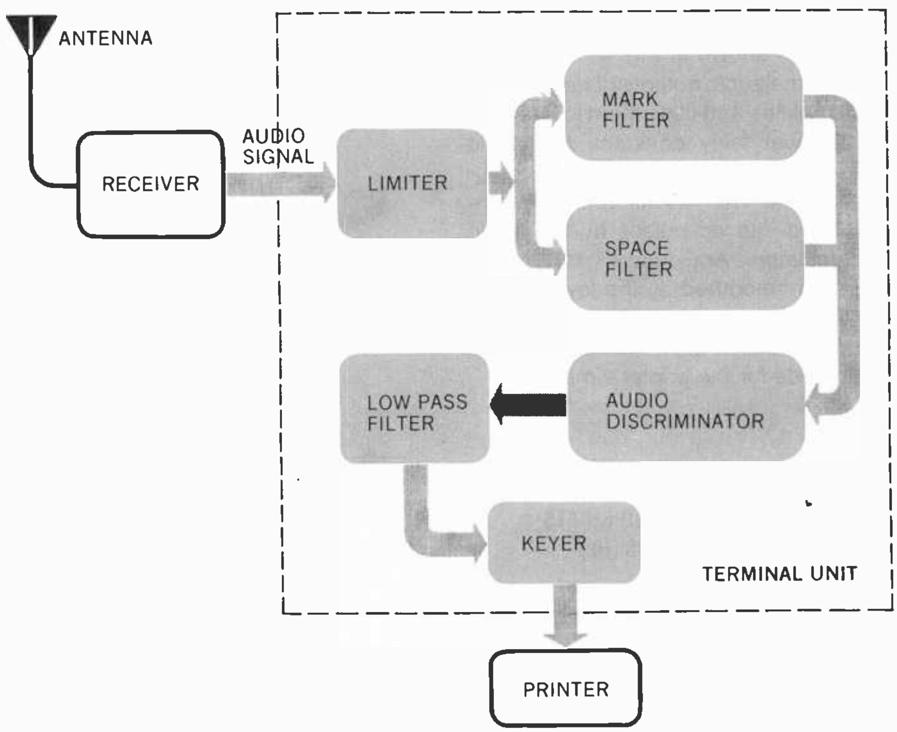


Fig. 4. Block diagram of typical audio terminal unit.

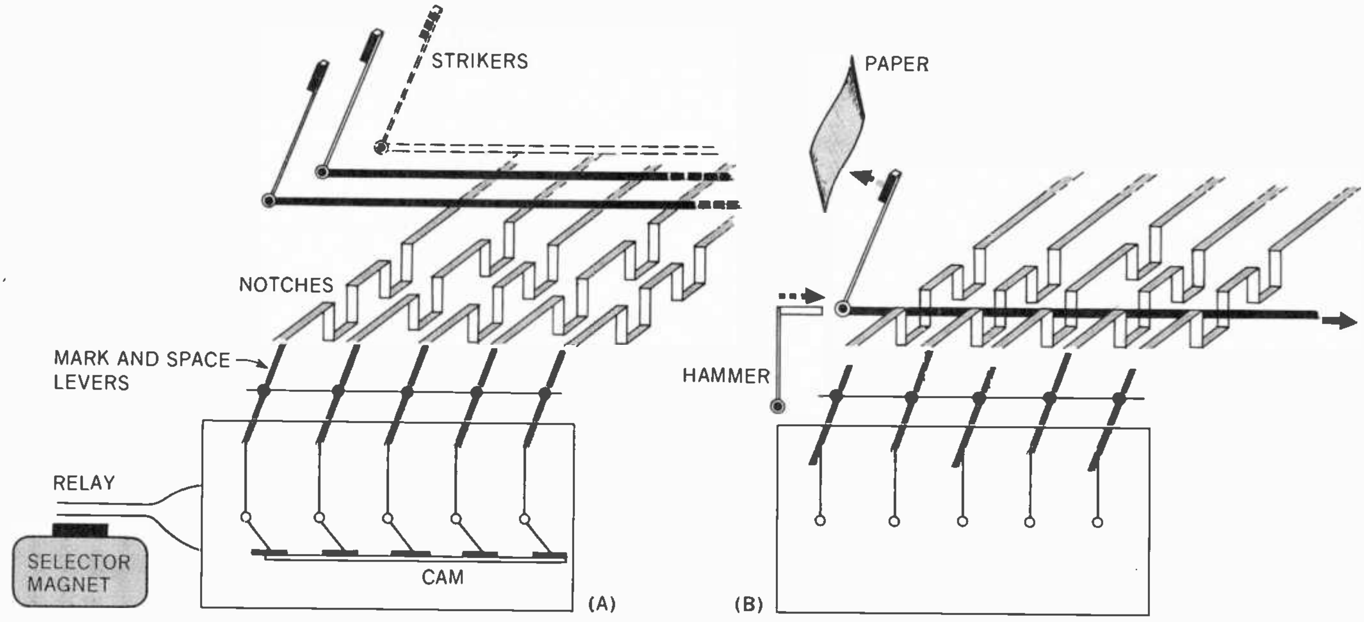


Fig. 5. Typical printer action. At (A), before letter is sent, notches are in random order. At (B), after letter is sent, one set of notches lines up under the correct striker.

typewriter in service is easily accomplished.

Local copy (typing on the keyboard and obtaining a print-out but no transmission) can be accomplished with the circuit shown in Fig. 6. Many teletypewriters employ two selector magnets (check your manual on this) that are connected either in series or in parallel with each other. Use an ohmmeter to check the resistance of the magnet circuit. Each magnet has approximately 100 ohms of dc resistance; so, an ohmmeter reading of 200 ohms indicates a series connection, while a 50-ohm reading indicates a parallel hookup. Because each magnet requires about 30 mA of current, parallel wiring calls for 60 mA in the loop circuit, while series wiring requires 30 mA in the loop. Adjust the series resistor for the proper magnet current.

Turn on the motor by applying 117 volts ac to its winding. With proper magnet current flowing and the motor running, you should be able to type on the keyboard and obtain a printed hardcopy message. If you have trouble obtaining local copy, check your wiring. Garbled or no printing at all could also be caused by poor adjustment of the "range selector."

Sometimes, distortion occurs in RTTY transmissions. Pulses often become longer or shorter because of propagation conditions. To counteract this, machines are designed to respond to only a small section in the middle of the pulse width. The exact location of this "window" is controlled by the range selector, a movable arm that has graduations from 0 to 120.

To test the range selector, type the letters RY. These letters, when alternately typed, produce a mark pulse in each of the five slots. Move the range selector toward 0. As you approach 0, the teletypewriter will begin to lose intelligibility and print random characters. Note the setting at which this occurs. Then increase the setting until the machine's printer "locks up," again noting the setting. Set the range selector midway between these two points.

The terminal unit should be connected as shown in Fig. 7. TU's vary in design, but some share basic characteristics. For example, they all have a method for adjusting the shift frequency, which is usually a variable inductance. And they all have controls for adjusting printer current, usually via a potentiometer. Both controls must be properly adjusted for correct TU operation.

TABLE III—SOURCES OF RTTY EQUIPMENT

Alltronics-Howard
Box 19
Boston, MA 02101

Atlantic Surplus Sales
3730 Nautilus Ave.
Brooklyn, NY 11224

Dovetron
627 Fremont Ave.
S. Pasadena, CA 91030

Fair Radio Sales
Box 1105
Lima, OH 45802

Teletype Corp.
5555 Touby Ave.
Skokie, IL 60076

Typetronics
Box 8873
Fort Lauderdale, FL 33310

Nat Stinette Electronics
890 Virginia Ave.
Tavares, FL 32778

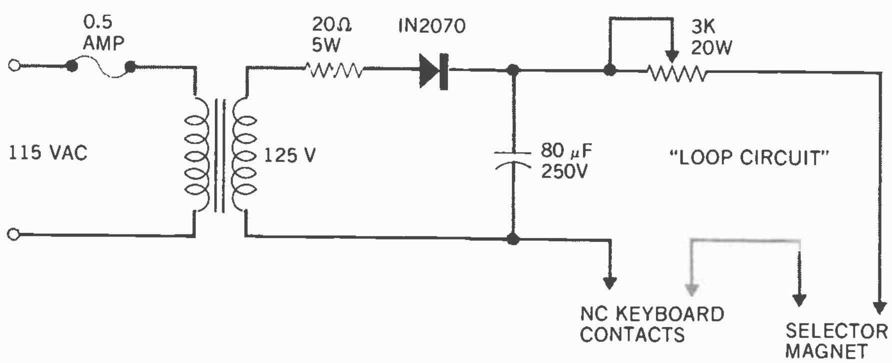


Fig. 6. Local copy can be obtained using the loop circuit shown here.

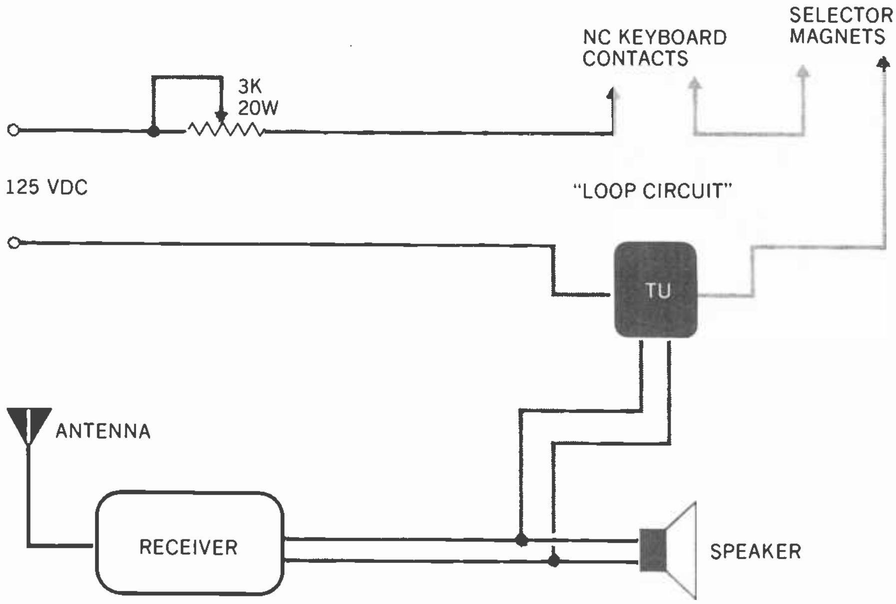


Fig. 7. How to set up an RTTY receiving station with a terminal unit.

Connect the TU to the receiver's audio output, keeping the speaker online so that you can hear the incoming signals. Find an RTTY station and tune it in carefully, using the TU's tuning indicator for accuracy. Because tuning in RTTY stations is tricky, you may get garbled copy until you become accustomed to tuning. Some operators tune until legible copy appears, while others can tune in the proper tones by ear. Either method is fine, but do not expect to be able to emulate this right away. It takes lots of practice.

If you get garbled copy, it may be due to one of several causes. The most common is that the station is transmitting at a different shift or speed from your settings. Again, experienced operators can "hear" different speeds and shifts. You will, too, after a while.

A station might be transmitting in reverse shift, with the space high and the mark low. Switching sidebands on your receiver or shifting the bfo output to the other side of zero beat will compensate for this. Many TU's have a reverse/normal switch that accomplishes the same thing. Military stations often transmit secret cipher messages that look like gibberish. If you are not aware of this practice, you can go crazy trying to copy them.

Listening. At least 200 stations, excluding radio amateurs and the military, transmit RTTY (see Table IV). Most use shifts of 425 to 850 Hz and speeds of 60 to 100 wpm. By tuning to them, you can receive news reports, weather forecasts, and commercial radiograms, as well as conversations between radio amateurs and military traffic. However, you should read Section 605 of the Communications Act of 1934 that concerns secrecy of communications.

In brief, the Act prohibits a listener from divulging to a third party or using for his own or a third party's benefit the contents of any interstate or foreign communication by radio or wire. Note, however, that this section does not apply to the contents of any radio communication broadcast or transmission by radio amateurs or others for use of the public or relating to ships in distress.

Getting Help. Besides the books listed in Table V, there are other sources of information and help to which you can turn. Although relatively few shortwave listeners use RTTY, many hams transmit and receive radioteletype messages. Most of them will be glad to show you the "tricks of the trade" they use to obtain perfect copy. Also, many computer hobbyists use teletypewriters to get hard copy or punch tape. ◇

TABLE IV—RTTY STATIONS

Call	Frequency (MHz)	Location	Service
9PX29	6.910	Barbados	Reuters
WFK80	10.7535	New York	Reuters
RVW57	12.315	Moscow	Tass (some English news
WER73	13.480	New York	UPI
WER24	14.770	New York	UPI
WEY45	15.914	New York	AP (some English news)
SOP29	15.989	Poland	Polish Press (some English news)

Note: Most ham operators use a 170-Hz shift at 60 wpm near 3.620, 7.040, and 14.090 MHz.

TABLE V—REFERENCE LIST

Confidential Frequency List
By Robert B. Grove
Pub. by Gilfer Assoc.
Box 239
Park Ridge, NJ 07656
(Extensive lists of stations transmitting RTTY. Updated periodically.)

The New RTTY Handbook
73 Publishers
Peterborough, NH 03458
(Good for beginners, slanted for hams.)

RTTY News
Canadian Amateur Radio Teletype Group
Gwen Burnett
85 Fifeshire Rd.
Willowdale, Ont., Can. M2L 2G9
(Technical information and amateur operating news.)

Teleprinter Handbook
By D. L. Goacher & J. G. Denney
Radio Society of Great Britain
35 Doughty St.
London, WC1N 2AE, England
(Thorough treatment of RTTY. Large section on machine repair and maintenance.)

RTTY Journal
P. O. Box 837
Royal Oak, MI 48068
(Published 10 times per year. Slanted for the ham, but has classified ads, technical pieces, and a DX-RTTY column. Publishers of *The Beginner's RTTY Handbook*.)

The Radio Amateur's Handbook
and
Specialized Communications Techniques for the Radio Amateur
American Radio Relay League
225 Main St.
Newington, CT 06111

Hex-to-ASCII Converter for your TVT-6

Simple module produces op-code display for entire computer.

BY DON LANCASTER

THE LOW-COST "Hex-to-ASCII Converter" described here allows you to simultaneously display the contents of every register, stack location, and memory slot in your microcomputer. The converter fits easily between the TVT-6 (July 1977) or most any other TVT and the μC with which it is working.

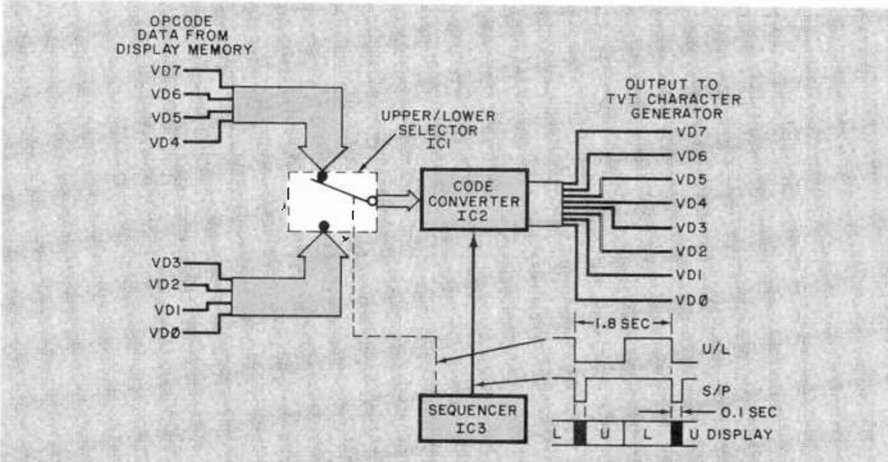


Fig. 1. Block diagram of system. Op code is displayed as brief blank, followed by upper then lower hex character.

In operation, the video monitor used in the system automatically converts and displays the hex op codes for the ASCII character set. This allows your TVT to act as a super "front panel" that permits you to check as many memory locations as there are in your system. This includes all registers, accumulator, stacks, RAM and ROM programs, I/O, or anything else connected to the system. Properly used, the converter is also an excellent debugging tool.

The complete hex-to-ASCII converter is built on a single compact printed circuit board. The circuit itself consists of three low-cost IC's and only five other parts.

About the Circuit. As shown in Fig. 1, the eight input lines from the display memory that normally drive the TVT character generator are intercepted and split into upper- and lower-case charac-

(Continued on page 51)

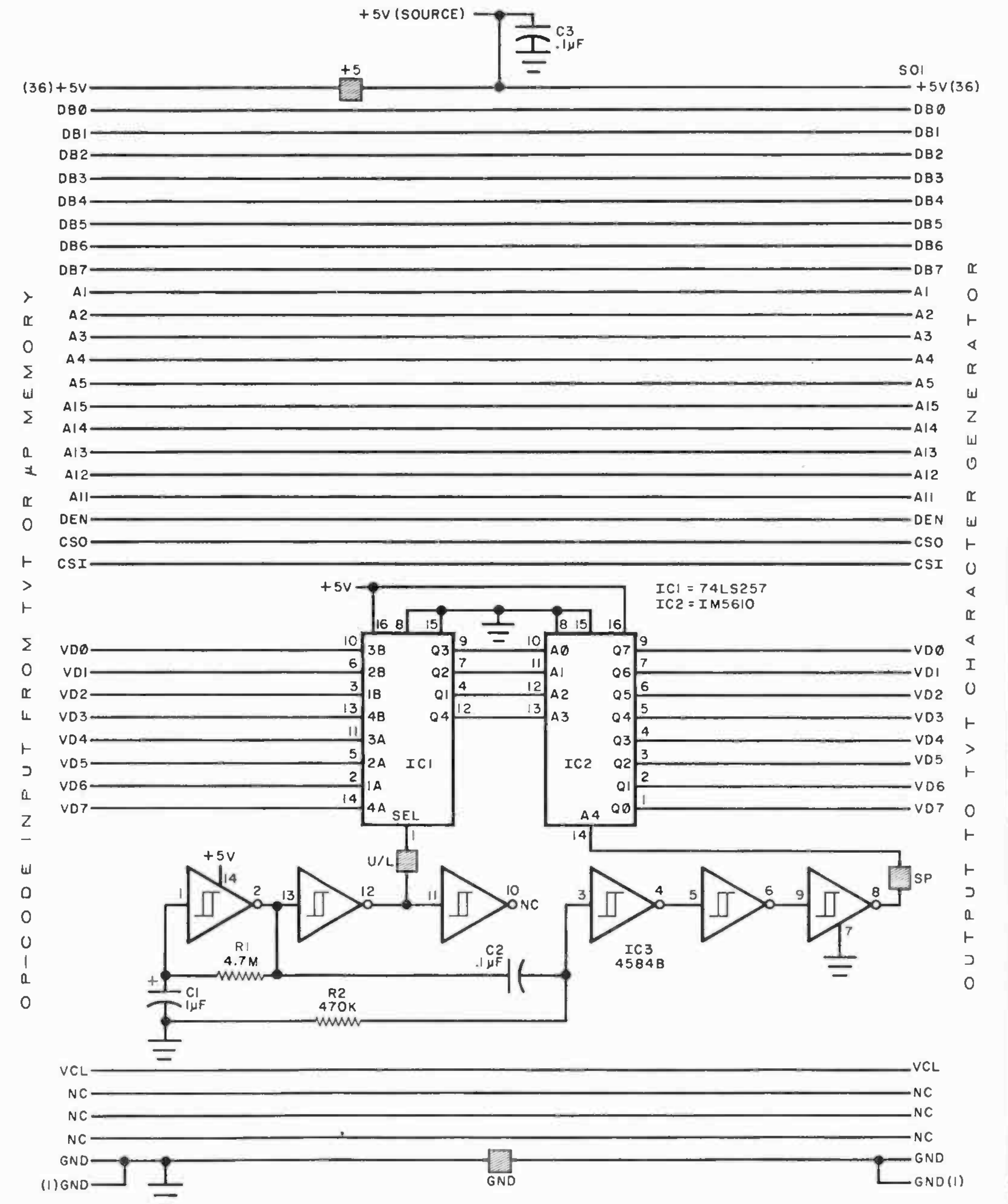


Fig. 2. Oscillator IC3 is circuit timer for upper/lower display and interbyte pause.

WORD	NOTES	8/7	7/6	6/5	5/4	4/3	3/2	2/1	1/0
0	Blank	□	□	□	□	□	■	□	□
1	"	□	□	□	□	□	■	□	□
2	"	□	□	□	□	□	■	□	□
3	"	□	□	□	□	□	■	□	□
4	"	□	□	□	□	□	■	□	□
5	"	□	□	□	□	□	■	□	□
6	"	□	□	□	□	□	■	□	□
7	"	□	□	□	□	□	■	□	□
8	"	□	□	□	□	□	■	□	□
9	"	□	□	□	□	□	■	□	□
10	"	□	□	□	□	□	■	□	□
11	"	□	□	□	□	□	■	□	□
12	"	□	□	□	□	□	■	□	□
13	"	□	□	□	□	□	■	□	□
14	"	□	□	□	□	□	■	□	□
15	"	□	□	□	□	□	■	□	□
16	0	□	□	□	□	■	■	□	□
17	1	■	□	□	□	■	■	□	□
18	2	□	■	□	□	■	■	□	□
19	3	■	■	□	□	■	■	□	□
20	4	□	□	■	□	■	■	□	□
21	5	■	□	■	□	■	■	□	□
22	6	□	■	■	□	■	■	□	□
23	7	■	■	■	□	■	■	□	□
24	8	□	□	□	■	■	■	□	□
25	9	■	□	□	■	■	■	□	□
26	A	■	□	□	□	□	□	■	□
27	B	□	■	□	□	□	□	■	□
28	C	■	■	□	□	□	□	■	□
29	D	□	□	■	□	□	□	■	□
30	E	■	□	■	□	□	□	■	□
31	F	□	■	■	□	□	□	■	□

0-WHITE; 1-BLACK

Fig. 3. Truth table for PROM IC2.

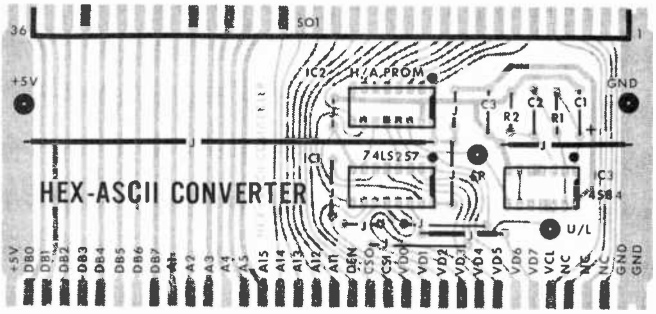


Fig. 4. Actual-size etching and drilling guide (right) and component layout (above) for the pc board. The board is connected between the TVT-6 and the KIM-1 microcomputer.

PARTS LIST

C1—1-µF, low-leakage tantalum electrolytic capacitor
C2,C3—0.1-µF Mylar capacitor
IC1—74LS257 quad 1-of-2 data selector
IC2—IM5610 or similar 32X8 bipolar tristate PROM (programmed in accordance with Fig. 3)
IC3—4584B CMOS hex Schmitt trigger
R1—4.7-megohm, ¼-watt resistor
R2—470,000-ohm, ¼-watt resistor
SO1—36-contact, single-entry edge connector with contacts located on 3.96-mm centers
Misc.—Sockets for IC's (one 14-pin, two 16-pin); press-fit test point terminals; printed circuit board; jumper wire; insulated sleeving; solder; etc.
Note: The following items are available from PAIA Electronics, Box 14359, Oklahoma City, OK 37114: No. HAC-1B etched and drilled pc board for $4; No. HAC-1P programmed IC2 for $5; No. HAC-1K complete kit of all parts for $14.95. All prices postpaid.

(Continued from page 49)

ters of four bits each. These two hex characters are alternately routed to a PROM that converts the hexidecimal input code to the equivalent ASCII output. The resultant display alternately flashes the upper hex character and then the lower hex character, with both appearing on-screen at the same location. Each character is displayed for slightly less than a second. A brief space command is sent to the PROM during the transition from the lower character of one set to the upper character of the following set.

To identify the memory locations, an overlay can be used on the CRT screen of the video monitor, or a china marker can be used to label the operating registers and other important slots with which you are working. If the TVT-6 is being used with the "Cruncher the Bear" mode in the August 1977 issue, it is possible to simultaneously display the 4096 hex characters that result from the 2048 opcode words simultaneously.

The complete schematic diagram of the converter is shown in Fig. 2 and the coding for the 32 × 8 code-converter PROM is shown in Fig. 3.

Integrated circuit *IC1* (Fig. 2) is used as a four-pole, double-throw data selector that drives *IC2*, the code converter. The hex CMOS Schmitt trigger (*IC3*) serves as a symmetrical oscillator that is used for automatically selecting the upper and lower character and to generate the brief blanking pulse that indicates a new character display.

Construction. The converter circuit is best assembled on a printed circuit board. The etching and drilling and components placement guides for the pc board are shown in Fig. 4.

Note on the components placement guide that 10 jumpers are used to interconnect various pads on the board. Only two of these jumpers, indicated by heavy lines, require insulated sleeving to be slipped over them before installation to preclude the possibility of accidental short circuits.

Install and solder into place press-fit terminals at the four test points labelled +5, GND, SP, and U/L. Then install and solder into place the three capacitors, two resistors, and the 36-contact connector. Sockets are recommended for the three IC's. Once the sockets are installed and soldered into place, install the IC's in their respective locations, taking care to properly orient them.

Checkout. To initially check out the converter, connect the TVT-6 to the KIM-1 microcomputer and use the

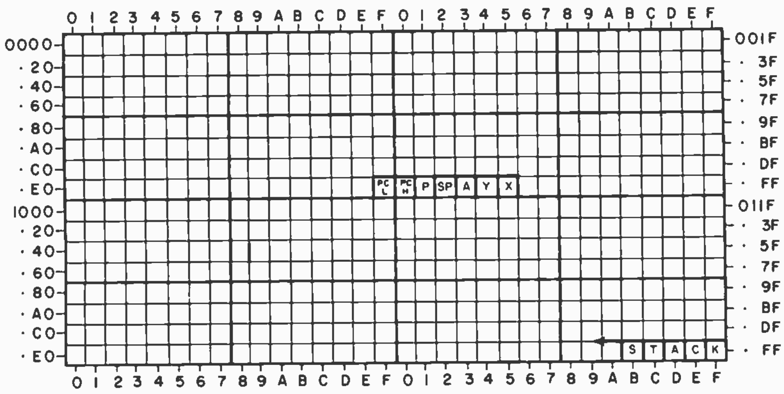


Fig. 5. Overlay mask for the KIM-1. All internal registers are displayed simultaneously with the entire stack.

512-character, page 2 and page 3 display of Table II in the August 1977 TVT-6 article. Make sure that the system is operating properly. Then remove the power and connect the hex-to-ASCII converter between the TVT-6 and μC. Power up again, reload the program, and run the computer. The original ASCII display should now appear in hexidecimal op code.

Test point U/L should have a 1.8-second square wave, while test point SP should be high for 1.7 seconds and low for 0.1 second. It is possible to "force feed" control signals into these test points. Connecting test point SP to +5 volts displays the characters; grounding SP blanks the screen. Connecting test point U/L to +5 volts displays the lower four bits, while grounding it displays the upper four bits.

Operation. If you are planning to run Table II from the August 1977 TVT-6 article, the usual display is of pages 02 and 03. This can be converted to a page 00 and 01 display by changing instruction 17AA to 82 and 17d2 to 80.

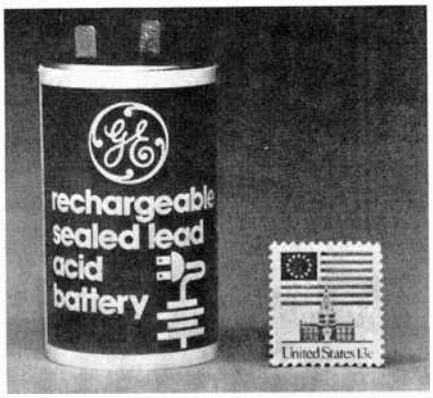
An overlay that identifies the stack and all important machine registers is shown in Fig. 5. The physical size of the overlay, of course, depends on the size of the CRT used in the monitor. A sharp china marker can alternatively be used as a low-cost, workable substitute for the overlay.

To debug a program, simply use the hex-to-ASCII converter with the KIM-1 operating system in the single-step mode. Each time the operating system returns to the keyboard display mode, all registers have their values reloaded into the proper slots shown in Fig. 5.

Hit AD 17 80, switch to SST OFF, and press GO to view the accumulator, stack pointer, program counter, status register, and the X and Y index registers simultaneously. To return to the keyboard display mode, simply press ST.

The Hex-to-ASCII converter can be used between memory and the character generator of many other TVT systems as long as an 8-bit word is used in the TVT's page memory. You can ignore the "Pass-through" lines on the converter, or you can redefine them in any way you need. The converter's processing delay is about 100 ns, which is fast enough usually to be ignored. ◇

Rechargeable Batteries for Consumer Products



THE USE of batteries to power electrical and electronic devices is on the rise. As more and more such products are introduced, the consumer is faced with the problem and cost of constant replacement of batteries.

General Electric has introduced an alternative with two new lines of rechargeable batteries and cells. A nickel-cadmium line consists of the most common-size cells and batteries used in such low- and medium-power items as hand-held calculators, photoflash camera units, and portable receivers. A sealed lead-acid (SLA) cell line is designed for devices that require medium-to-high-power, such as alarms, emergency lighting, and computer memory systems.

The new sealed lead-acid cells are designed to be completely maintenance-free. They can be used in any position without posing a problem with electrolyte spillage. The outer metal case of the cell is electrically isolated from the power-carrying plates. Both the positive and the negative terminals are at the top of the cell. A special glass fiber separator used in construction permits the cell to withstand high temperatures without suffering damage.

The discharge characteristics and cycle life of the SLA cells duplicate or exceed those of other lead-acid cells. The SLA cells are said to have a charge/discharge life of about 300 cycles, which favorably compares with the life of nickel-cadmium cells whose life is typically about 1000 cycles.

The internal resistance of the SLA cell is 10 milliohms (0.01 ohm). This low value makes possible high charge/discharge rates with minimum danger of overheating the cell. A resealable safety vent in the cell prevents cell bursting under extreme abuse.

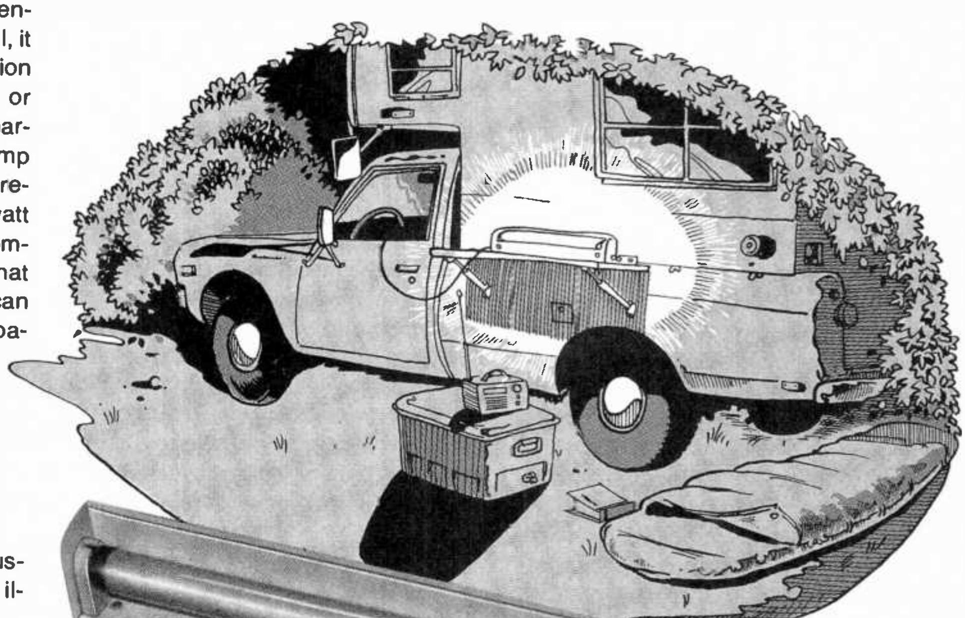
The first of the new SLA cells to come on the market is a cylindrical D cell. It is designed to deliver 2.5 ampere-hours at a 250-mA discharge rate. The cell is capable of delivering up to 40 amperes of continuous current and 75 amperes of momentary (1-second) current. The line of SLA cells will eventually include batteries rated at 6 and 12 volts and 2.5 AH.

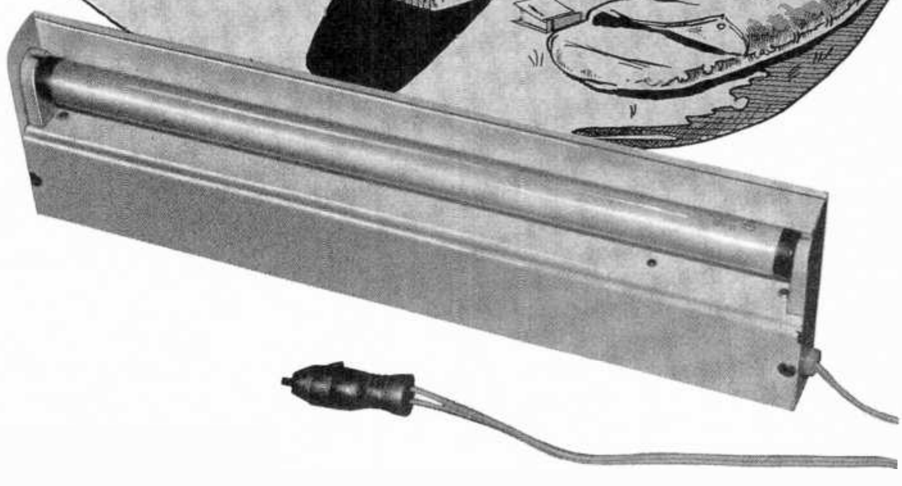
The rechargeable nickel-cadmium battery system consists of AA, C, and D cells and a 9-volt transistor size battery, each of which is available separately or packaged with its appropriate snap-on module that connects it to the Model BC3 miniature charger. The rechargeable NiCd cells and batteries are designed for any application where ordinary carbon-zinc batteries are used. They are directly interchangeable with other AA, C, and D cells and 9-volt transistor batteries. ◇

Build a FLUORESCENT Utility Lamp

Operates from 12-volt dc source.

BY JOE DUNCAN





A PORTABLE, battery-powered emergency lamp can be a life-saver on the highway and a great convenience at camp sites. To be truly useful, it should provide reasonable illumination without quickly depleting the battery or confining its light output within too narrow a beam. The utility fluorescent lamp described here satisfies these requirements. It uses a conventional 15-watt fluorescent tube and drive circuitry compact enough to fit in the fixture that houses the tube. Operating power can be drawn from any 12-volt source capable of delivering 2 amperes continuously. Thus, the lamp can also be used to illuminate the inside of a camper.

Circuit Operation. Timer integrated circuit *IC1* in Fig. 1 serves as a pulse generator whose output frequency is determined by *R1*, *R2*, and *C3*. When the output of *IC1*, at pin 3, goes low, current flows from the base of *Q2* through *R4* and *R5* and then to ground via pin 1 of the 555 timer. The voltage drop developed by the load current across *R3* is applied to the base of *Q1*, turning on this transistor, while part of the load current from *R4* and *R5* flows through transistor *Q1* to ground.

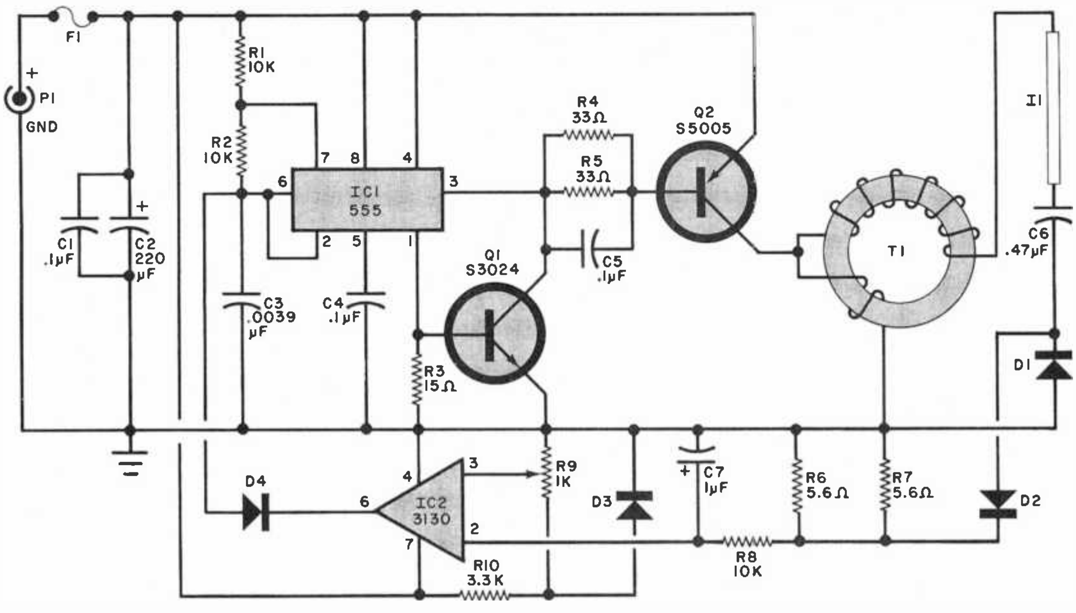


Fig. 1. The 555 oscillator drives Q2 which causes a high voltage across the lamp through T1. The IC2 circuit is a form of voltage regulator.

PARTS LIST

C1,C4,C5—0.1-µF, 50-V disc capacitor
C2—220-µF, 50-V electrolytic capacitor
C3—0.0039-µF silver-mica or polystyrene capacitor
C6—0.47-µF, 200-V capacitor
C7—1-µF, 35-V electrolytic capacitor
D1,D2—1N4001 (1-ampere, 50-PIV) rectifier diode
D3,D4—1N914 or similar switching diode
F1—3-ampere fuse
I1—F15T8 15-watt fluorescent lamp (with fixture, Sears Model 8934 or similar)
IC1—555 timer
IC2—CA3130 op amp (RCA)
P1—Auto lighter accessory plug (Radio Shack No. 274-331 or similar)
Q1—HEP S3024 transistor (Motorola)
Q2—HEP S5005 transistor (Motorola)
R1,R2,R8—10,000-ohm, ¼-watt resistor
R3—15-ohm, ½-watt resistor
R4,R5—33-ohm, 2-watt resistor
R6,R7—5.6-ohm, ½-watt resistor
R9—1000-ohm trimmer potentiometer (Radio Shack No. 271-227 or similar)
R10—3300-ohm, ½-watt resistor
T1—See text (No. T-184-2 ferrite core available for $3.50, including postage and handling, plus 6% tax for California residents, from Amidon Associates, 12033 Ostego St., N. Hollywood, CA 91607)
Misc.—In-line fuse holder for F1; 18' No. 20 enamelled wire; 126' No. 26 enamelled wire; 18' conventional twin-lead lamp cord; machine hardware; hookup wire; solder; etc.

When the output of *IC1* goes high, the voltage drop across *R3* is very low. This turns off *Q1* and the transistor increases the current-drive capability of *IC1* without altering the output wave-shape.

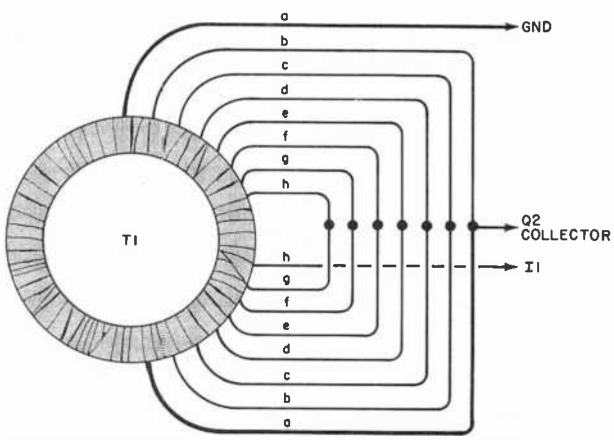
The current-boosted output of *IC1* is applied to switching transistor *Q2*, which drives step-up transformer *T1*. The transistor for *Q2* has an 80-volt breakdown rating and can handle 8 amperes. In operation, fluorescent lamp *I1* requires 1.75 amperes, and the peak current flowing through *Q2* is slightly greater than 6 amperes.

During the first few moments of operation and before the fluorescent lamp strikes, the rapidly changing magnetic field of *T1* produces voltage pulses in excess of 600 volts. It is these pulses that are applied to the lamp to cause it to conduct. After the lamp starts, it serves as the load for *T1* and limits the output potential of *T1* to about 90 volts. The time between power-on and lamp lighting is about a second.

A vehicle's electrical system voltage might vary by 15% or more, depending on whether or not the engine is running and also on the condition of the battery. In the utility light circuit, a 15% input voltage variation could mean low lamp brightness and might cause *Q2* to burn out. The *IC2* circuit is used to obviate these possibilities. Operational amplifier *IC2* functions as a current regulator that maintains a constant light level over the range of battery voltages usually encountered in mobile electrical systems.

The voltage drop across *R6* and *R7* is proportional to the current through the fluorescent lamp. This voltage is filtered and smoothed by *C7* and *R8* before being applied to *IC2*. The op amp then compares the filtered voltage from *C7* with a reference voltage that is preset by *R9*. The output of *IC2* then develops a correction signal that is fed to *IC1* to vary the oscillator's frequency and pulse

Fig. 2. Wiring diagram for T1. Conductor "a" is No. 20 wire. Others are No. 26.



width as required to maintain a constant current and lamp brightness.

During operation, the potential at pins 2 and 3 of *IC2* is only on the order of 0.5 to 0.6 volt above ground, which is sufficient to drive the FET input stage of the CA3130 used for *IC2*. This potential, however, is too low to drive other op amps, such as the 741, that do not have FET input stages.

Construction. With the exception of *F1*, *Q2*, and *T1*, all components should be mounted on a small piece of perforated board or a printed circuit board of your own design. The circuit board assembly and other components then mount inside the selected fluorescent lamp fixture. Hence, select the fixture before making the board assembly so that you are sure the latter has space to fit inside the fixture. Also, select a metal fixture so that it can serve as a heat sink for *Q2*. The fixture should have at least a 2½" (6.4-cm) wide by l" (2.54-cm) deep channel to accommodate the board assembly and *T1* (see Fig. 3). If the selected fluorescent fixture has a ballast and starter, remove them.

Transformer *T1* must be home fabricated by winding enamelled wire on a ferrite core. Cut an 18' (5.5-m) length of No. 20 enamelled wire and seven l8' lengths of No. 26 enamelled wire. Form the eight wires into a single bundle and temporarily tie one end to a door knob or other support. Liberally coat the bundle with contact cement. The easiest way to do this is to pour a small amount of the cement into the palm of your hand and pull your hand along the length of the bundle. Leave one end of the bundle attached to the support as you coat it with enough cement to make all wires adhere to each other. Remove the contact cement from your hand with acetone or nail polish remover. Allow the cement on the bundle to dry before removing it from the support.

The wire bundle forms about 75 turns around the ferrite toroid core specified in the Parts List. Before proceeding, carefully scrape away about ½" (12.7 mm) of the enamel coating from all wire ends. Then, referring to Fig. 2, locate one end of the No. 20 wire and attach a tag labelled GND to it. Now, using an ohmmeter, identify and label all remaining wire ends for quick identification.

Once the No. 26 wires have been identified, connect them in series exactly as shown in Fig. 2. As you twist together and solder each wire connection, be sure to insulate the connection. Note that the unconnected end of the wire labelled *h* goes to the fluorescent lamp and that the junction where the heavy *a* and lighter *b* wires meet connects to the collector of *Q2* This method of winding produces the tight coupling required to prevent high-voltage switching transients from appearing at the collector of *Q2*. The finished transformer can be mounted in the trough of the fixture with silicone rubber or urethane adhesive.

Transistor *Q2* mounts on the metal fixture so that it makes thermal but not electrical contact. Use a mica insulator and silicone heat-transfer compound to assure good heat-sinking action. A typical installation of the components in the central channel of the light fixture is shown in Fig. 3.

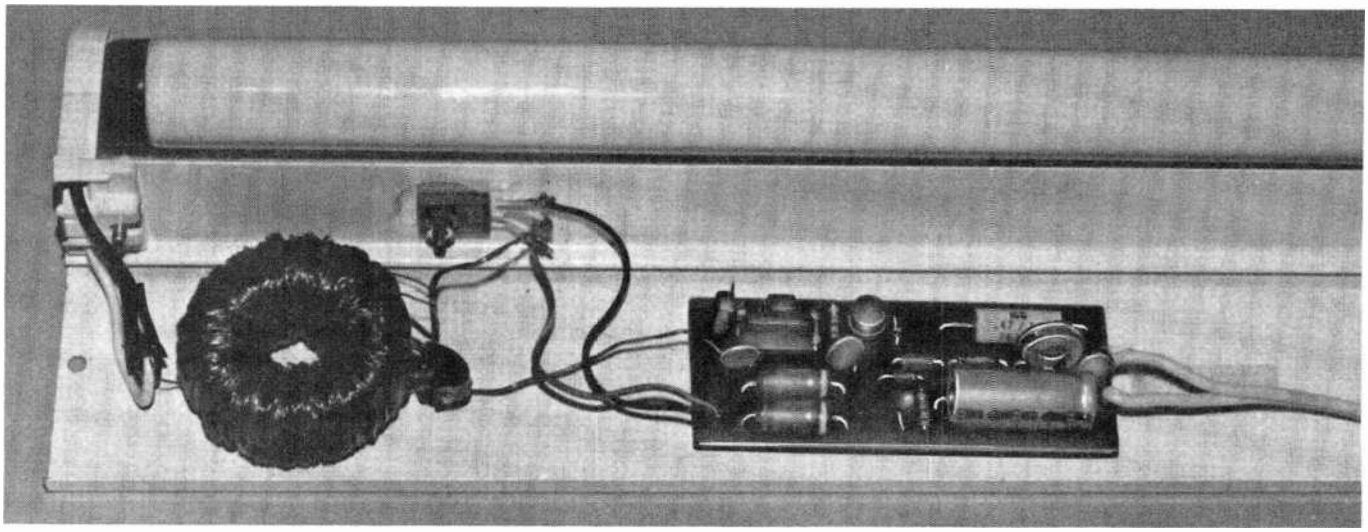


Fig. 3. Photo shows author's prototype. Note how fixture is used (with insulation) as heat sink for Q2.

Test and Adjustment. You can test the utility lamp by applying 12 volts dc to the power input before final mounting of all elements. Fuse *F1* goes in an in-line fuse holder located in the power cable. The free end of the cable can be terminated with an automobile cigarette lighter plug or some other type of connector that mates with its counterpart in an electrical system. Make certain that the correct polarity is observed when connecting the power line leads.

There is only one adjustment that need be made to get the lamp operating properly. This is to set the current drawn by the lamp by adjusting *R9*. To do this, it is necessary to measure the current to the lamp. Set your multimeter to the 2- or 5-ampere range and connect it in series with the fuse holder. (If your meter does not have a 2- or 5-ampere measuring capability, temporarily connect a 0.1-ohm resistor in series with the fuse holder and measure the voltage across it. The current is then this voltage divided by 0.1.)

Set *R9* to midscale when you initially power up the utility lamp. As you adjust the setting of *R9* to both sides of its center position, you will note that the meter indication will vary from a low of about 0.5 ampere to a high in excess of 2 amperes. Adjust *R9* for a 1.75 ampere indication (0.175 volt across the 0.1-ohm resistor). Once *R9* is properly set, daub some nail polish on its rotor to fix the setting. If you used a 0.1-ohm resistor in series with the fuse holder, remove it. The lamp is now ready to use.

One word of caution is necessary at this point: DO NOT plug the utility light into a power source unless a fluorescent lamp is in the circuit. Without the lamp serving as a load, high voltage switching transients are likely to destroy *Q2*. ◇

HOW TO DESIGN TTL DIGITAL SYSTEMS

BY JIM HUFFMAN

tips for the circuit designer on using the popular Transistor-Transistor Logic family

DIGITAL circuits and techniques are finding their way into all areas of electronics, including many of the "all-linear" circuits of just a few years ago. Because of this ever-increasing popularity, it behooves the electronics experimenter to sharpen his knowledge of digital circuits and devices. The focus here is on the popular and low-cost transistor-transistor logic, or TTL, family of digital integrated circuits.

The TTL Family. The transistor-transistor logic family uses built-in transistors both as electronic switches and gates, is highly immune to noise, and has very fast operating speeds. The most common forms of the TTL family are the industrial-grade 7400 and military-grade 5400 series. Some manufacturers have 8000 and 9000 series of TTL devices. There is no relationship between the type of IC function and the last two digits in the IC's identifying number. A 7400 is a quad NAND gate, while a 7490 is a decade counter.

Within the 7400 series, letter designations are often added to further identify the type of IC. For example, the 7400 is a standard four-input NAND gate, but the L in 74L00 identifies the IC as a low-power four-input NAND gate. To get this characteristic, one sacrifices speed. The H in 74H00, on the other hand, tells us that this is a high-power version of the same IC. Its output stage can drive higher current loads and is capable of driving normal loads faster because of its ability to charge the inherent output capacitance at a faster rate.

The 74S00 is a fairly high-power device that is extremely fast because its inputs are clamped by Schottky diodes. These diodes have very fast switching characteristics and thus make the 74S00 series the fastest of the TTL devices. The Schottky diode approach has been combined with the low-power approach to produce the 74LS00 series. The typical 74LS00, for example, consumes very little power, yet it operates at speeds as high as the conventional 7400 device.

Each of the types of TTL devices described above has its place in your circuit designs. Your choice of devices will be dictated by the power and speed requirements of your specific project.

Application. TTL IC's have very good noise immunity characteristics and operate with a good tradeoff in speed. Even so, they must be used with some care in circuit design to minimize interaction between elements. For example, in Fig. 1, gates A and B can suffer from unwanted coupling through the invisible but very real inductance of the common ground lead that ties the two gates to the negative side of the power supply line and the input to buffer C that is not supposed to operate at this time.

When gate A discharges the stray capacitance at its output, an erroneous signal appears because of the ground inductance at gate B. These undesirable outputs are commonly called "glitches." They can be eliminated mostly through proper circuit layout. The way to do this is illustrated in Fig. 2. Here the ground interconnection between the two gates is a "bus" lead.

Assume that gate A in Fig. 2 is a low-power 74L00 series IC and that buffer B is a high-power 74H00 device. As soon as the high-power stage switches on, a high-speed, high-current switching transient is generated and causes a voltage drop through the resistance of the ground or V+ bus. This voltage is applied to the input of the low-power gate, which "sees" it as a real signal. The usual remedy for this situation is to use bypass capacitors directly at the V+ and ground pins of the IC's. Proper circuit layout, however, can minimize glitches in the wiring without the need for bypass capacitors.

An example of bypassing is shown in Fig. 3. Note that there still exists a slight variation in the power supply along the bus and that although the transients (compared to Fig. 2) are almost eliminated by the bypass capacitors, the high current drain will still affect the voltage at one end of the bus. The point to remember in designing TTL circuits, and any other logic system, is that it is best to know what will be the effect of an action taken rather than attempt to make up for inadequacies after the fact.

The best way to lay out a TTL logic system is to use the V+ bus and ground-plane approach. Ideally, it would be best to have all V+ points in the circuit on one side of the board and all ground points on the other side. Unfortunately, circuit considerations dictate otherwise, since interconnections between elements must be made somewhere. However, it is possible to simulate the V+/ground bus approach by using the layout illustrated in Fig. 4. IC's can be

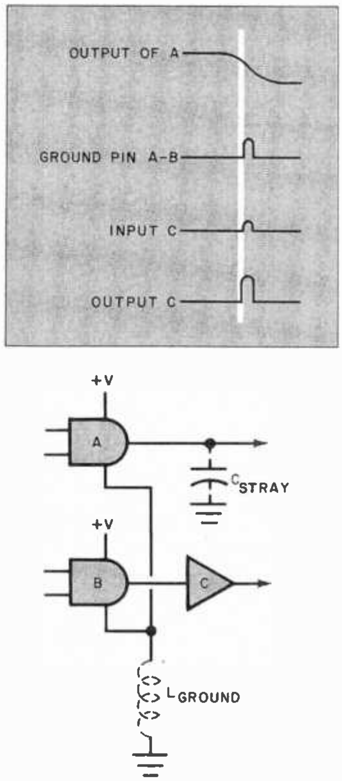


Fig. 1. Common ground inductance and stray capacitance cause "glitch" at output gate of C.

distributed along this bus system. Each of the two buses appears on both sides of the board. It matters little that each bus begins on one side of the board and ends on the other; electrically, each is a continuous bus.

The Fig. 4 approach lessens the effect of distributed capacitance, while the capacitors at the points where the buses cross over through the printed circuit board are adequate for bypassing. If this type of layout is not possible, it is best to locate the ground bus entirely on one side of the board and the V+ bus entirely on the other side of the board.

High-current devices should be located as close as possible to the V+ and ground bus connections. This will assure a minimal effect by these devices on the more sensitive, lower-current devices in the circuit. Bypassing at the input stages will then have greater effect.

Once you have fabricated a pc board for a certain digital function, you may find it necessary to include more than one pc board assembly in your finished system. In this case, each pc assembly must be designed to minimize the inherent stray inductance and capacitance and heavy bus structures should be used to connect the V+ and ground lines to all boards. In some cases, it may even be necessary to use separate ground leads to high-power circuits.

Design Hints. The first step in designing a logic system is to lay it out on paper. The next is to breadboard your layout. While you are breadboarding the circuit, try to use the same physical layout you plan to use in the finished project. This will reduce the chances of any surprises after you etch a pc board and are committed to a given layout.

In the breadboarding stage, there are a few things to keep in mind. The popular "solderless" breadboard has a distinct problem—there is very high capacitance between the interconnecting strips within the socket. At high frequencies and at very fast switching speeds, capa-

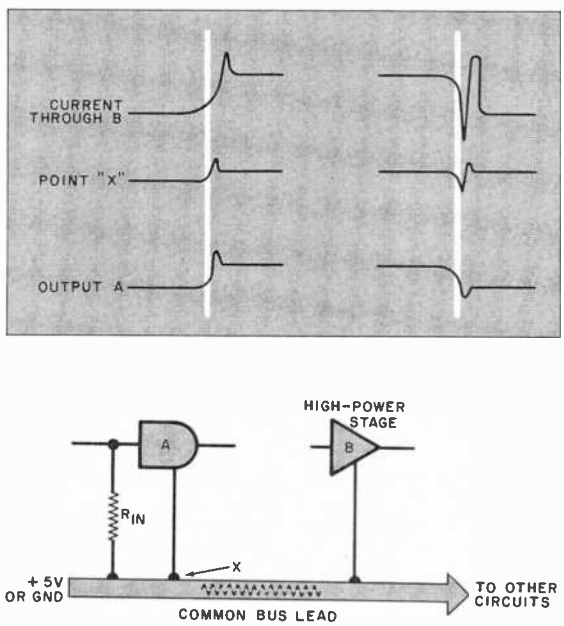


Fig. 2. Both glitch and voltage drop can occur along a common bus lead as shown here.

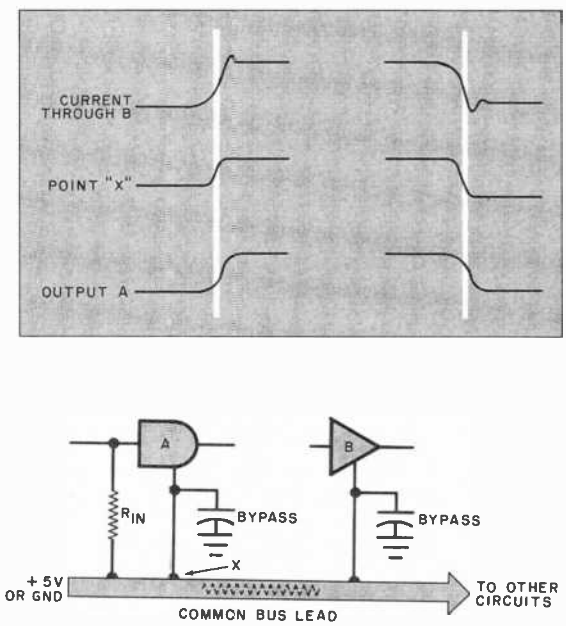


Fig. 3. Bypassing can eliminate glitch but not voltage change which produces erroneous signal.

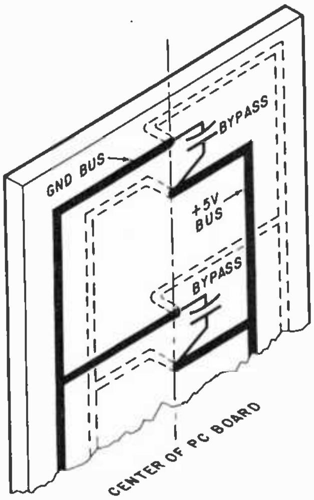


Fig. 4. Ground plane simulation where buses start on one side of board and cross to other side, with bypassing at crossovers.

citive coupling may occur between the closely spaced internal "tracks" or between the holes on the board. Do not use these breadboards for high-frequency circuits. They are, however, adequate for breadboarding low-frequency circuits in which the switching speeds are low.

The last and perhaps most important design stage is to debug the circuit you set up on the breadboard. To do this, you will need certain test equipment, such as an oscilloscope or logic probe. The logic probe is handy to have in cases where your scope has a limited bandwidth that prevents it from registering on-screen fast pulses. Almost any type of multimeter can be used to check for the presence of the proper dc voltages on the various IC pins.

Typical Design. To illustrate the general procedure to use in designing a TTL system, let us work up a six-decade decoder/driver/display system for a 30-MHz frequency counter. Since operation is to 30 MHz, we can use standard 7490 decade counters and 7447 decoder/drivers for the seven-segment LED displays. We will also use separate 5-volt supplies for the display system and IC portion of the circuit.

First, we would start by laying out on paper the basic circuit configuration. Then, we circle the portions of the system that draw high current, as shown in Fig. 5. The areas of highest current demand are the outputs of the 7447 LED drivers and the LED displays, neither of which are required to do high-speed switching. The highest speed device in this circuit is *IC1*, which must operate at frequencies up to 30 MHz. Consequently, this IC must be located at the point of least possible noise and bus glitches. By using independent V+ and ground leads at the input of *IC1*, there is no need for bypass capacitors.

The next step is to breadboard the circuit and debug it. Once this is done, a printed circuit board can be made. An actual pc assembly for this circuit is shown in Fig. 6. Note that the pc board has copper traces on both sides of the board, which eliminates the need for separate wire jumpers to interconnect all points in the circuit.

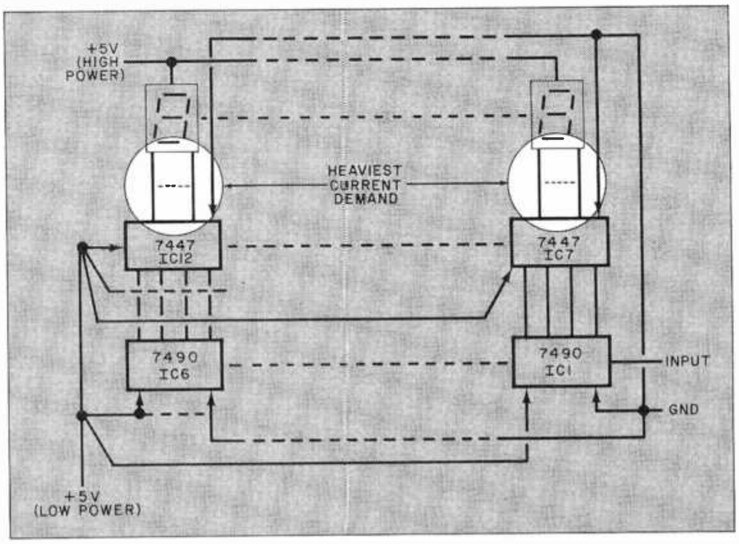
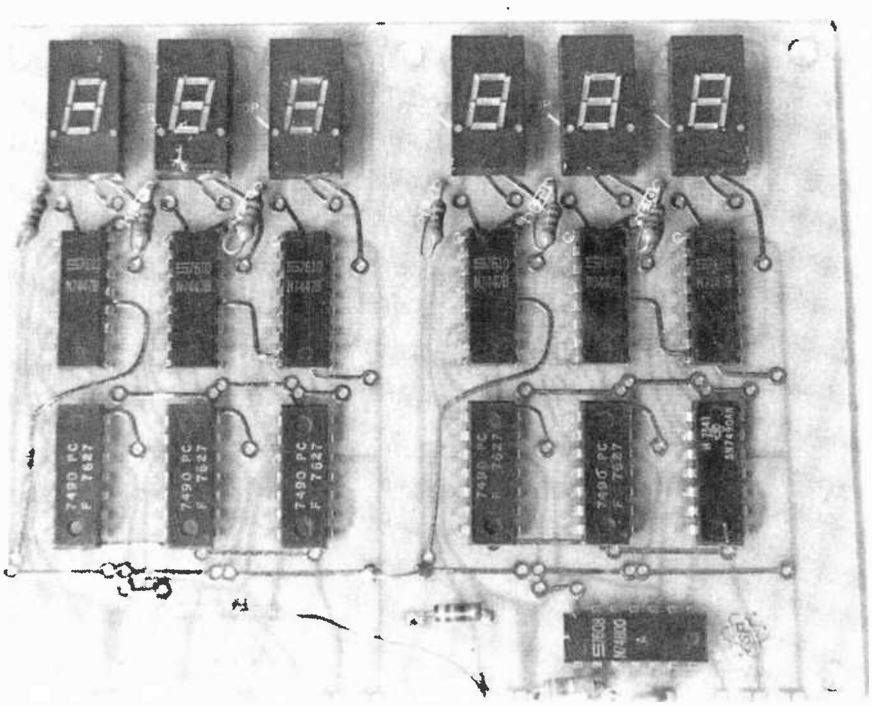


Fig. 5. Sample circuit has independent grounds and supplies to reduce glitches. Circled areas have own supply leads.

Closing Remark. As you can see from the foregoing, designing with TTL is relatively easy—if you give careful attention to circuit layout. One way you can get a "feel" for proper design is to experiment with the various types of TTL IC's available at low cost from the advertisers in the back of this magazine. ◇

Fig. 6. The final layout of the decade counter follows the general outline suggested in Fig. 5.



HIGH SENSITIVITY SWR Meter for Low-Power Communications Equipment

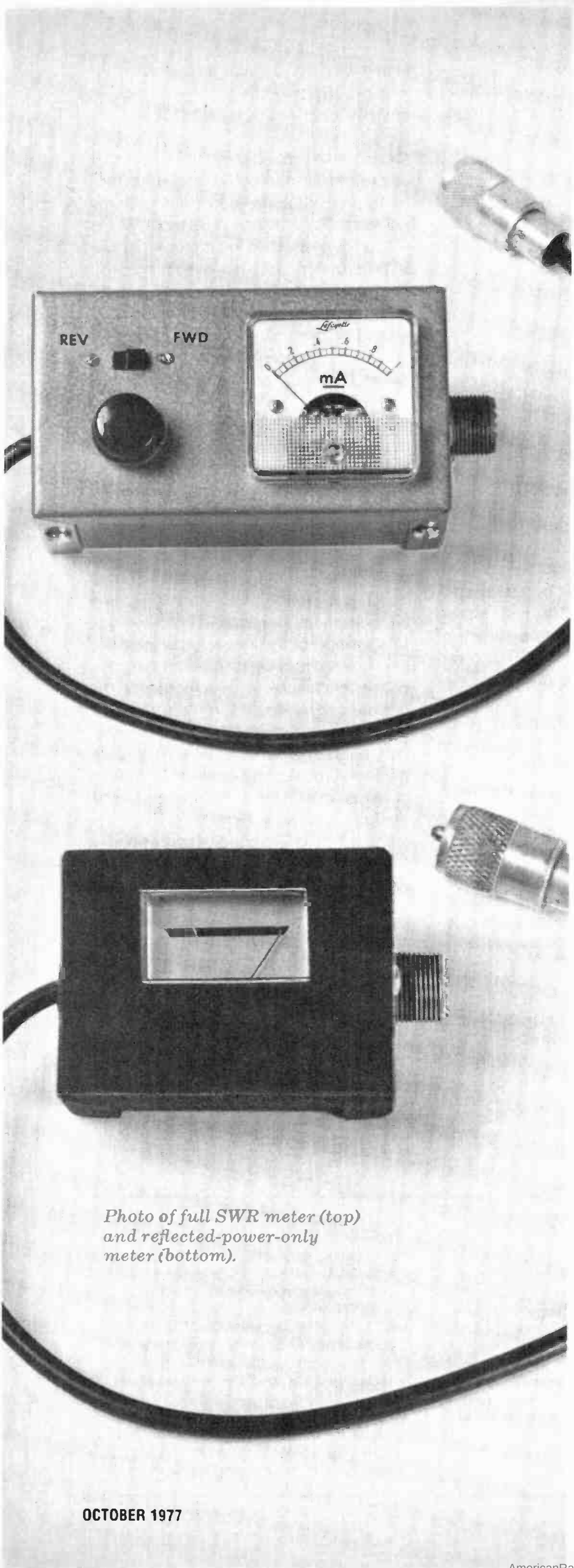


Photo of full SWR meter (top) and reflected-power-only meter (bottom).

Easy-to-build instrument uses a ferrite toroid coil for accurate readings at low power levels.

BY WILLIAM VANCURA

LOW-POWER communications gear such as CB transceivers and amateur QRP rigs have no r-f output to spare. So it's especially important to make maximum use of available power (as well as receive capability) by properly tuning the antenna system. These adjustments are most often made with an SWR meter, such as the instrument described here.

This SWR meter is easy to build and inexpensive. Moreover, it features a ferrite toroid pickup coil to achieve high sensitivity. This makes it possible to get an accurate SWR reading even at low r-f power levels.

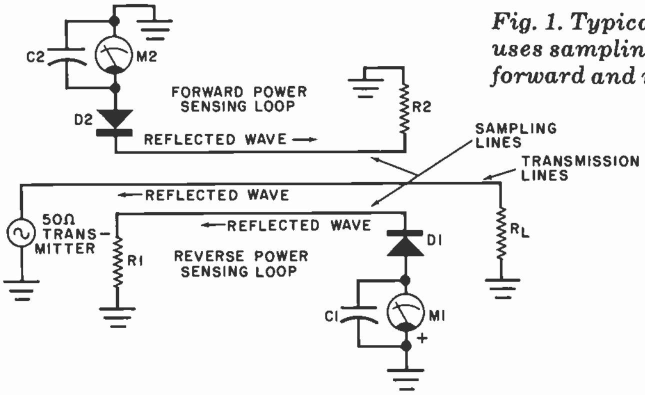


Fig. 1. Typical SWR meter uses sampling lines to detect forward and reflected waves.

How It Works. The SWR meter indicates the relative amplitudes of the forward and reflected waves travelling on the transmission line. (These two combine to create a standing wave.) When the line is connected to a perfectly matched load, no standing wave exists. The forward-going wave will travel down the line and will be completely transferred to the load. A mismatched load, however, will not accept all of the energy from the line. It will reflect a portion back toward the source, causing a standing wave to appear on the line.

The forward and reflected waves must be isolated to effect their measurement. This is done by sampling lines (Fig. 1) that are properly terminated at one end and mismatched at the other. When energy is coupled to a sampling line, the mismatched termination will reflect some portion toward the proper termination, just as the transmission line will. However, the reflection produces a travelling wave on a sampling line, as opposed to the standing wave on the transmission line. This travelling wave corresponds to either the forward or reflected component of the energy on the transmission line.

Figure 1 shows that the two sampling lines are identical except for the physical locations of the matched (resistors) and mismatched (diodes, capacitors, and meters) terminations with respect to the transmission line. The reflected waves on these lines travel from the mismatch to the matched terminations, and are therefore moving in opposite directions. But only one is travelling in the opposite direction of the reflected wave on the transmission line. Thus, reflected waves on the sampling lines are out of phase.

When the reflected waves on a sampling line and the transmission line are moving in the same direction, the reflected component on the sampling line is reinforced and the forward component is cancelled. This occurs in the reverse power sensing loop, and *M1* will display the relative magnitude of the reflected wave on the transmission line. When the reflected waves are travelling in the same direction, the reflected component is cancelled, leaving the forward wave for display by *M2*

In this project, a toroid coil is used in place of the sampling lines, greatly simplifying construction and increasing sensitivity as compared to standard "trough line" designs. Two SWR meter configurations are presented. The first, shown schematically in Fig. 2, is the simpler of the two. It is intended for CB applications where the only requirement is to measure SWR on a line with a fixed input power of four watts. The meter reads only reflected power. A zero indication suggests a perfect match, and any reading above half scale points to a bad mismatch that should be corrected.

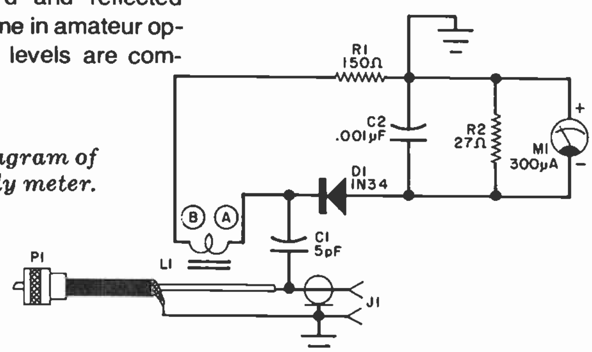
The second configuration (Fig.3) is more flexible, containing a switch and a sensitivity control to allow measurements of both forward and reflected power. It is more at home in amateur operations where power levels are commonly varied. To obtain a meaningful reading, the sensitivity control must be adjusted each time the meter is used.

Construction. Decide which circuit you will build, and select a suitable meter for *M1*. The one used in the author's reflected-power-only prototype is a 300-μA meter, while the meter in his full-SWR prototype has a 1-mA movement. Any meter from 50 μA to 1 mA can be used with good results. The project should be housed in a metal enclosure just large enough to accommodate the meter, switch, potentiometer (if used) and SO-239 coaxial connector. A 4" x 2⅛" x 2⅛" (10.2 x 5.4 x 5.4 cm) aluminum utility box can be used for the full-SWR meter.

Attach a PL-259 connector to one end of an 18-to-36-inch (45.7-to-91.4-cm) length of RG-58-U cable. Remove 1" (2.54 cm) of the cable's black vinyl outer jacket, and comb out the exposed braid. Twist the combed braid to form one large stranded conductor. Then remove ¼" (6.4mm) of the insulation around the inner conductor. Drill a hole on one side of the enclosure to accommodate the coaxial cable. Mount a rubber grommet in the hole and push the coax through it. Drill holes for an SO-239 coaxial connector on the opposite side of the enclosure and mount the connector and a solder lug as shown in Fig. 4.

Pass the inner conductor through a ferrite toroid (see parts list) before soldering the coaxial conductors to the con-

Fig. 2. Schematic diagram of reflected-power-only meter.



PARTS LIST

C1—5-pF, 500-volt disc ceramic or silver mica capacitor
C2—0.001-μF, 500-volt disc ceramic or silver mica capacitor
D1—1N34 or 1N914 diode
J1—S0-239 coaxial connector
L1—Two turns of No. 26 enamelled copper wire on a Fair-Rite Products Corp. 638MT-L (No. 5963000301) ferrite toroid. See note.
M1—300-μA or 1-mA meter (see text)
P1—PL-259 coaxial connector
R1—150-ohm, 10%, ½- or¼-watt carbon composition resistor
R2—27-ohm, 10%, ½- or ¼-watt carbon composition resistor *OR* 100-ohm trimmer or panel-mount potentiometer (see text)
S1—DPDT switch
Misc.—RG-58-U coaxial cable, No. 26 enamelled copper wire, insulated sleeving, solder lug, terminal strip, suitable enclosure, rubber grommet, machine hardware, solder, etc.
Note: Ferrite toroids for *L1* are available for $1.00 each from William Vancura, 4115 35th Ave., Moline, IL 61265. Include a stamped, self-addressed envelope.

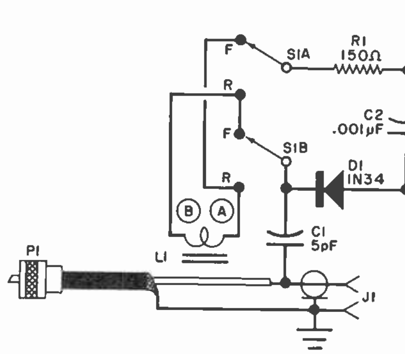


Fig. 3. Schematic diagram of the full-SWR meter.

nector and solder lug. Prepare a 6" (15.2-cm) length of No. 26 enamelled copper wire and wrap two turns around the toroid *exactly* as shown in Fig. 4. Mount the meter (and switch and potentiometer, if used) on the front of the enclosure. Follow the appropriate schematic (Fig. 2 or Fig. 3) and wire the circuit, using the switch lugs and meter terminals as tie points. You can also use a terminal strip to provide circuit tie points and mechanical support for components. Use insulated sleeving, if necessary, to prevent accidental shorting between leads, and keep all leads as short as possible. Be sure to scrape ¼" (6.4 mm) of enamel from the end of each lead of the pickup coil before soldering. Observe the lead designation in Fig. 4 when soldering these leads to the rest of the circuit.

Testing the Meter. Fashion a dummy load by soldering a 50-ohm, 2-watt carbon resistor between the inner and outer conductors of a PL-259 coaxial connector. Insert the dummy load into the SO-239 connector on the meter enclosure, and attach the PL-259 on the length of cable from the meter to the antenna output jack of the transmitter or transceiver. Then close the PTT microphone switch or telegraph key.

If you built the full-SWR meter, switch *S1* to the FORWARD position, adjusting *R2* for a full-scale reading. Then switch *S1* to the REVERSE position. The meter needle should barely move, if at all. If you built the reflected-power-only meter, key the transmitter briefly. Similarly, the meter needle should barely move, if at all. Do not apply r-f to the dummy load for more than a few seconds, however, to avoid overheating.

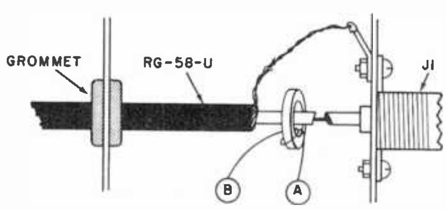


Fig. 4. Detail of toroid coil.

Replace the dummy load resistor with an 18-ohm, 2-watt carbon component. Key the transmitter briefly. The meter should read about half-scale. If the full-SWR meter was built, recalibrate by adjusting *R2* for full-scale FORWARD deflection before taking a REVERSE reading. If the reflected-power-only meter was built—and a meter movement other than 300 μA used—consult Fig. 5. A small trimmer potentiometer is included in this alternate meter wiring to compensate for different movement sensitivities. Reverse toroid leads *A* and *B*, and adjust *R2* for full-scale deflection as the transmitter is keyed. Then reverse leads *A* and *B* once more, taking care not to disturb the setting of *R2*.

Using the Meter. The SWR meter will not read SWR directly, but will indicate the reflection coefficient ρ. The SWR is related to ρ by the equation $SWR = (1+\rho)/(1-\rho)$. The following is a list of various values of ρ and SWR.

Reflected Meter Reading (% of full scale)	SWR
0	1:1
10	1.22:1
20	1.5:1
30	1.85:1
33⅓	2:1
40	2.33:1
50	3:1
60	4:1
66⅔	5:1
70	5.66:1
80	9:1
90	19:1
100	∞

If desired, a new scale for the meter can be drawn and glued onto the faceplate to read SWR directly. At any rate, a reading of 25% of full scale (SWR 1.7:1) or less means the antenna is closely matched to the transmission line. Readings greater than 33⅓% of fullscale (SWR 2:1) indicate a mismatch that should be investigated.

In practice, the short length of coax from the SWR meter is connected to the antenna output jack on the transceiver, and the feedline from the antenna is connected to the coaxial jack on the meter enclosure.

Antenna Tuning. The SWR meter can be used to adjust a CB antenna for resonance. Antenna tuning should be done in a clear, open area, away from any substantial metallic objects. Keep your hands and tools away from the antenna when checking the SWR. Connect the meter to the transceiver and the antenna, and momentarily key the transmitter at both edges of the band (channels 1 and 23 or 1 and 40, depending on your transceiver's capabilities). Note the meter readings.

If the needle stays below 25% of full scale at both band edges, the antenna is

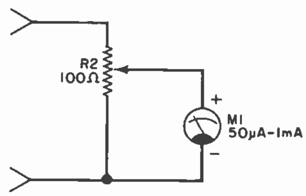


Fig. 5. Alternate meter wiring.

already properly tuned. A reading at the band center (channel 13) should show an even smaller meter deflection. When the meter reads above 25% at either end, the antenna is either too short or too long. If the deflection is greater at channel 1, the antenna is too short. A larger meter reading at channel 23 or 40 implies that the antenna is too long.

Most mobile CB antennas have provisions (usually a set screw) for length adjustment. Loosen the set screw and shorten or lengthen (whichever is required) the antenna by about ¼" (6.4 mm). Take new readings at the band center and edges. Continue this procedure until an acceptable match exists across the band. Most loaded antennas are very sensitive to length adjustments, especially when they are near resonance. Accordingly, determining the "right" setting requires patience.

Some full-size antennas don't have a length adjustment and will have to be cut to resonance. *Never* cut off more than ¼" at a time—you can't lengthen a short antenna! Remember that it's not absolutely necessary to have a 1:1 SWR. You will rarely achieve this ideal in practice. In fact, you won't measure much under 2:1 with mobile miniwhips. Thus, your antenna adjustments goal should be for a tolerable *minimum* SWR. The high sensitivity of this SWR meter project will pinpoint this reading with high accuracy. ◇

If you can't go to college for your career in electronics —read this!

CREI brings college-level training to you with eight educational advantages, including special arrangements for engineering degrees

The best way to qualify for top positions and top pay in electronics is obviously with college-level training. The person with such training usually steps more quickly into an engineering level position and is paid considerably more than the average technician who has been on the job several years.

A regular college engineering program, however, means several years of full-time resident training—and it often means waiting several years before *you can even start your career*. This, of course, is difficult if you must work full time to support yourself and your family.

If your career in electronics is limited without college-level training, take a look at the advantages a CREI home study program can offer you.

1. Convenient Training

CREI brings the college to you. Through the convenience of home study, you receive exactly the same level of training you will find in any college or university offering programs in electronic engineering technology. With CREI, however, you can "go to college" whenever you have spare time at home or on the job.

2. Specialized Programs

With CREI, you enjoy the advantage of *specialized* training. That is, your program will include only those courses directly applicable to your career in electronics. We omit such courses as English, social studies and other subjects, which are usually required in resident schools. Therefore, with CREI, you move ahead faster to the more interesting and useful part of your training.

3. Practical Engineering

CREI programs give you a *practical engineering* knowledge of electronics. That is, each part of your training is planned for your "use on the job." By using your training, you reinforce the learning process. And by demonstrating your increased knowledge to your employer, you may qualify for faster career advancement.

4. Engineering Degrees

CREI offers you a number of special arrangements for earning engineering degrees at recognized colleges and universities. You can earn college credit while you are taking your CREI program or apply later, whatever is best for your career plans.

5. Unique Laboratory
Only CREI offers you the unique Electronic Design Laboratory Program. This complete college laboratory makes learning advanced electronics easier and it gives you extensive practical experience in many areas of engineering, including design of electronic circuits. No other school offers this unique program. It is a better "Lab" than we have found in many colleges. And the professional equipment included in the program becomes yours to keep and use throughout your professional career.

6. Wide Program Choice
CREI gives you a choice of specialization in 14 areas of electronics. You can select exactly the area of electronics best for your career field. You can specialize in such areas as computer electronics, communications engineering, microwave, CATV, television (broadcast) engineering and many other areas of modern electronics.

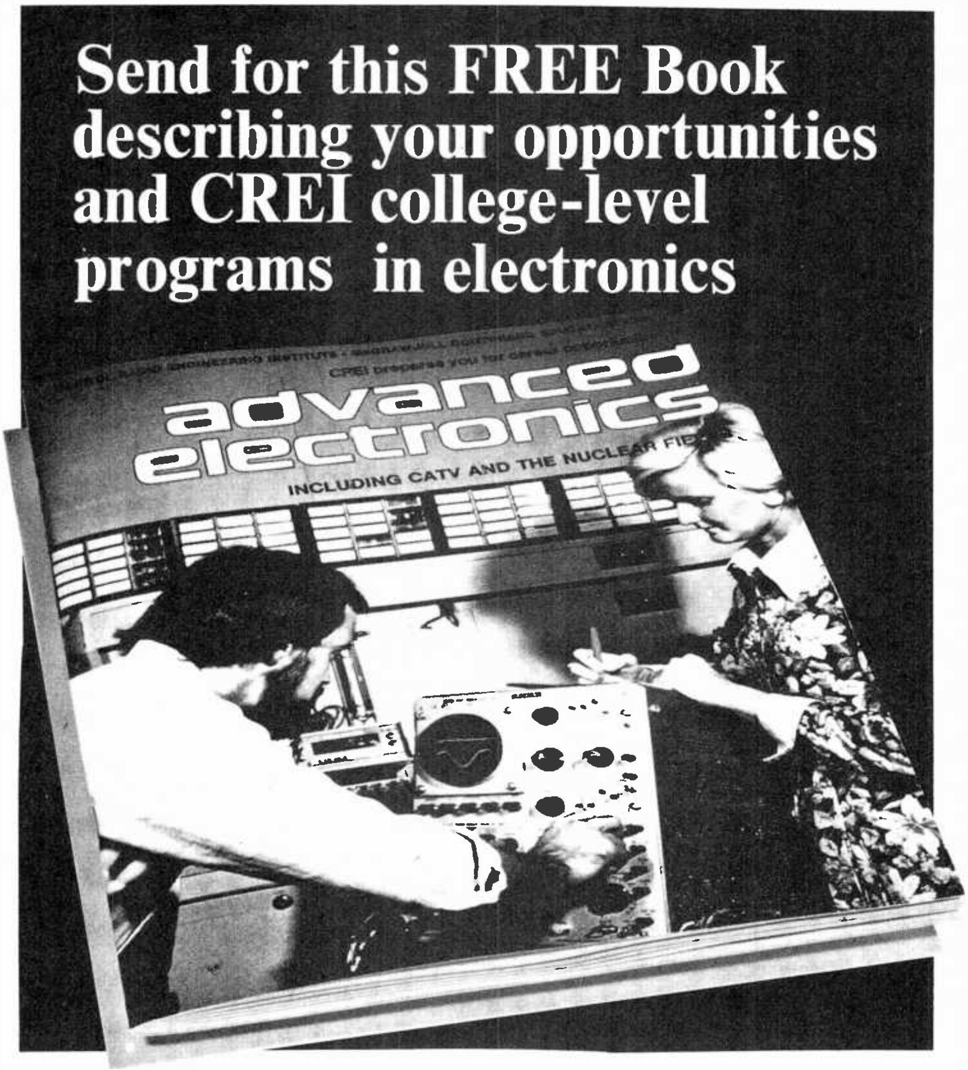
7. Prepared by Experts
Experts in industry and technical organizations of government develop CREI programs. Each part of your training is developed by a recognized expert in that area of electronics. That means you get the most up-to-date and practical instruction for your career.

8. Industry Recognition
That CREI training is recognized by industry and government is evident from the fact CREI provides training to advanced technical personnel in over 1,700 technical organizations. Many subsidize the training of their employees with CREI. If there is any question about the advantages of CREI training for you, ask your employer or any engineer to evaluate the outline of a CREI program for you.

Other Advantages
Of course, there are many other advantages to CREI training. For example, throughout your training, CREI's staff gives you personal instruction for each step of your program. And in many industrial areas, both in the U. S. and abroad, CREI Field Service Representatives provide a number of important personal services for your training and your career.

FREE Book
There isn't room here to give you all of the facts about career opportunities in advanced electronics and how CREI prepares you for them. So we invite you to send for our free catalog (if you are qualified). This fully illustrated, 80 page catalog describes in detail the programs, equipment and services of CREI.

Qualifications
You may be eligible to take a CREI college-level program in electronics if you are a high school graduate (or the true equivalent) and have previous training or experience in electronics. Program arrangements are available depending upon whether you have extensive or minimum experience in electronics.



Mail card or write describing qualifications to

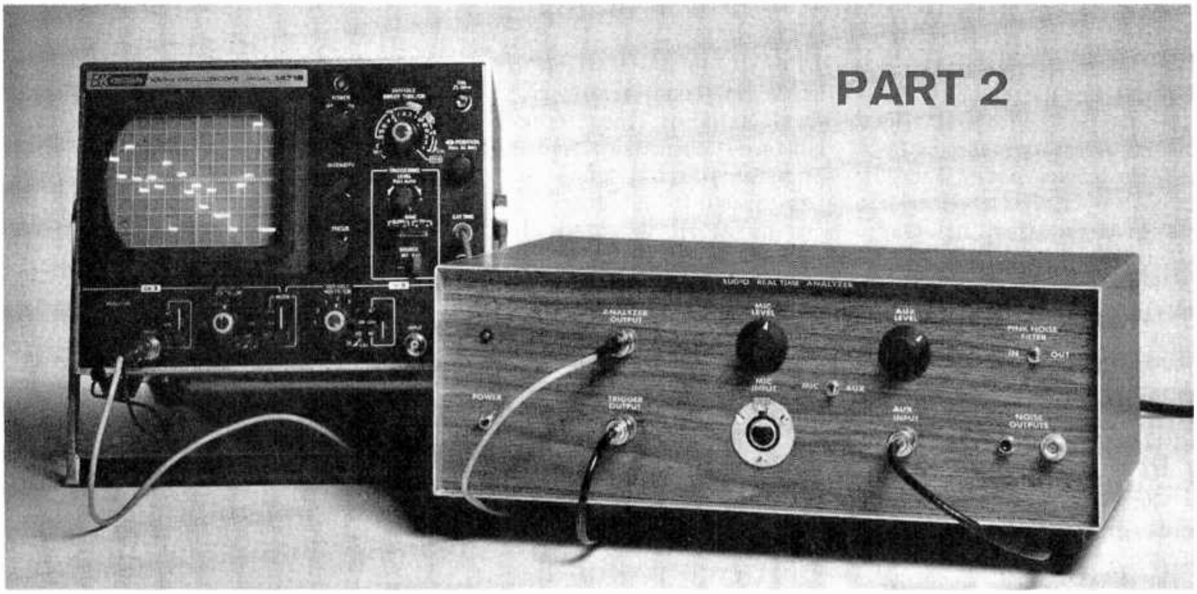
CREI CAPITOL RADIO ENGINEERING INSTITUTE

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

Accredited Member National Home Study Council

GI Bill
CREI programs are approved for training of veterans and servicemen under the G.I. Bill.

1/2-Octave Real Time Audio Analyzer



Test and calibration procedures, typical applications and how to add an optional logarithmic converter.

BY BOB JONES AND RICHARD MARSH

LAST month, we discussed the circuitry of the Real Time Analyzer, examined overall system operation, and presented construction details. Now we'll describe the optional Logarithmic Converter and outline test and calibration procedures. Also, typical applications for the Analyzer will be suggested.

The Log Converter, shown schematically in Fig. 11, is a useful accessory which allows display of amplitude variations on the scope directly in dB. The heart of this linear-to-logarithmic converter is *IC36*, a 76502 integrated circuit. One half of *IC35A* is used as a buffer for log converter *IC36*. This buffer is powered by a bipolar 5-volt supply, so its output (and thus the input to *IC36*) is limited to +5 volts maximum. The ORIGIN ADJUST control (*R144*) and op amp *IC35B* determine the amount of dB per division of scope display. Stages *IC37A* and *IC37B* provide gain and rectification, respectively. The rectifying action of *IC37B* prevents any negative voltages from reaching the scope's vertical input. However, "negative" outputs are generated by *IC36* whenever its input signal drops below the ORIGIN level.

Power for the log converter is derived from the RTA, with zener diodes *D26* and *D27* providing the required ±5 volts dc. Etching and drilling and parts placement guides for the log converter pc board are shown in Fig. 12. Use IC sockets or Molex Soldercons to facilitate installation of the integrated circuits. Pay attention to pin basing and polarities.

Tests and Calibration. With all IC's removed from their sockets (except the voltage regulators), plug the line cord into a wall socket and close *S2*. Measure the following regulated dc voltages: +5 volts across *C112*; −15 volts across *C111*; +15 volts across *C110*. Then see if *LED1* lights. If not, check the polarity of the LED. If all is well, turn off the ac power and insert all IC's.

If you are installing the optional log converter, perform the following steps (1) through (7). Otherwise, they can be bypassed.

(1) Decide how many dB/division you want displayed on the scope, and determine how many dB will be shown in a full-scale deflection. For example, if the vertical scale of the scope is 6 cm and 4 dB/cm is desired, 24 dB will be displayed full-scale.

(2) Calculate the origin voltage. (See Table II.) The maximum permissible input to the log converter chip (*IC36*) is one volt. In our example, −24 dB referenced to one volt is 0.063 volt.

(3) Apply 0.5 volt dc across the converter input and adjust *R140*, the INPUT LEVEL control, so that the voltage at *TP1* equals the calculated origin voltage.

(4) Adjust *R144*, the ORIGIN ADJUST potentiometer, for zero volt (±0.1 volt) at *TP2*. This is a sensitive adjustment.

(5) Increase the dc voltage applied across the input to 1.5 volts. Then adjust *R140* so that 1.0 volt appears at *TP1*. Monitor the converter output on your oscilloscope and adjust *R148*, the SLOPE ADJUST control until full-scale deflection of the scope trace occurs. Set the scope's vertical sensitivity to whatever value is most suitable for adjustment.

(6) Repeat steps (3), (4), and (5) until all adjustments are correct.

(7) Adjust the INPUT LEVEL control, *R140*, so that the signal voltage at *TP1* *never* exceeds one volt. The RTA's maximum level reference (which appears at the Analyzer output at clock pulses 23 and 24) is 10 volts. You can use this as the signal applied to the converter input for this adjustment. But be sure to back down on *R140* before you apply 10 volts at the converter input. When *R140* is properly adjusted, the 10-volt reference from the RTA will cause full-scale deflection.

Next, adjust all LEVEL ADJUST controls (*R75* through *R94*) on the filter boards to

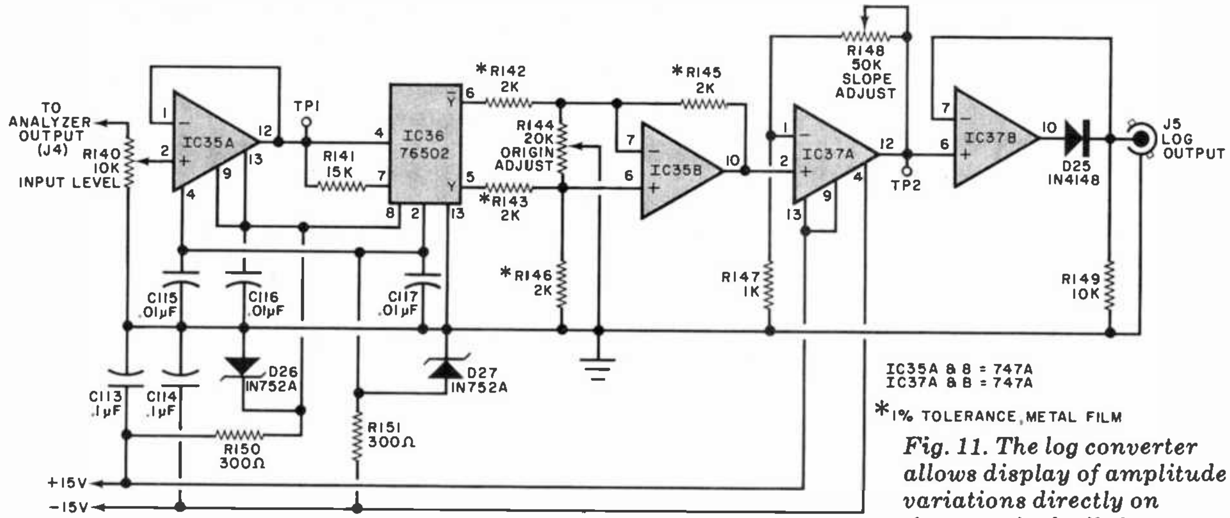


Fig. 11. The log converter allows display of amplitude variations directly on the scope in decibels.

LOG CONVERTER PARTS LIST

C113, C114—0.1-µF, 50-volt disc ceramic capacitor
C115 through C117—0.01-µF, 50-volt disc ceramic capacitor
D25—1N4148 silicon diode
D26, D27—5.6-volt, ¼-watt zener diode (1N752A, HEP Z0212 or equivalent)
IC35, IC37—LM747A dual operational amplifier IC
IC36—SN76502 linear-to-logarithmic converter IC (Texas Instruments)**
J5—BNC connector
The following fixed resistors are 5% tolerance, carbon composition components.
R141—15,000 ohms, ½ W
R147—1,000 ohms, ½ W
R149—10,000 ohms, ½ W
R150, R151—300 ohms, ¼ W
The following fixed resistors are 1% tolerance, ½-watt metal film components
R142, R143, R145, R146—2000 ohms
The following resistors are multi-turn, ¾-watt Cermet trimmer potentiometers (Spectrol type 43Y or equivalent).*
R140—10,000 ohms
R144—20,000 ohms
R148—50,000 ohms
Misc.—Printed circuit board, IC sockets or Molex Soldercons, hookup wire, pc board spacers, coaxial cable, machine hardware, solder, etc.
Note: The following is available from Southwest Technical Products Corp., 219 W. Rhapsody, San Antonio, TX 78216: etched and drilled pc board LC-2b for $3.25 ppd.
*Available through distributors such as Allied Radio or Newark Electronics.
**Consult a Texas Instruments local distributor or sales representative.

their maximum or full clockwise positions, and all Q ADJUST potentiometers to their minimum or full counterclockwise positions. Apply ac to the RTA by closing *S2*. Connect your dc-coupled oscilloscope to the RTA output. Set the front panel AUX LEVEL potentiometer to its full clockwise position. Adjust the scope's vertical sensitivity for approximately ⅔-scale display of the 10-volt reference signal from the RTA. Place *S1* in the AUX position, and apply a 0.1-volt rms, 22.4-Hz sine wave to the AUX input.

Adjust *R15* (the Q ADJUST potentiometer for filter one) until an increase in dc level occurs. (There may have already been a dc level at the RTA output if there was an offset at *IC31*.) As the control is

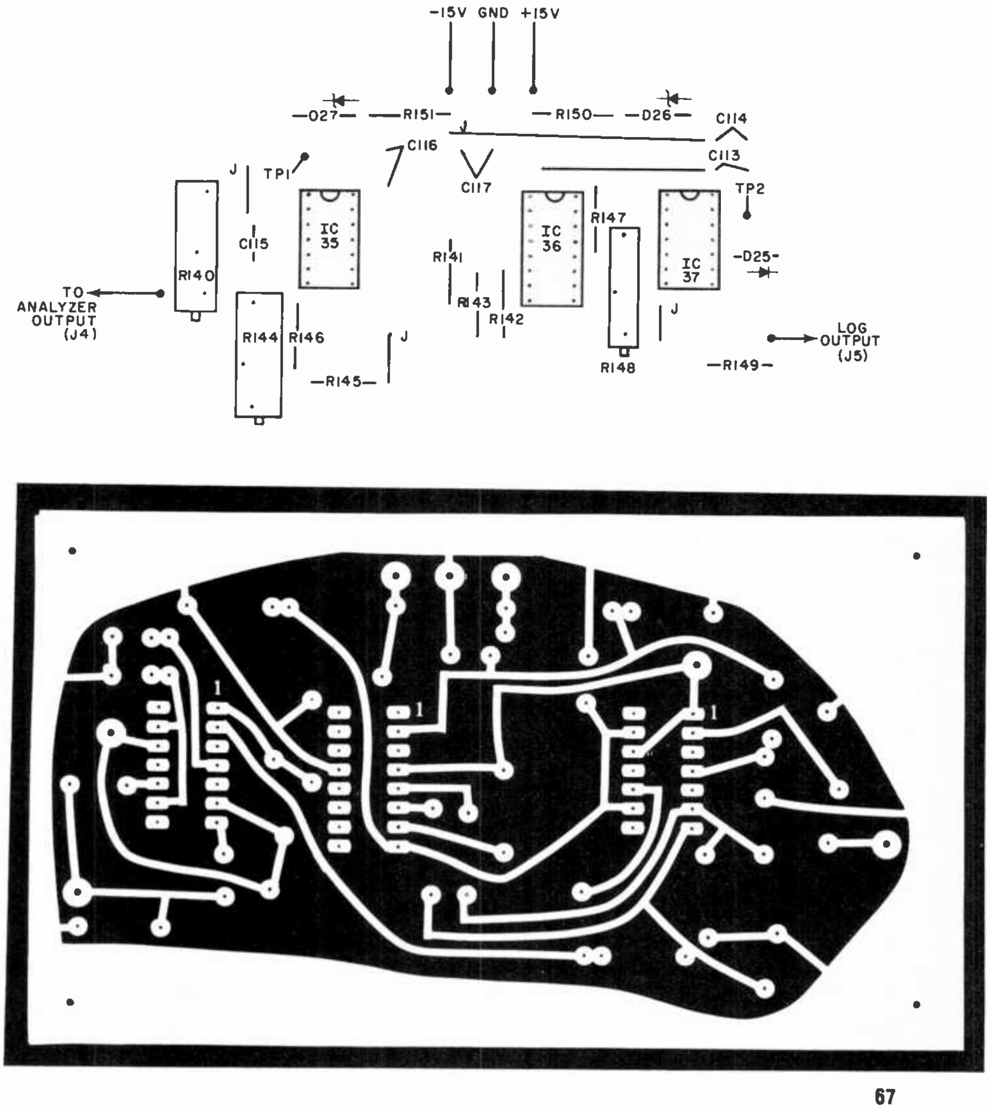


Fig. 12. Etching and drilling guide for the pc board is at right. Component layout shown above.

further adjusted and filter Q increased, the dc level will rapidly increase. Eventually, if the Q is set to high, the filter will break into oscillation. When you notice the increase, retune the sine-wave oscillator for a peak dc reading. Read the frequency off the oscillator control dial or with a frequency counter. This is the true center frequency of the filter. It may be somewhat different from the calculated f_C due to component tolerances.

As the Q increases, it will be more difficult to locate the center frequency. The band-pass slope will become very steep, so vary the oscillator frequency very slowly to be sure you are on the very top of the filter peak. Note the voltage level on the scope and adjust the vertical position control so the trace is at some convenient reference position. Retune the oscillator so that it is one-quarter octave above the center frequency you have just measured. The output voltage should decrease.

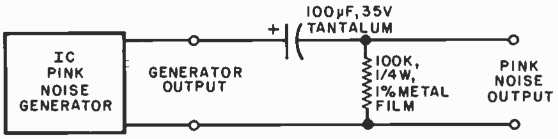


Fig. 13. Modifying the IC pink noise generator for use with the RTA.

Now, adjustments will be made so that the output will be more than 12 dB below that at the center frequency. The ideal value is −18 dB, but it is more critical to adjust the filter for the necessary response. Also, it will then be close to oscillating or ringing when excited by a steep input signal.

Alternately set the oscillator output frequency to the center frequency of the filter and at a frequency one-quarter octave away. Each time you retune the oscillator, trim the Q ADJUST potentiometer to obtain the desired response. You will find that varying this control will change the center frequency gain. Therefore, be sure to reset the center frequency output level to your reference position and/or note the new level. Keep in mind that −12 dB is 0.251 times the center frequency output level, −14 dB is 0.199, −16 dB is 0.159, and −18 dB is 0.128. When the first filter is properly adjusted, move on to the next and repeat the procedure for each remaining filter.

If the log converter has been installed and calibrated, you can use the calibrated dB (vertical) scale on your oscilloscope. Adjust the center frequency output level to equal the maximum reference level at bands 23 and 24 on the right side of the scope trace. Then tune half-way toward the next filter's center frequency and trim the Q for −12 to −18 dB as read directly on the scope. Try to adjust all filters to the same Q or bandwidth, preferably at −18 dB.

TABLE II—SELECTING LOG CONVERTER ORIGIN POINT

Total cm on Scope Face	dB/cm Desired	Total dB	Origin Voltage (volts)
10	2	20	0.100
10	3	30	0.031
8	3	24	0.063
8	4	32	0.025
6	4	24	0.063
6	3	18	0.126

Origin volts = 1/antilog(total dB/20)
Example: Scope has 6-cm vertical scale.
4 dB/cm desired yields 24 dB total.
Origin volts = 1/antilog (24/20)
= 1/antilog 1.2 = 1/15.8
=0.063 V or 63 mV

Next, the filter output LEVEL ADJUST potentiometers will be trimmed. The best way to do this is to apply pink noise to the AUX input and set the LEVEL ADJUST controls (*R75* through *R94*) to obtain a flat, horizontal scope trace. You can use the pink noise generator which appeared in the July 1977 issue of POPULAR ELECTRONICS, or one of the test records available which have a pink noise cut. If you use the pink noise generator, you must add a high-pass filter (a 100-µF tantalum capacitor and a 47,000-ohm resistor) as shown in Fig. 13. This filter will block the 8.5-volt dc level at the noise generator output, but its cutoff frequency is so low that the spectral content of the pink noise will not be disturbed.

If you don't have a pink noise generator or a suitable test record, here's a "ballpark" adjustment procedure. Find the one-half octave filter center frequency with the *lowest* output level and adjust the other filter output levels so they equal this minimum. (The variation in filter gain is partly due to the roll-off at high frequencies of the operational amplifiers' open-loop gains.)

Using the RTA. Now that you've built the RTA, how is it used? First of all, you will need a signal or sound source. This can be a frequency-swept oscillator or a wideband noise generator. There are two types of wideband noise. White noise is defined as having equal energy at all frequencies, and is thus represented on a frequency vs. amplitude plot as a straight horizontal line. Pink noise, on the other hand, is wideband noise with an amplitude characteristic that decreases 3 dB per octave.

This Analyzer is a "constant percentage bandwidth" type. That is, the bandwidth of each filter is an unchanging percentage of its center frequency. This implies that, as the center frequency increases, so does the bandwidth. If a white noise input is applied to the RTA, the "flat" signal will show a rising amplitude characteristic (see Fig. 14) as the multiplexer samples the output of higher-frequency filters. However, pink noise has a complementary decreasing characteristic (−3 dB/octave) that produces a flat display on the scope. Pink noise also more closely approximates the energy distribution of natural sounds, and thus is a more accurate source for measurements.

You will also need a microphone to pick up the sounds you want to analyze. (A microphone stand or camera tripod is very useful.) One microphone characteristic that must be known is its random-incidence response. This describes the output signal voltage generated by the

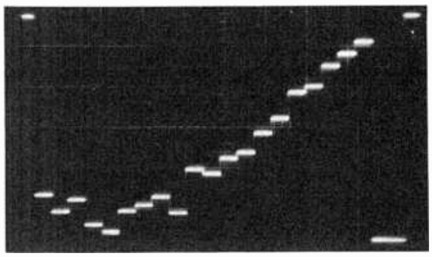


Fig. 14. Typical RTA output on a dc-coupled oscilloscope when "semi-white" noise from an FM tuner is applied to the Analyzer.

microphone when it is placed in a diffuse sound field—the most common type due to the effects of nearby reflecting surfaces. In such a field, the flow of sound energy in any direction is (almost) equally probable.

Several companies, such as General Radio and Bruel & Kjaer, supply microphones with flat random-incidence response, as well as flat 0° (perpendicular) or flat grazing (90°) incidence responses. These measurement microphones are omnidirectional. Unfortunately, most other manufacturers only supply the on-axis (0° incidence) responses of their omnidirectional microphones. This is fine if you want to perform, say, loudspeaker measurements when most of the sound comes from one direction—in the outdoors or in an anechoic chamber. Otherwise, the random-incidence response should be known.

For a high quality, wide bandwidth, omnidirectional microphone, the 70°-incidence response closely approximates the random-incidence response. Suitable dynamic measurement microphones include the AKG Model D160E (calibration curve $10 extra), the Beyer Model 101 (calibration curve included), the Electro-Voice Models RE55 and 654A (calibration curves $15 extra), the Shure Model SM76 (no charge for calibration curve) and the Sennheiser Model MD 21N (calibration curve $1 extra).

Experience has shown that rooms are best equalized first by employing acoustic methods, followed by graphic equalizer adjustments. For example, you should first try repositioning the loudspeakers, modifying the absorption coefficients in the room, and adjusting the loudspeakers' crossover level controls. Only after these steps are taken should you begin to compensate with the equalizer.

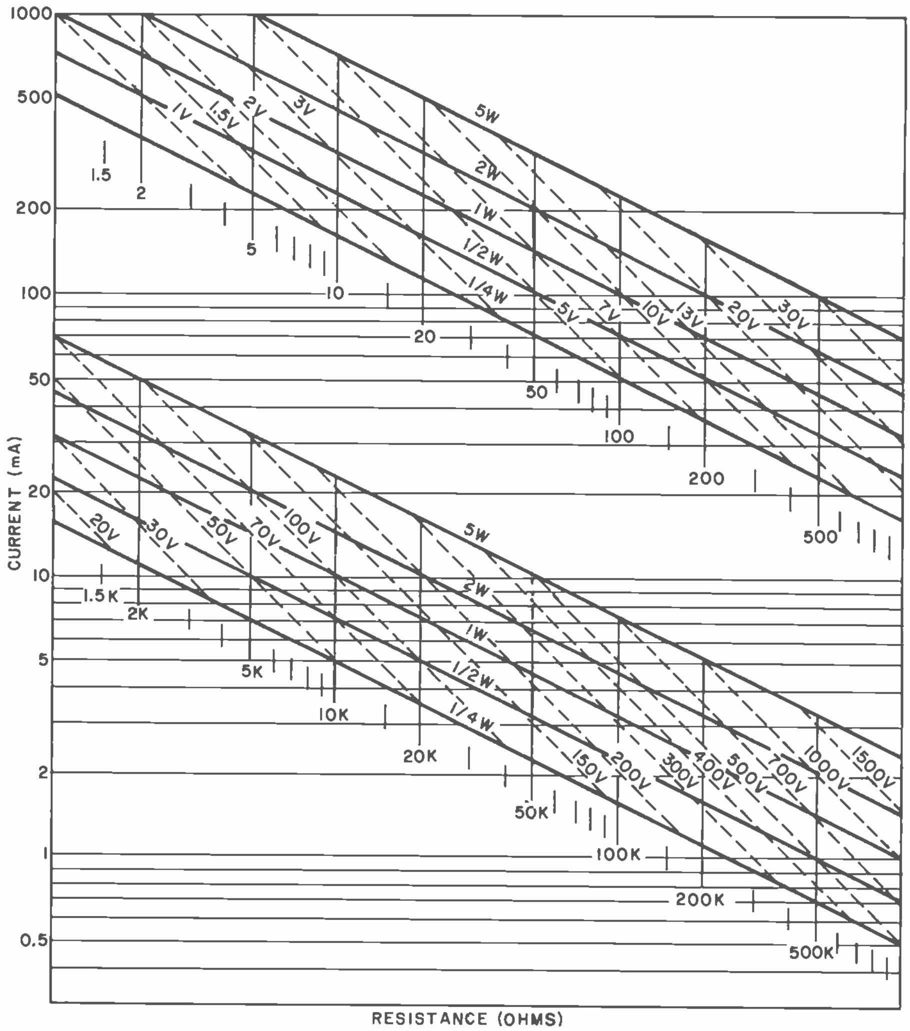
Most often, a lack of deep bass and extreme highs will show up on the scope trace. This is usually due to the limitations of dynamic drivers, and is less severe when sub-woofers and electrostatic or piezoelectric tweeters are employed. Don't use your equalizer to try to force flat response at these audio extremes. The results of such attempts frequently include overloaded amplifiers, excessive distortion, and blown voice coils. Remember—equalization should be used only as a last resort, and must not be used with a heavy hand.

There are many other uses for the RTA, as mentioned earlier. Avenues of RTA-aided research include noise pollution analysis, psychoacoustics, and circuit design. ◇

A POWER NOMOGRAPH

BY MARK L. McWILLIAMS

THE NOMOGRAPH shown here can be quite a time saver when designing and/or breadboarding a circuit. It shows at a glance the maximum resistance required to safely pass a given current as well as the minimum resistance required for a given voltage drop to be applied safely across it. In addition, the nomograph tells what the wattage rating for a given resistor should be, given the voltage and current.

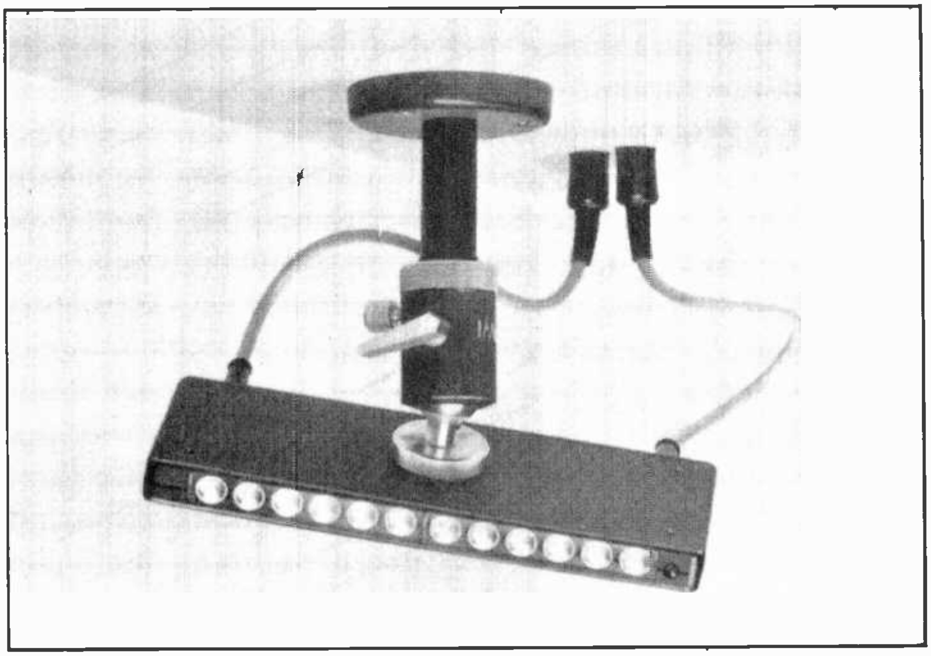


The nomograph is used as follows. Assume a 10-mA current is to be passed through a ½-watt resistor. Referring to the nomograph, we can see that the maximum allowable resistance is 5000 ohms. This would be a 50-volt drop across the resistor. Using another example, if 100 volts were to be applied across the ½-watt resistor, we can see that the minimum allowable resistance must be 20,000 ohms. This means that 5 mA of current would flow through the 20,000-ohm resistor at 100 volts.

Other combinations of voltage, current, resistance, and power rating, keeping two figures constant and determining the third figure, are possible.

The seemingly linear plot of the nomograph can be explained by the fact that the plot is made on log-log paper. From Ohm's Law, $P = I^2R$ (P is power in watts, I is current in amperes, and R is resistance in ohms). Hence, I versus R on log-log paper is a straight line with a slope of $-\frac{1}{2}$. This greatly simplifies plotting and makes it easy to use the nomograph in calculations. ◇

Infrared Systems for Wireless Stereo



Siemens infrared radiator for ceiling mounting.

IR technology and how receivers and transmitters are used in audio.

BY ARTHUR MAKOSINSKI

UNTIL a couple of years ago, infrared communication devices were almost unheard of in high-fidelity electronics. Then, the availability of relatively inexpensive IR light-emitting diodes that could be conveniently and easily amplitude, frequency, or pulse modulated started manfacturers on a whole new line of audio products for hi-fi. With the introduction of the first IR products, a heretofore untapped area of electronics technology began to create a revolution in hi-fi listening.

In this article, we will briefly discuss the history of IR communication and the devices that made it possible. Then we will detail some of the audio IR products that have been developed and marketed during the past two years.

A Brief History. Experiments in data transmission and communication using light beams can be traced back to 1880 and Alexander Graham Bell. But modern work in this area has been concentrated mostly on the use of infrared radiators in line-of-sight communication systems. Early experimental infrared data transmission and voice communication suffered from complexity and high cost insensitive IR detectors and inefficient radiators that often had to be liquid-helium cooled.

Why you should buy a digital multimeter from the leader in digital multimeters.

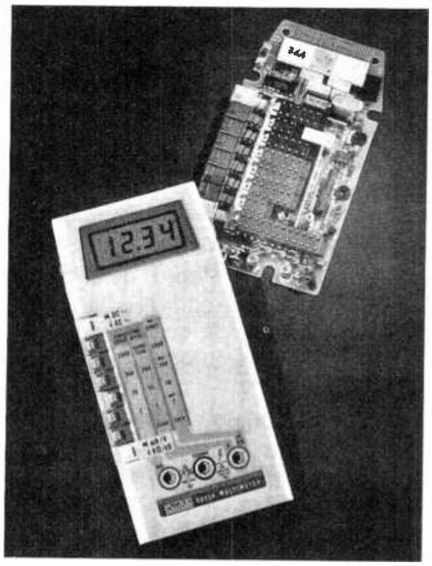
If you're shopping for your first multimeter, or moving up to digital from analog, there are a few things you should know.

First, look at more than price. You'll find, for instance, that the new Fluke 8020A DMM offers features you won't find on other DMMs at *any* price. And it's only $169.*

Second, quality pays. Fluke is recognized as the leading maker of multimeters (among other things) with a 30-year heritage of quality, excellence and value that pays off for you in the 8020A.

Third, don't under-buy. You may think that a precision 3½-digit digital multimeter is too much instrument for you right now. But considering our rapidly changing technology, you're going to need digital *yesterday*.

If you're just beginning, go digital.



Why not analog? Because the 8020A has 0.25% dc accuracy, and that's *ten times better* than most analog meters.

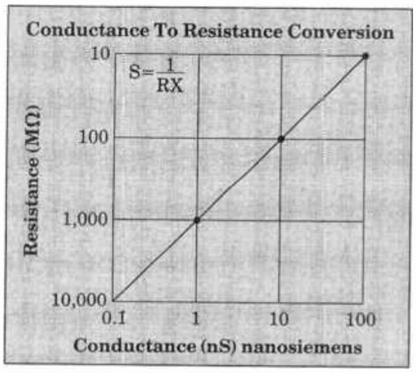
Also, the 8020A's digital performance means things like 26 ranges and seven functions. And the tougher your home projects get, the more you need the 8020A's full-range versatility and accuracy. The 8020A has it; analog meters don't.

If you're a pro.

You already know Fluke. And you probably own a benchtop-model multimeter.

Now consider the 8020A: smaller in size, but just as big in capability. Like 2000-count resolution and high-low power ohms. Autozero and autopolarity. And the 8020A is MOV-protected to 6000V against hidden transients, and has overload protection to 300V ac.

Nanosiemens?



Beginner or pro, you'll find the meter you now have can't measure nanosiemens. So what? With the 8020A *conductance* function, you can measure the equivalent of 10,000 megohms in nanosiemens. Like capacitor, circuit board and insulation leakage. And, you can check transistor gain with a simple, homemade adapter. Only with the 8020A, a 13-oz. heavyweight that goes where you go, with confidence.

What price to pay.

$169.*

Of course, you can pay more. Or less. In fact, you could pay almost as much for equally compact but more simplistic meters, and get far less versatility. And, the 8020A gives you the 'plus' of custom CMOS LSI chip design, and a minimum number of parts (47 in all). All parts and service available at more than 100 Fluke service centers, worldwide. Guaranteed, for a full year.

Rugged. Reliable. Inexpensive to own and to operate; a simple 9V battery assures continuous use for up to 200 hours.

Where to buy.

Call (800) 426-0361 toll free. Give us your chargecard number and we'll ship one to you the same day. Or, we'll tell you the location of the closest Fluke office or distributor for a personal hands-on feel for the best DMM value going.

*U.S. price only

Fluke 8020A DMM for Home Electronics Experts: $169

FLUKE®

1808-7001

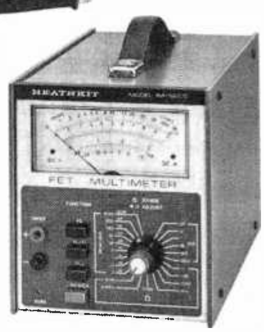
they're here!

the new HEATHKIT® Computers... plus exciting new kits for fall!

GD-1186 Digital Scale Kit $99^{95}

AD-1304 Active Audio Processor Kit $199^{95}

IO-4555 Single-Trace Experimenter Oscilloscope Kit $299^{95}



IM-5225 Deluxe FET Multimeter Kit $119^{95}

The new Heathkit Fall catalog has a lineup of new products for just about every interest. Along with our complete line of personal computer systems and accessories, you'll find interesting and useful products for your home, your hi-fi system, your test or hobby bench. Learn more about these exciting new kits YOU can build—send for your FREE Heathkit catalog today!

NEW H8 8-Bit Computer. The 8080A based machine with the "intelligent" front panel. 9-digit readout and keypad entry make it one of the easiest-to-use personal computers available today!

NEW H11 16-bit Computer. Heath, world leader in kit form products, and Digital Equipment Corporation, world leader in minicomputers, combine to bring you the ONLY 16-bit personal computer priced within reach of the general public. Based on the powerful LSI-11.

NEW H9 CRT Terminal. General-purpose peripheral for use with the H8 or H11 or others. Has long and short-form display, 80-character lines, full ASCII keyboard, auto-scrolling, plot mode and more. An excellent terminal value.

NEW H10 Paper Tape Reader/Punch. Paper tape mass storage peripheral for use with the H8 or H11. Features totally independent punch and reader; a copy mode for fast, easy tape duplication; precision machined punch block for accurate, consistent punching.

NEW GD-1186 Digital Electronic Scale. Tells you your weight (up to 300 lbs.) in big, bright, easy-to-read digits. Reads out to 2/10ths of a pound with far more precision than conventional dial scales. Extra cable lets you mount the readout at eye level.

NEW AD-1304 Active Audio Processor. Minimizes background noise from records or broadcast sources. Also adds 7 dB dynamic range to your hi-fi system. Provides greatly enhanced sound reproduction.

NEW IO-4555 Single-Trace Oscilloscope. A bright, easy-to-read scope ideal for radio-TV servicing, design experiments, general-purpose troubleshooting. Has super-bright trace, easy to operate controls, TV trigger switch, lots more.

NEW IM-5225 deluxe FET Multimeter. Quality general-purpose tester measures AC and DC volts, AC and DC current and resistance. Checks semiconductors in or out-of-circuit too! Has pushbutton function switches, full overload protection, easy-to-read meter with color-coded scales.

Preemphasis and deemphasis may be used in transmitter and receiver.

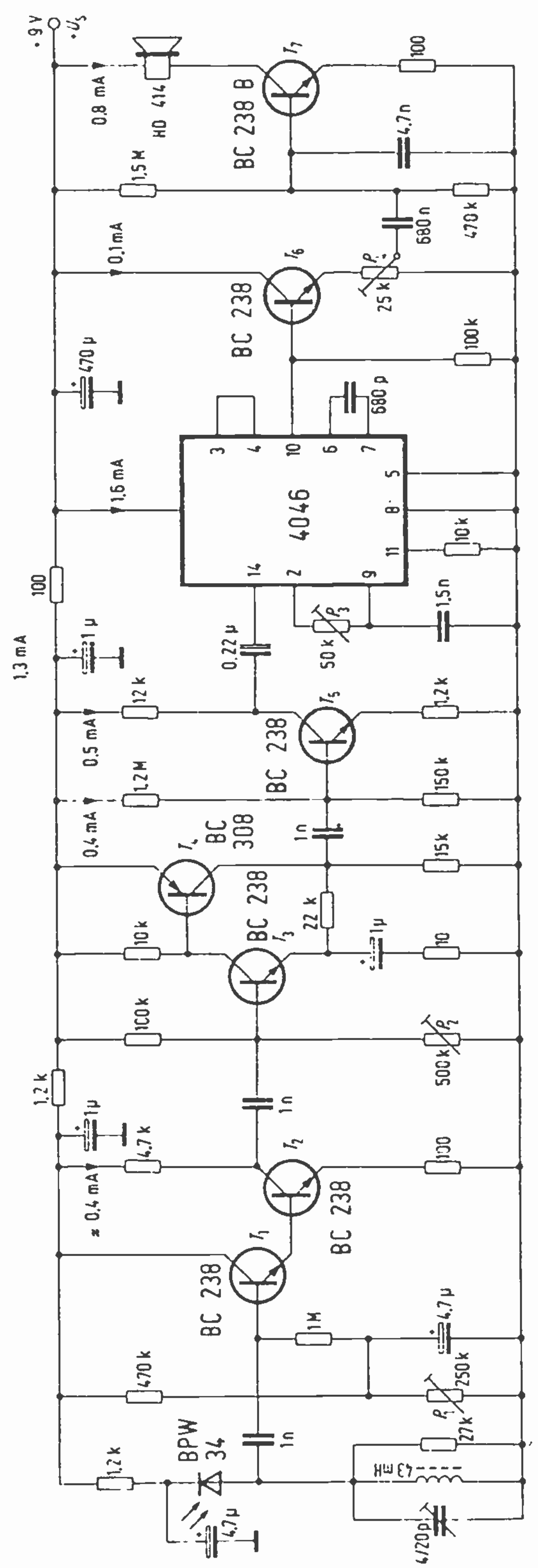


Fig. 4. The Siemens FM infrared receiver uses a 4046 integrated circuit as a wide-band FM demodulator.

these systems has made it to the U.S. market.

All commercial IR stereo systems intended for the stereo enthusiast are relatively inexpensive. They also conform to the recommended standard—95-kHz and 250-kHz carrier frequencies for the left and right channels, each of which can be deviated by ±50 kHz. (Mono systems use a 95-kHz carrier and ±50-kHz deviation.) Each system uses a stationary IR transmitter that connects to the line output jacks of a stereo system and a portable receiver that can be carried around by the user.

The IR stereo transmitters are, in fact, two transmitters in a single case. One operates at 95 kHz and carries the left-channel signal, while the other operates at 250 kHz and carries the right-channel signal. The LED radiators that are driven by the transmitters are housed in the same case that houses the transmitter.

The receiver in the case of Beyer's Model DT444 and Sennheiser's Model HDI434 IR stereo phones is built right into the phones themselves. A small lens on one of the earcups focuses the IR energy intercepted onto a BPW34 photodiode that serves as a common receptor for both channels. Circuitry within the headphones themselves demodulates the signal to separate out the two channels. Then the left and right channel signals are amplified to drive the phones.

The headphones also have built into them rechargeable nickel-cadmium cells that power the receiver circuitry. Even with the built-in circuitry and power sources, the IR stereo headphones are about the same size and weight of conventional headphones.

Testing the Sennheiser Model AD416 IR stereophones at a distance of 4 meters from a 60-mW radiated IR transmitter in a room 5 × 4 × 3 meters with light colored walls and a flat ceiling, we obtained a 58-dB S/N in daylight (200 Lux). Under worst-case conditions, with the receiver's pickup facing away from the transmitter's IR radiators, the S/N degraded to 40 dB. Needless to say, IR stereo headphones offer an attractive and practical alternative to conventional phones. They typically have good S/N characteristics and wide frequency response. (Beyer, for example, rates its IR phones at 20-to-20,000 Hz frequency response).

Closing Comment. Infrared radiation radiated by LED's in an IR audio system scatters and is reflected and diffused by the room's walls and ceiling. Some materials in a listening room reflect IR energy better than do other materials. Hence, the mixture of materials found in a typical home environment may cause signal dropouts when the receiving element of the IR receiver is facing away from the transmitter.

One drawback for the IR system is that the receiver's sensitivity to the transmitted signal is reduced in the presence of an additional high-level IR source, such as a tungsten lamp or the sun. Strong incandescent lamps, too, can add noise, obscuring the signal. Even so, the advantages to using IR phones are so great that they far outweigh the disadvantages of conventional phones with their trailing cords. ◇

What a Brain!

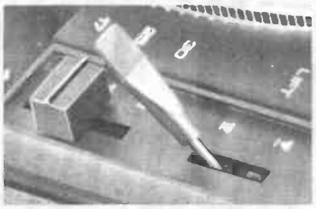
New Realistic® belt-drive changer with electronic speed control

These days a multi-play turntable can't make it on brawn alone. Not if it's going to cope with the challenges of power "brown-outs," surges, extremely light-tracking cartridges, and the increasingly stiff demands of hi-fi listeners for both performance *and* convenience.

That's why we put an electronic "brain" in the LAB-200. The sophisticated IC chip uses a phase-locked loop oscillator for steady speed despite wide fluctuations in voltage. And it instantly handles your commands for speed change (33⅓ or 45 RPM) and pitch adjustment (±3%) — all with the precision of a far more expensive turntable.

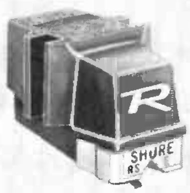
A high-torque, 24-pole synchronous motor provides the muscle for the LAB-200. Its slow-speed design keeps rumble well below audible limits. Wow and flutter: <0.06% WRMS. Rumble: −65 dB (DIN B).

A brain like this belongs on a pedestal, and it is — just look at the ultra-modern base! Check out the amazing Realistic LAB-200 — it's a smart buy at just 119.95.*

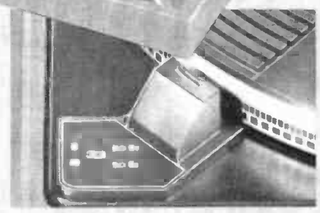


Two-way viscous damped cueing raises and lowers arm gently to protect cartridge and records

Lightweight, dynamically balanced tonearm with counterweight and built-in stylus force gauge



30-20,000 Hz magnetic elliptical cartridge by Realistic/Shure — a $29.95-value in itself!



Strobe ring with neon lamp helps you make precise settings at 33⅓ or 45 RPM

FREE! New '78 Catalog

Come in for your copy and see what's *really* new in electronics. 164 pages, 100 in full color.

Over 2000 exclusive items.

SOLD ONLY WHERE YOU SEE THIS SIGN:

Radio Shack®

A TANDY COMPANY • FT. WORTH, TX 76102 • 6000 LOCATIONS IN 9 COUNTRIES

*Price may vary at individual stores and dealers. Does not include optional dust cover.

Solid State

By Lou Garner

HOORAY FOR ARRAYS!

COMBINING the flexibility and versatility of discrete devices with the economy and minimum space requirements of integrated circuits, semiconductor *arrays* offer the best features of both classes. Suitable for a wide range of experimenter and hobbyist projects, arrays consist of two or more devices or circuits in a single package. Each unit in the package may be as simple as a diode or as complex as an operational amplifier. The individual devices may be completely independent, even though assembled on the same substrate, or share an element or connection, such as a common anode, cathode, emitter, collector, power source, or ground terminal.

By strict definition multiple logic circuits, such as dual or quad NAND or NOR gates, flip-flops, latches and multiplexers, may be considered arrays. However, the term generally is reserved for packages containing discrete devices such as diodes and transistors, amplifiers, special function circuits such as timers and comparators, and combinations of these. Semiconductor arrays are available from virtually every major semiconductor manufacturer, including Fairchild, Motorola, National, RCA, Signetics, Siliconix, Intersil, Texas Instruments, Plessey, Sprague, Raytheon, Teledyne and Harris.

Depending on specific type and manufacturer preferences, semiconductor arrays are offered in 8-pin miniDIP's, 8-to-12-pin cylindrical cases, or 14- and 16-pin DIP's, with the latter the most popular. The maximum number of individual devices which can be contained in a single packaged array depends on the number of electrodes per device and on the total number of terminals available. For example, a maximum of seven independent diodes can be provided in a 14-pin DIP, but as many as thirteen may be included if there is a common cathode (or anode) connection. Similarly, only five transistors can be supplied in a 16-pin DIP, but up to seven can fit in the same package if there is a common emitter (or collector) terminal.

Typical diode array package diagrams are shown in Fig. 1. RCA's CA-3039, Fig. 1A, offers six diodes in a 12-pin TO-5 style package, while the firm's CA3019, Fig. 1B, includes a four-diode, full-wave bridge and two independent diodes in a 10-pin case. Ten diodes are grouped as five pairs, three with common cathodes, two with common anodes, in a 16-pin DIP as RCA's CA3141, Fig. 1C. Fairchild's FSA2619M, Fig. 1D, is a typical monolithic diode arrangement in a 16-pin DIP, offering 8 independent diodes similar to the 1N914 and 1N4148. Thirteen diodes are supplied in the FSA2565M, a 14-pin DIP (Fig. 1E), by using a common-cathode connection. Common-anode diode arrays are also available, not only from Fairchild, but from most other manufacturers. Diode arrays can be used in test and musical instruments, communications equipment, control systems, and computers. They are especially useful as part of the drive circuitry for core and matrix memories.

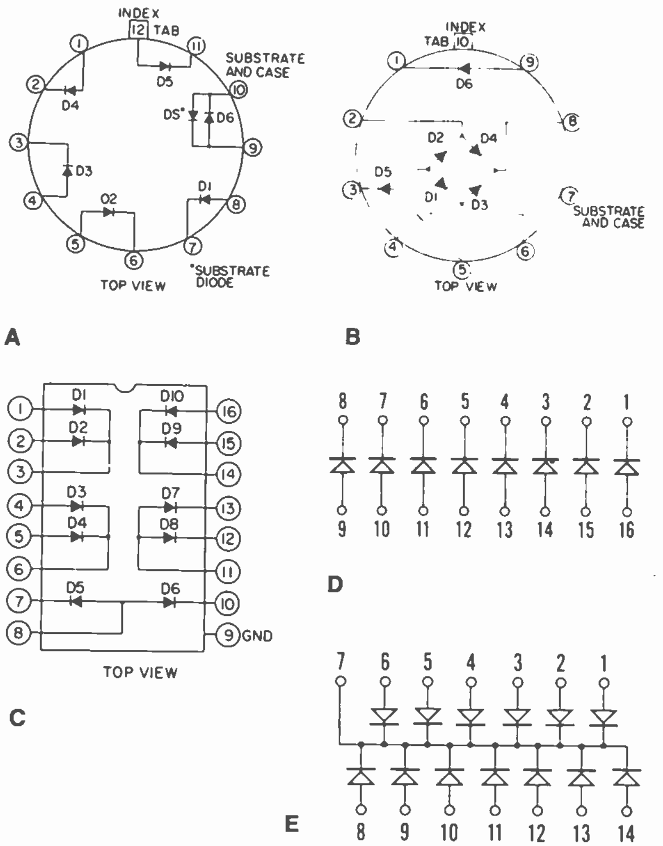


Fig. 1. Typical diode arrays: (A) CA3039; (B) CA3019; (C) CA3141; (D) FSA2619M; (E) FSA2565M.

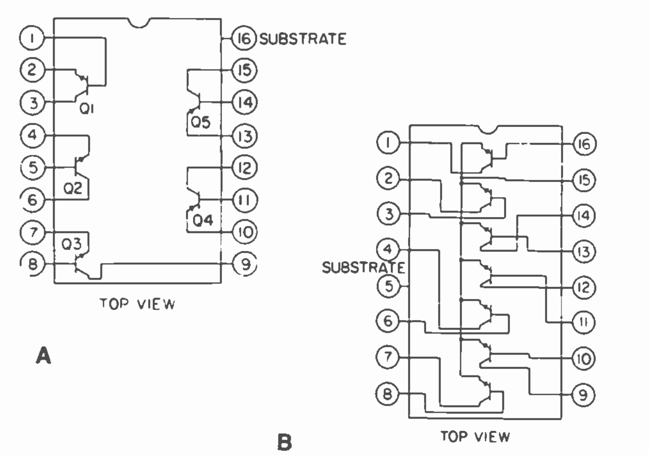
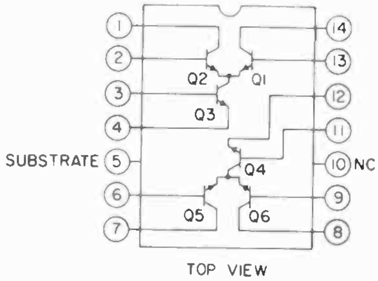
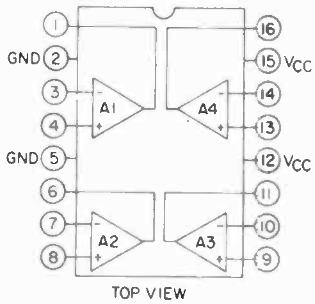


Fig. 2. Transistor arrays: (A) CA3096; (B) CA3081.



A



B

Fig. 3. Amplifier arrays: (A) CA3054; (B) CA3048/CA3052.

Representative transistor arrays in 16-pin DIP's are shown in Fig. 2. Three npn (*Q1, Q2,* and *Q3*) and pnp (*Q4* and *Q5*) types are offered in RCA's 5-transistor CA3096, Fig. 2A, while seven npn types are included in the CA3081 by using common-emitter connections, as shown in Fig. 2B. Where independent units are furnished, they can be used in practical applications as if they were discrete devices, provided maximum ratings are observed. In addition, one or more transistors can be connected as a diode if needed to meet circuit requirements. Where there is a common connection between devices, on the other hand, this must be considered when designing circuits using the array. Common-emitter and common-collector arrays are used extensively as 7-segment LED display drivers, but also can be used in multiple filter, distribution, and output applications.

Semiconductor arrays can feature multiple amplifiers as well as simple discrete devices. Dual differential amplifiers, each consisting of three npn transistors, are offered in *RCA*'s types CA3054 (Fig. 3A), CA3026, CA3049, and CA3102. Of these, types CA3026 and CA3049 are supplied in 12-pin round cans, while types CA3054 and CA3102 are furnished in 14-pin DIP's. Supplied in 16-pin DIP's, similar arrays CA3048 and CA3052 each contain four independent ac amplifiers, as shown in Fig. 3B. Versatile quad op amp arrays, generally in 14-pin DIP's, are available from many sources. Popular types include the LM124/LM224/LM324, LM148/LM248/LM348, and LM2900/LM3900 families, the TL084 series, and the HA4741.

Except where common power and ground connections may cause cross-coupling or feedback problems, the separate units of an amplifier array can be used in the same applications as their individual counterparts. Amplifier arrays are particularly valuable for multi-channel equipment designs, such as stereo and quadraphonic audio systems, color organs, and instrument recorders.

The special semiconductor arrays illustrated in Figs. 4 and 5 are samples of the scores of types offered by various manufacturers. RCA's CA3095, supplied in a 16-pin DIP (Fig. 4A), includes three independent npn transistors (*Q6, Q7* and *Q8*)

The better the training the better you'll

(Simulated TV Reception)

As an NTS student you'll acquire the know-how that comes with first-hand training on NTS professional equipment. **Equipment you'll build and keep.** Our courses include equipment like the **NTS/Heath GR-2001 computerized color TV (25" diagonal)** with varactor diode tuning and digital read-out channel selection; (optional programming capability and digital clock avail.).

Also pictured above are other units — 5" solid state oscilloscope, vector monitor scope, solid-state stereo AM-FM receiver with twin speakers, digital multimeter, and more. It's the kind of better equipment that gets you better equipped for the electronics industry.

This electronic gear is not only designed for training; it's field-type — like you'll meet on the job, or when you're making service calls. And with NTS easy-to-read, profusely illustrated lessons you learn the theory behind these tools of the trade.

Choose from 12 NTS courses covering a wide range of fields in electronics, each complete with equipment, lessons, and manuals to make your training more practical and interesting.

Compare our training; compare our lower tuition. We employ no salesmen, pay no commissions. You receive all home-study information by mail only. All Kits, lessons, and experiments are described in full color. Most liberal refund policy and cancella-

and the equipment be equipped.

COMPARE OUR KITS AND LESSONS. COMPARE OUR TUITION.

tion privileges spelled out. Make your own comparisons, your own decision. Mail card today, or clip coupon if card is missing.

NO OBLIGATION. NO SALESMAN WILL CALL

APPROVED FOR VETERAN TRAINING
Get facts on new 2-year extension

NATIONAL TECHNICAL SCHOOLS

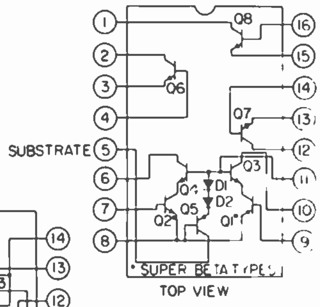
TECHNICAL-TRADE TRAINING SINCE 1905
Resident and Home-Study Schools
4000 So. Figueroa St., Los Angeles, Calif. 90037

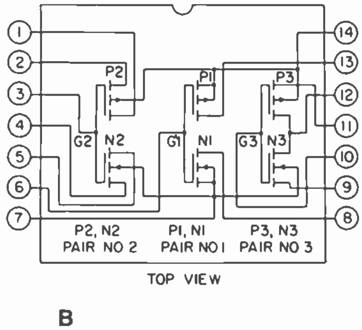
NATIONAL TECHNICAL SCHOOLS Dept. 205-107
4000 South Figueroa St., Los Angeles, Calif. 90037
Please send FREE Color Catalog and Sample Lesson.
NO OBLIGATION. NO SALESMAN WILL CALL.

- ☐ Color TV Servicing
- ☐ B & W TV and Radio Servicing
- ☐ Electronic Communications
- ☐ FCC License Course
- ☐ Electronics Technology
- ☐ Computer Electronics
- ☐ Basic Electronics
- ☐ Audio Electronics Servicing

NAME ____________ AGE ____
ADDRESS ____________ APT # ____
CITY ____________ STATE ____
Please fill in Zip Code for fast service ____________

☐ Check if interested in G.I. Bill information.
☐ Check if interested ONLY in classroom training in Los Angeles.





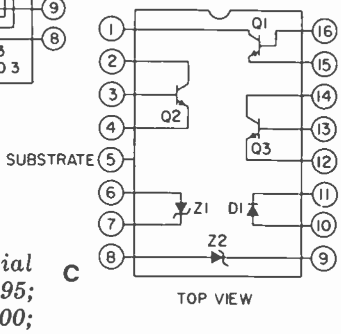


Fig. 4. Special arrays: (A) CA3095; (B) CA3600; (C) CA3093.

and a differential cascode amplifier using super-beta devices. It is especially useful as a high impedance transducer amplifier or in long-interval timer applications.

Three COS/MOS transistor pairs are featured in the CA3600, Fig. 4B, with each stage offering a typical gain of 32 dB and an input impedance of 100 Gohms. The CA3093, Fig. 4C, contains three npn transistors, *Q1, Q2*, and *Q3*, two 7-volt zeners, *Z1* and *Z2*, and a general-purpose diode, *D1*.

Each member of *Motorola*'s MC1411 array family (MC1411/12/13/16) comprises seven npn high-gain Darlingtons with integral suppression diodes in a 16-pin DIP, as shown in Fig. 5. With relatively high voltage and peak current ratings, these arrays can be used as drivers for incandescent lamps, relays or printer hammers. Finally, Hewlett-Packard's HCPL-2770 array offers four independent optocouplers in a single 16-pin package. Each section has a 1500-V dc insulation voltage rating and requires an input current of only 0.5 mA. The input elements are GaAsP LED's and the outputs are photodiodes coupled to modified high-gain npn split Darlington pairs.

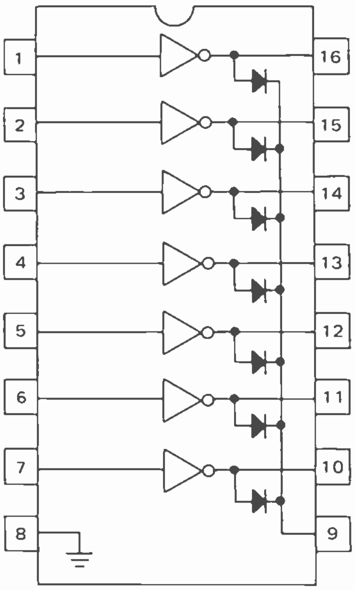
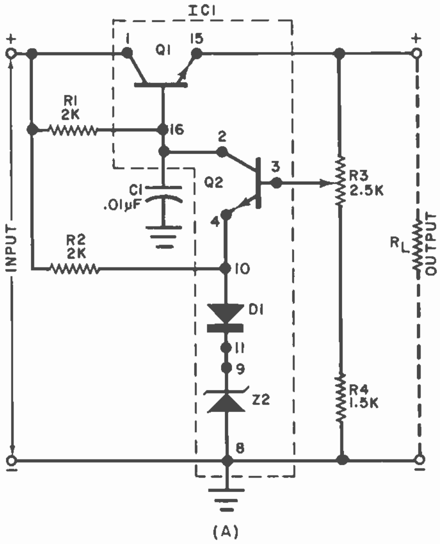


Fig. 5. Another special array: the MC1411 family.

Array Applications. The potential applications for semiconductor arrays are virtually unlimited. Generally, the separate elements of such arrays can be used in the same applications as their corresponding discrete or individual IC counterparts as long as maximum ratings are observed. However, arrays usually require less space and volume than their discrete counterparts and are frequently less expensive. In addition, the special combinations found in some arrays offer unique project possibilities. Representative of the hundreds of designs possible with semiconductor arrays are the circuits shown in Fig. 6.



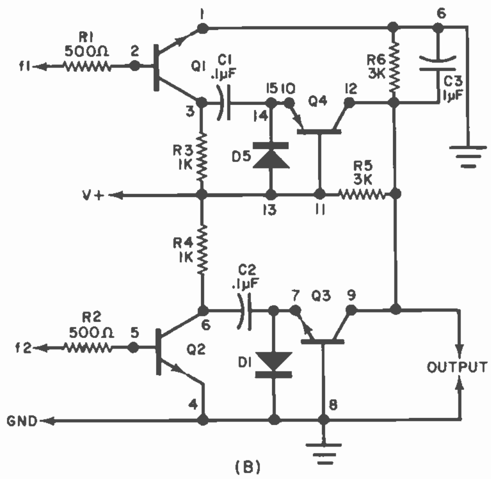


Fig. 6. Array applications: (A) Temperature compensated series regulator; (B) Frequency comparator.

Featuring a CA3093 (*IC1*), the temperature-compensated series voltage regulator in Fig. 6A requires only five additional components—three half-watt resistors, a low voltage ceramic capacitor, and a potentiometer. Designed to accept an unregulated dc input of 18 volts, the regulator can supply a regulated output of 8.5 to 15 volts, depending on the setting of *R3*. If adjusted for 12 volts output, the temperature regulation is 0.009%/°C, while the load regulation is ±0.4% from 0 to 40 mA and the typical line regulation is ±0.45%/V. The circuit can be used as part of an overall power supply design or assembled as an "add-on" accessory for an existing supply.

An audio frequency comparator circuit (Fig. 6B) using the CA3096 5-transistor array is designed for operation on a 10-V dc supply. Accepting input signals up to 10 kHz (f1 and f2), the circuit develops an output voltage which varies from a median level of 5 volts proportionally to the relative difference in frequencies. In operation, the output remains at 5 volts if the two input signals have the same frequency, rising if f1 is greater than f2 and dropping below this level if f2 is greater than f1. Four of the transistors in the array (*Q1*, through *Q4*) serve as conventional amplifiers with the fifth (*Q5*) used as a diode by connecting its collector (pin 15) and base (pin 14) terminals together. One external diode, *D1* (type 44003), is required to complete the circuit. Among its possible applications, the frequency comparator can be used in test instruments, as a second demodulator in FM/FM telemetry systems, and in communications equipment.

Reader's Circuit. Intended for checking TTL circuits, the logic test probe shown in Fig. 8 was contributed by reader David K. Merriman (Lockheed Electronics Co., Las Cruces, NM 88001). The probe will provide a visual readout of a low logic state as a "0" and of a high logic state as a "1," while identifying a pulse train as "P."

Easily assembled in a single evening, the project requires one section of a 7402 quad NOR gate, *IC1*, a 7-segment numeric LED display, two half-watt resistors, *R1* and *R2*, plus mounting hardware, wire, etc. The unit derives its dc operating power from the equipment under test, as do most logic probes. Terminal 1 is connected to display segments a, b, f and g, while terminal 2 is connected to segment e, or vice versa, depending on whether a common-cathode or common-anode type display is used.

The series current limiting resistor values (*R1* and *R2*) are calculated by dividing the difference between the dc supply

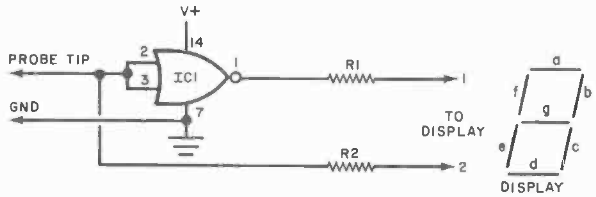


Fig. 8. Reader's logic probe circuit.

voltage (generally 5 V) and the rated display voltage by the total drive current required by the LED segment(s). These currents range, typically, from less than 5 to as much as 20 mA per segment, depending on the display used. The lower current types are preferred to avoid overloading the NOR gate or test circuit.

In operation, the display is connected so that segments a, b, f and g are activated when a logic zero level is applied to the probe tip, forming a 0, with segment e activated when a high logic level is applied, forming a 1. When a pulse train is applied, the 0 and 1 segments are activated alternately, with persistance of vision blending the two together to form a P.

Device/Product News. If you're working with high-frequency circuits, you should be interested in the new products recently announced by the Amperex Electronic Corporation (Hicksville, NY 11802). First, the firm has introduced a new line of uhf power transistors. Types BLW79, BLW80 and BLW81 offer r-f power gains of 10, 9 and 7 dB with power outputs of 2, 4 and 10 watts, respectively. Each transistor can withstand VSWR's of 50:1 with high line voltage and 20% overdrive at a heatsink temperature of 70°C. All three are for operation in the mobile frequency band of 380 to 512 MHz at collector voltages of 12.5 volts. Available in either flange or stud packages, unit prices range from $5.25 to $7.90.

Amperex is also offering a new line of vhf amplifier modules containing internal matching networks for broadband applications. Identified as types BGY32 and BGY36, the units are de-

(Continued on page 118)

Experimenter's Corner

By Forrest M. Mims

IC VOLTAGE REGULATORS

Batteries are ideal for powering portable electronic equipment, but you should think twice before using them to power anything within reach of an ac power outlet. Why? To save money! Electricity from batteries is much more expensive than electricity from a wall socket.

Batteries are rated in ampere-hours (AH). A 1-AH battery, for example, can deliver a current (I) of 1 ampere for 1 hour before its voltage (E) falls below a specified level. If the battery puts out 1 ampere at 1 volt, it delivers 1 watt of power (P=EI).

Now let's convert this analysis into dollars and cents by applying it to a typical 1.5-volt alkaline "C" cell rated at 5 AH. You can buy such a cell at a discount house for about 65¢. Neglecting any internal voltage drop, the cell has a potential power output of 7.5 watts over its useful life. This means an equivalent cost of $86.67 per kilowatt-hour for electricity from the battery! That's over a thousand times more costly than electricity supplied by power companies.

There are at least two ways to avoid the high cost of battery power. One is to use rechargeable nickel-cadmium or lead-acid storage cells instead of the expendable variety. You can charge the cells with a commercial charger or with solar energy. (See "Experimenter's Corner," November 1976.) Another alternative is to use one of the inexpensive, unregulated power supply adapters designed for radios, tape recorders, shavers, and calculators. These adapters are compact—usually housed in a molded enclosure with the ac power plug—and are ideal for applications requiring unregulated voltage at moderate current levels. Most adapters have output leads terminated with some type of small plug. If you attach appropriate jacks to each of your projects, you can use the same adapter to power each project. What's more you can quickly disconnect the adapter from one circuit and apply it to another by unplugging the output leads from one and and plugging it into the other.

There's a third alternative which can even be used to improve the operation of the first two. It's the integrated circuit voltage regulator. Many computer hobbyists and manufacturers place several IC voltage regulators "on-card" to provide regulated power for each of several circuit boards in a computer system. IC voltage regulators are also useful as power supplies for solderless prototyping breadboards.

IC voltage regulators are ideal for use even with comparatively simple circuits and projects. Many have only three connection terminals or pins: input, output, and common. This makes them easy to use—even though the IC chip may contain dozens of transistors, resistors, and diodes. For example, Fig. 1 shows the amazing simplicity of a typical IC voltage regulator circuit. Anyone who has tried to design and build a precision regulator with an automatic shutdown capability can appreciate the engineering sophistication provided by these chips.

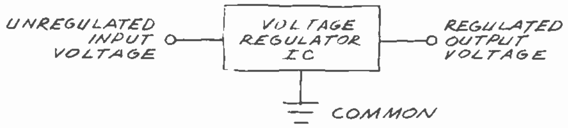


Fig. 1. Basic 3-terminal IC voltage-regulator power supply circuit.

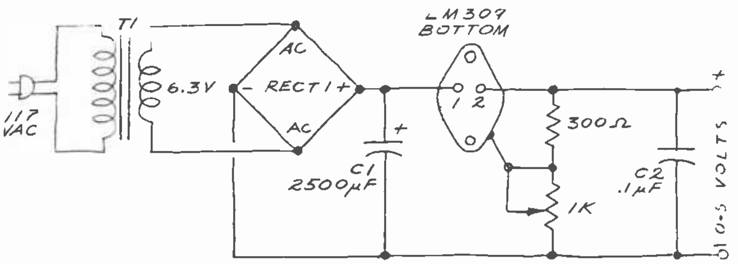


Fig. 2. Five-volt TTL power supply.

5-Volt TTL Supply. Some TTL devices (the 7441 decoder for example) are designed to tolerate as much as 70 volts on their output lines, but all TTL chips require a single power supply voltage of 5 volts, plus or minus a quarter of a volt.

Several IC voltage regulators are designed to deliver a regulated 5-volt output. One is the LM309, a readily available regulator which can accept up to 35 volts at its input. The LM309 is available in both TO-39 and TO-3 cases. The latter package will dissipate more than 3 watts at room temperature without a heatsink and more than 10 watts with the addition of a Wakefield 680-75 heatsink. If these power levels are exceeded, an automatic sensor circuit will detect the resultant increase in chip tem-

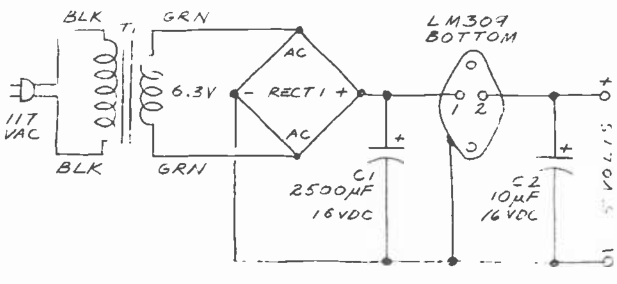


Fig. 3. Variable 0-5-volt power supply.

perature and shut down the regulator to protect it from damage.

Figure 2 shows how to use the LM309 in a simple TTL 5-volt power supply. Transformer *T1* is a 6.3-volt filament transformer which reduces the line voltage to a practical level and provides line isolation. Modular bridge rectifier *RECT1* converts alternating current into pulsating direct current. Any 60-to-200-PIV bridge, such as Radio Shack 276-1147 can be used. Capacitor *C1* filters the rectifier output into a reasonably ripple-free voltage which is applied to the input of the regulator IC. The regulated voltage appearing at the IC's output pin is 5.05 volts plus or minus 0.2 volt.

You can assemble this circuit on a small perforated board in under an hour using readily available components. Since the circuit is line powered, use care in connecting the power supply cord to the primary (black) leads of *T1*. You'll have a safer circuit if you mount *T1* on the board with 6-32 hardware. Insert the free end of the power cord through a hole drilled in the board near *T1*, and tie a knot a few inches from the end of the cord. Then solder the free end of the cord to the two black leads of *T1* and carefully insulate the connections with heat-shrink tubing or several layers of black electrical tape.

Variable-Voltage Supply. You can convert the fixed 5-volt supply in Fig. 2 to a variable 0-to-5-volt supply by adding a voltage divider as shown in Fig. 3. The result is handy for experimenting with LED's and other low-voltage components and circuits.

Other IC Voltage Regulators. IC voltage regulators with outputs of from 5 to 24 volts are readily available from many of the parts suppliers who advertise in POPULAR ELECTRONICS. Chances are one of these regulators can be used to power almost any IC circuit or project you have in mind. For example, the 78L12 will deliver 12 volts plus or minus half a volt at a current up to 100 milliamperes. The 78L12 is part of a series of three-terminal regulators with a wide range of regulated voltage outputs.

You can get lots of design tips and application ideas about using voltage regulator IC's from manufacturer's data sheets and the excellent data books which are available. One such book is National's "Voltage Regulator Handbook." You'll soon find that IC voltage regulators can increase the reliability of your circuits while saving you a bundle of battery money. ◇

Hobby Scene Q&A

By John McVeigh

Have a problem or question on circuitry, components, parts availability, etc? Send it to the Hobby Scene Editor, POPULAR ELECTRONICS, One Park Ave., New York, N.Y. 10016. Though all letters can't be answered individually, those with wide interest will be published.

TIMER IC INFO

Q. ***Can you provide any information on using the LM322 precision timer?—Rene Buteau, Quebec, Canada.***

A. The LM322 can operate with unregulated supplies from 4.5 to 40 V, maintaining constant timing over a wide range of periods. The output of the timer is a floating transistor with current limiting. It can drive either ground- or supply-referenced loads up to 40 V and 50 mA. This floating output offers the user great flexibility in circuit design. Also included is an on-chip "logic reverse" circuit that can be programmed by the user to have the output transistor either on or off during the timing period. The trigger input has a 1.6-volt threshold (independent of supply voltage), but is protected against inputs as large as ±40 volts, even when a 5-volt supply is used. The IC reacts only to the rising edge of the trigger signal, and is immune to any trigger pulse during the timing period.

An internal 3.15-volt regulator keeps the timing period independent of supply fluctuations and provides the user with a convenient reference. External loads drawing up to 5 mA can be driven by the regulator. An internal 2-volt divider between the reference and ground provides a timing period of T = RC. This timing period can be voltage controlled by driving the divider from an external source through the V_{ADJ} pin. Timing ratios of 50:1 can be achieved. The LM322's internal comparator has a 300-pA typical input bias current over a common-mode range of 0 to 3 volts. A boost terminal allows the user to increase comparator operating current for timing periods less than 1 millisecond. This allows the timer to function over a 3-μs to multi-hour timing range.

Some circuits using the LM322, from the National Semiconductor catalog, are shown. At A, is a basic timer with the output taken at the emitter of the floating transistor. A basic timer with collector output is shown at B. A timer with collector output and manual reset and cycle end is illustrated at C, and a timer triggered by the negative edge of the trigger pulse is shown at D.

FINDING VARIABLE CAPACITORS

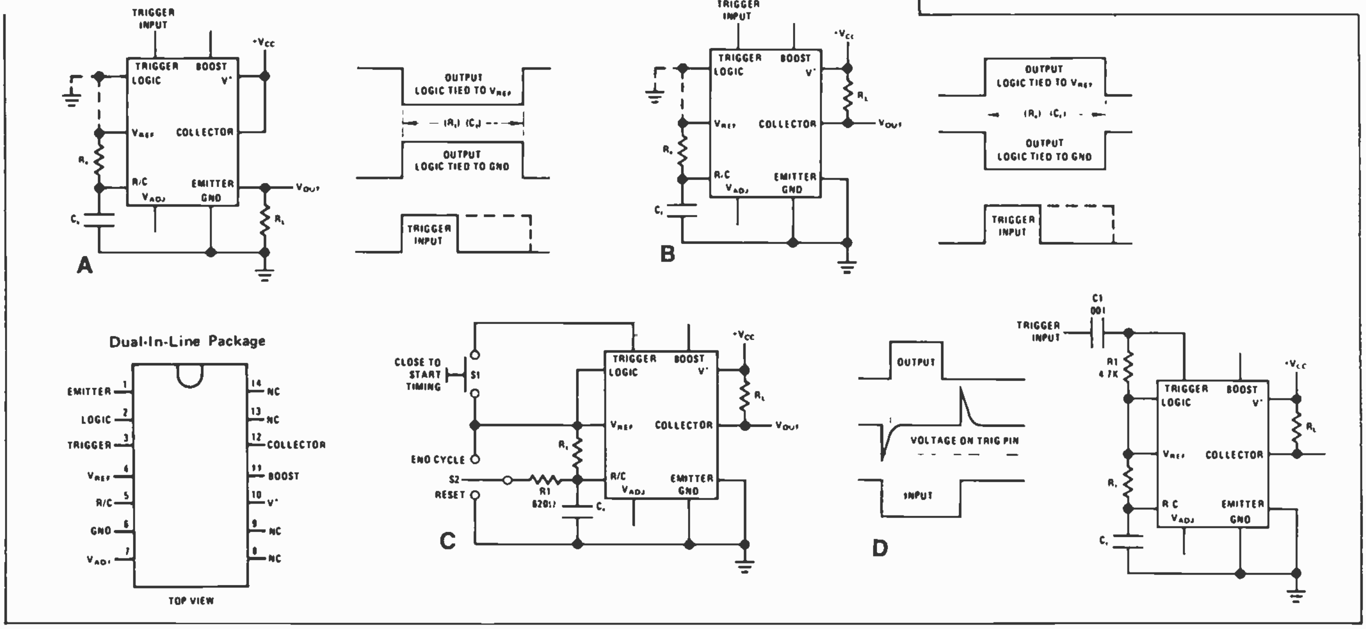
Q. ***I have searched high and low, but have not been able to find anyone who stocks or manufactures three-section, 10-to-365-pF "variable condensers." I'm very surprised by this. A few years ago I could find these condensers anywhere. Do you know of any parts distributors who carry them?—Jerry John Raimondo, Astoria, NY.***

A. Variable capacitors are getting very scarce. Many of the companies that used to make them (e.g. Hammarlund) are no longer in business. Accordingly, you'll have the greatest chance of finding the parts you're looking for at a surplus outlet. (Since you are near Manhattan, try the electronics dealers on Canal Street or Barry Electronics at 512 Broadway.) Also, procure a copy of the catalog published by Fair Radio Sales Co., 1016 E. Eureka Street, Box 1105, Lima, OH 45802. Fair Radio carries a large line of surplus equipment and components.

ADJUSTABLE REVERB

Q. ***I am building an electronic organ and need adjustable reverberation in the audio output. I would appreciate your help with a circuit diagram using the new "bucket brigade" IC for this application.—Colin Nusum, Willowdale, Ontario, Can.***

A. The "Bucket Brigade" Audio Delay Line in the June 1976 issue is well suited for this application. It employs the Matsushita MN3001 dual 512-stage analog shift registers. Total delay time depends on various resistor values. A table is included for component selection.



Product Test Reports

HY-GAIN MODEL 2716 MOBILE AM CB TRANSCEIVER

Calculator-type keyboard controls remote transceiver.

DURING the past year or so, a number of mobile CB transceivers have been designed to be operated by remote control, with the transceiver itself located somewhere other than under the dashboard. The operating controls for such rigs are on the case of the microphone, which generally serves as the speaker, and is connected to the transceiver via a detachable cable. This type of setup permits the transceiver to be installed in a hidden location to minimize the possibility of theft.

The Hy-Gain Model 2716 40-channel rig is this type of remotely controlled AM mobile transceiver, but with a new twist. It differs from the usual control scheme in that instead of rotary controls and switches, the microphone housing has a calculator-like keyboard to control all (14) functions except power on/off. Moreover, a number of unusual functions are provided. Among these are a LED clock display; two independent channel memories; and S/r-f numerical LED indicators. Other facilities include digital frequency synthesis; VOLUME, SQUELCH, and CHANNEL up/down control buttons; channel 9 override key; switchable noise blanker; and PA operation. All functions are operated by depressing pushbutton keys.

The main transceiver unit includes an automatic noise limiter, external-speaker jacks; 13.8-volt dc, negative- or positive-ground operation; reverse-polarity protection; and line filter.

The main transceiver unit measures 7½" × 6½" × 2¼"(19.1 × 16.5 × 5.7 cm). The entire system carries a price tag of $249.95, with mounting hardware, microphone, and cables for "up-forward" installations. An extension-cable pack for trunk installation is available at additional cost.

General Description. The main transceiver unit has only the necessary connectors and speaker jacks mounted on its simple plastic housing. It also has flanges for convenient installation. A 5′ (1.5-m) control cable can be installed on an L-shaped bracket (supplied) and mounted on a dashboard or transmission hump. The mike cable is then plugged into it.

The case of the microphone is somewhat similar to a telephone handset. The numeric display "window" is located at the top of the housing, the 12 calculator-type pushbutton "keys" are in the middle, and the microphone/speaker is at the bottom. The push-to-talk lever is on the left side of the mike's housing, and the power on/off switch and mike hanger clasp are on the rear of the housing.

Neither the volume nor the squelch operate continuously. They function at a fixed step each time the appropriate button is pressed. The VOLUME steps are about 3 dB each. CHANNEL selection, in either direction, can be stepped sequentially one at a time or continuously when the up or down button is tapped or held down, respectively.

A MEMORY button permits a channel in use to be stored so that the operator can quickly return to the original channel (by pressing MEMORY again) after checking out other channels. Another button, labelled EMERG CH-9, instantly goes to Channel 9 when pressed.

Separate buttons switch in and out the noise blanker. Setting the hours and minutes for the clock is accomplished with the same buttons used for the noise blanker after first pressing a special F button. This same button switches between CB and PA operation after the F button is first tapped.

The S/r-f readings appear in place of the channel numerals in the display each time a button labelled # is pressed. A green indicator lights during receive. A red indicator comes on on transmit.

Technical Details. The double-conversion receiver, which includes the usual r-f and mixer stages and a noise blanker, provides i-f's of 10,695 and 455 kHz. Selectivity is obtained with a 455 kHz ceramic filter. The remainder of the receiver section includes a diode detector, agc, series-gate anl, and squelch. A single IC contains the entire audio section, including the power-output stage, which doubles as the modulator for the transmitter.

The digital frequency synthesis system utilizes the usual phase-locked-loop (PLL) principle in which a voltage-controlled oscillator (vco) provides the heterodyning frequencies required to produce the 10,695-kHz i-f at the first mixer. A 10,240-kHz crystal oscillator converts the first i-f to 455 kHz at the second mixer. The standard-reference signal is also derived from this oscillator.

In the transmitter section, the carrier is obtained at a mixer by combining the vco frequency with that from a 10,695-kHz crystal-controlled oscillator. Following a spurious-noise-rejection filter are predriver, driver, and the r-f power-amplifier stages. A multi-section network matches the output of the r-f power amplifier to 50-ohm loads and minimizes harmonics. Collector modulation includes automatic modulation control (amc). Transmit/receive switching is accomplished electronically.

Laboratory Measurements The sensitivity of the receiver section of the transceiver is rated at 0.7 μV for 10 dB (S + N)/N. We measured a 0.5-μV sensitivity on our test transceiver, using a 1000-Hz test tone and 30% modulation. The range of the squelch threshold was 0.5 to 200 μV. The agc system held the change in audio output to 10 dB with a 26-dB r-f input signal change at 0.5 to 10 μV. The change was held to 5 dB with an 80-dB input-signal change at 1 to 10,000 μV. A nominal 50-μV signal registered S9 on the S meter numeric display.

Adjacent-channel rejection and desensitization were 50 dB. Image and i-f rejection measured 70 dB, while other unwanted or spurious signals were down 50 to 60 dB.

The audio output of the transceiver measured 2.5 watts at less than 1.5% THD, using a 1000-Hz test tone and an 8-ohm load. The overall 6-dB response was 275 to 1850 Hz (+1 dB at 700 Hz). Using a 1000-Hz test tone and an 8-ohm load, the output power on PA measured 5 watts at 1.1% THD. At 400 Hz on PA, the power was down to 4.5 watts and the THD was up to 2.2%.

Powering the transceiver from a nominal 13.8-volt dc source, the transmitter's carrier output measured 4.5 to 4.75 watts, depending on the channel in use. The modulation held to up to 100% with only an occasional spill-over, even with mike input levels 16 to 25 dB greater than required for 50% modulation. The THD under these conditions was less than 3% and 5% at 1000 and 500 Hz, respectively. Adjacent-channel splatter with a test tone and with voice was 50 to 55 dB down at ±5000 to 10,000 Hz from the carrier frequency. The overall 6-dB audio response was 440 to 3600 Hz (375 to 5300 Hz at −10 dB).

User Comment. The Model 2716 represents the exciting new breed of CB transceivers coming to the fore that takes fuller advantage of modern solid-state technology. For example, the MEMORY function enables a CB'er to recall at the push of a button a channel that's been stored instead of going through the cycle of up to 40 channels to locate it. This proved to be a boon to us during our road test, when we quickly switched directly to channel 10 from channel 19 as we turned from one highway to another. The same convenience factor (and safety consideration) held true when switching to channel 9, where there is a separate emergency channel override key.

The "hide-away" aspect of the 2716 is most welcome as a theft preventive measure, of course. Besides this, the transceiver section does not usurp leg room in an auto. Owing to its shallowness, it can be mounted on the auto's firewall, where it will not be in the way of a passenger and is virtually invisible.

The use of a keyboard-type control system is most interesting. Whereas other types of microphone control systems offer severely limited controls, this one has almost a plethora of functions. As a result, one has to have some practice with the control head in order to use it effectively. Since the keys are not illuminated, handling them at night requires greater familiarity with the keypad layout than one would ordinarily expect. Since CHANNEL selector, VOLUME and SQUELCH buttons are located at the right side of the handset's control panel and arranged in logical order, the positions are rather easy to memorize for one-hand operation.

There are a few other minor discomforting factors with this new control facility, most of them due to basic unfamiliarity with the system—which should be simple to overcome. For instance, one cannot see where the VOLUME and SQUELCH controls are set since they are electronically stepped controls. The S/r-f display, too, operates in a different manner. It's in whole numbers, which precludes being able to read in-between values. In addition, the signal-strength reading comes up for the level only at the particular instant it is called up and remains the same for any given signal level as long as the display is on. The numbers do not change in step with the changes in signal level as they do with a conventional meter. Even so, the disadvantages in the display are not really important. After all, the object is to adequately hear a signal, not look at it.

The built-in digital clock functions continuously as long as the microphone is plugged in, even when the vehicle is not in use. However, disconnecting the mike interrupts the clock's operation. Therefore, it is necessary to reset the clock when the mike is disconnected and again plugged into its connector. (The current drain with just the clock in operation is about 200 mA, which makes it desirable to disable the mike when the vehicle is not to be used over an extended period of time.)

The main transceiver unit features a phono jack that can be used with certain

Hy-Gain AM/FM radios to permit reception of the broadcast bands when the CB rig is squelched. The CB signal has priority in this case so that when a signal is detected, the AM/FM radio is automatically squelched to allow the CB to come through. This is a nice touch, though we did not have an opportunity to test it out.

In addition to providing certain conveniences as well as minimizing the possibility of theft, this transceiver provides good overall performance. Particularly impressive is its ability to suppress noise via its full-time anl system. In our noisy test vehicle, we seldom had to add the noise blanker. In any case, weak signals could be easily copied without adverse deterioration of the S/N ratio.

The small calculator-size LED numeric displays used for indicating the channel are bright and readable even in sunlight. This contrasts sharply with the large-size displays normally used, which readily wash out in bright light.

Our overall personal reaction to this transceiver is very good, except for the lack of illumination for the control buttons at night. For anyone with especially small hands, though, one-hand operation was sometimes cumbersome, inasmuch as the width of the handset's case is about 3" (7.6 mm).

Of special import is the high quality of reception and reported transmission signals. The mike-contained speaker is driven very well by the transceiver's audio amplifier, producing a loud, clear signal. Furthermore, we had no difficulty contacting CB'ers a few miles away on the lower 23 channels, whereas a pre-40-channel unit could barely reach out one mile in the testing area. On a channel-32 contact, we reached out an extra mile, which says a lot for the advantage of communicating on the 17 new channels.

CIRCLE NO. 104 ON FREE INFORMATION CARD

CONTINENTAL SPECIALTIES MODEL MAX-100 FREQUENCY COUNTER

No-controls counter indicates frequency to 100 MHz with 8 digits.

FEW TEST instruments are as simple to operate as the Model MAX-100 frequency counter from Continental Specialties Corp. It is devoid of all controls except a power on/off switch. You simply turn on the power and connect the instrument's input cable to the circuit under test. Unlike most other low-cost counters that have a frequency range of 30 MHz and a four- or six-digit numeric display, the MAX-100 goes out to 100 MHz and indicates the frequency directly on its eight-digit display.

The frequency counter can be operated from any of three possible power sources. In its basic configuration, the MAX-100 is powered by alkaline cells (or optional rechargeable nickel-cadmium cells). For on-the-bench use, an optional battery charger/eliminator allows operation from 117/220-volt ac line power sources. And for extended field use, another optional charger/eliminator allows operation from mobile electrical systems.

The MAX-100 comes in a modernistic package. It measures 7.75"D × 5.63"W × 1.75"H (19.7 × 14.3 × 4.5 cm) and weighs 1.5 lb (0.68 kg), less batteries. The price of the basic MAX-100 frequency counter, which includes the input cable, is $134.95. Optional accessories include: the ac and mobile battery charger/eliminators mentioned above; a mini-whip antenna for inductively coupling in r-f signals; and a low-loss tap-off for physically coupling to an r-f line under test.

General Description. The MAX-100 has a guaranteed specified frequency range of 20 Hz to beyond 100 MHz (110 MHz typical). Its rated sine-wave input sensitivity is 30 mV for frequencies up to 50 MHz, 100 mV between 50 MHz and 80 MHz, and 300 mV beyond 80 MHz. The crystal-controlled time base accuracy is specified as ±1 count. Overload protection is provided for potentials up to 200 volts between 10 and 500 Hz; 100 volts between 500 and 1000 Hz; 75 volts between 1000 Hz and 10 MHz; and 50 volts between 10 and 100 MHz.

The eight-digit display consists of 0.6" (15.2-mm) high red seven-segment numerals. There is no leading-zero blanking for all but the least-significant digit. When the display indicates greater than 1 MHz, a decimal point automatically appears between the sixth and seventh digits. When the instrument is operated on battery power, if the potential drops to less than 6.6 volts, all eight numerals in the display flash once per sec.

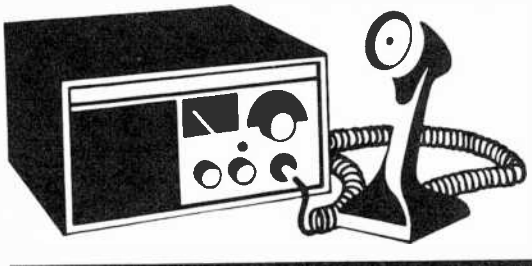
Alkaline cells (six AA size) can power the MAX-100 for about three hours under continuous use or up to eight hours of intermittent use conditions. When operation is from NiCd cells, up to three hours of continuous use or six hours of intermittent use can be expected. Using the optional recharger, the NiCd cells can be fully charged in 12 to 14 hours.

User Comment. The only practical way of evaluating the performance of a frequency counter is to measure a number of signal frequencies of known accuracy across the instrument's entire response range. Bench tests verified that the MAX-100 very accurately indicated the full range of frequencies down to the single hertz. Our test counter was able to measure frequencies well beyond 100 MHz and maintain its basic accuracy. When we did measure frequencies beyond 100 MHz, the display (which has a maximum count range of 99.999999) indicated the proper frequencies and flashed the most-significant digit at the far left to indicate an overflow condition.

We also made a series of sensitivity tests, again covering the entire frequency range of the instrument. In direct physical connections, the MAX-100 was considerably more sensitive than its published ratings. The same held true for our inductively coupled signal tests. We used a relatively low-powered signal generator (a grid-dip meter) at a distance of a couple of inches away from the r-f connector for the inductive-coupling test and obtained excellent results.

We particularly like the no-controls approach to the operation of the MAX-100. This plus its large, bright displays and relatively low price should make it a popular counter.

CIRCLE NO. 105 ON FREE INFORMATION CARD



CB Scene

By Ivan Berger

TRENDS IN CB

WITH ALL of the publicity that CB radio has garnered in the past few years, you'd think it would have dominated the Consumer Electronics Show last June. It didn't. (Audio did!) But, then, CB radio has its own show going for it—the Personal Communications Show, held a few months earlier. Nonetheless, there were still plenty of CB rigs displayed at the gigantic CES show, and it was most interesting to observe new trends in equipment.

For example, the outstanding developments last year were in the use of phase-locked-loop circuitry (PLL) and theft-proofing accessories. This year, everyone utilized PLL circuits, a not-surprising fact in view of the new 17 channels added to the CB band. Anti-theft movement was in two areas: new antennas and remotely located CB transceivers.

Manually retractable AM/FM/CB antennas were shown by Tenna, Shur-Lok and SparkOmatic, pointing to those people who can't afford the power types that proliferated last year. Shur-Lok's (also available in a CB-only version) can also be roof-mounted, which permits the user to retract or remove it from the inside of the car. Antenna Systems' "Automatch" antenna is a nonretracting "disguise" type with a matching box beneath it. When the user transmits on a new channel, a motor in the box adjusts a matching network to retune the antenna to that channel to maximize radio power output. A few companies also exhibited networks which use the car's whole body as an antenna.

New designs, which included remotely located CB transceivers with microphone control systems, were given heavy emphasis this year. Hy-Gain set the pattern for this type of transceiver design last year with its 23-channel Hy-Gain 9. At this year's CES, I observed new versions from Hy-Gain, as well as remotes from Audiovox, Boman, Clarion, Johnson American, Medallion, Pace, Panasonic, SBE, Sharp, SparkOmatic, Surveyor and Texas Instruments (not yet FCC type accepted at show time), among others. As you'd expect, each company has added a few ideas to the basic theme.

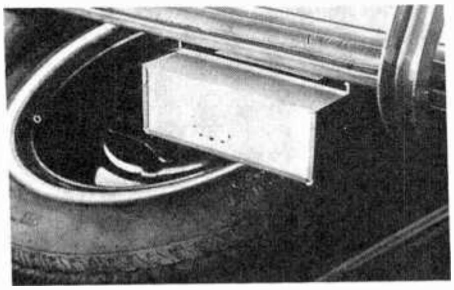
One interesting new feature is the linking of a CB transceiver to a car's stereo system with a "stand-by" switch so that one can monitor a channel and listen to stereo at the same time. When a CB signal overrides the squelch level, the stereo source is automatically cut off and the CB communication comes through. The stereo sound also cuts off when transmitting, of course. It appears that Audiovox and SBE units work this way with any car-stereo unit, while Clarion, Hy-Gain and SparkOmatic interface with specific car stereo models of their own. Kraco has one built into a car radio. There are also combination AM/FM/CB in-dash units with controls in the mike head and the channel display on the radio itself from Clarion, Cobra, JIL, Kraco, Medallion, and Superscope, among others. (Note that using a car's stereo speakers does not necessarily mean clearer CB sound since stereo speakers cover a wider frequency range than CB produces and might, therefore, reproduce noise of higher frequency than CB speakers will.)

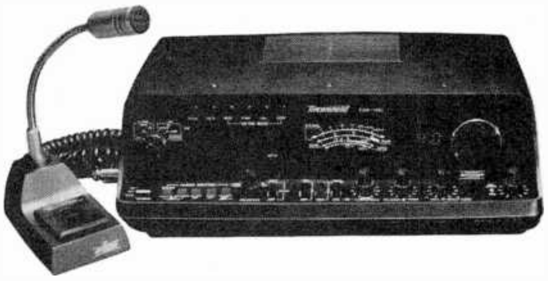
Most remote control CB transceivers use the microphones as speakers, too, though most also have jacks for external speakers. But those from Johnson American, Sharp, and Texas Instruments employ speakers that are not contained in the mike. These speakers are located in the small junction boxes that the microphone/control units plug into, generally at a location under the dashboard and near the driver. Though this does not necessarily make for better sound quality, the mike unit can be made smaller for easier handling.

In one of Sharp's models, the box also has a big signal/r-f meter on its face. Johnson's box, which also contains the digital channel readout can be mounted above or below the dash.

Some microphones used as speakers lack top-quality sound performance. Even the full-size speakers of underdash rigs may not produce audio as well as they might because the sound waves go way down to the floor carpeting and bounce back up to you. There were a lot of external speakers at CES to solve these problems. I also noted external speaker models with built-in tone controls from SparkOmatic and Kraco, as well as AFS's flush-mounted CB radio speaker. The latter saves space, and helps to conceal the fact that you have a

Panasonic's "Big Mike Model RJ-3450 with microphone control system (left) and remotely located transceiver (below).





Superscope Aircommand Model CBB-1050 base station with channel 9 scan.

CB unit in the car (assuming you've hidden the transceiver and the antenna). Still another method to enhance sound was offered by Prime Electronics with its PR-1000 Variable Audio Filter. The filter's center frequency and bandwidth can be varied to exclude as much or as little sound as one likes. It's for 115-V ac operation.

Digital Designs. Digital channel display is a great advance, especially for mobile CB use. It's far easier to read one big number than a cluster of little ones around a dial.

The early digital-display units had little else digital about them. Now digital circuitry is showing up in a number of new ways. For example, the displays themselves are giving more than just the channel number. Hy-Gain's new 2716 remote unit and Pace's 8092 mobile have digital clocks built-in, and both the 2716 and the new Texas Instruments SSB base and remote display signal strength and r-f output digitally. (Many Johnson American models and SBE's Stowaway" remote unit take a different approach to this: a line of LED's above the digital channel display serves as an S/r-f "meter.")

Texas Instruments' SM-172 mobile unit and matching SM-173 base also display SWR when a keypad button is depressed. But more important is TI's automatic SWR monitor that automatically shuts down the transmitter when it senses that the SWR is approaching the point where transmitter damage might occur. In this event, the user is alerted by the display, "AAAAA."

Monitoring SWR is just one of several functions handled by a microprocessor built into TI's main circuit module. The processor also controls a variable-bandwidth filter that narrows when adjacent channels are busy. And when talking to another TI set on SSB, the same filter shifts frequency as well, acting as an automatic clarifier.

Microprocessors are also built into the Hy-Gain 2716 and the SBE Key-Com. Others are sure to follow suit.

Smarter Tuning. Microprocessors and other digital techniques are changing the way we tune our transceivers—and for the better. Most of the new digital sets have two-button tuning—one button to scan up the scale, and the other to scan down. (An improvement I'd like to see here is the inclusion of a soft beep each time the channel changes, so a driver could count how many channels he's shifted without taking his eyes off the road. With a nondigital set, one can count clicks.)

Several SBE and SparkOmatic transceivers have two-speed tuning, so you can zip quickly to the other end of the "dial" (more time on 40 than on 23 channels), then slow down so as not to overshoot your mark. Panasonic's RJ-3450 "Big Mike" model, SBE's colorful Key-Com and TI's units scan the band to find clear channels (if you want to move your conversation to a less crowded one) or to find active ones (if you're looking for someone to talk to). SBE's version of this feature scans the whole band for an open channel and scans the 10 stations you use most (and have stored in its memory) for activity, on the assumption that you're looking for someone specific to talk to. TI's clear-channel scan returns you to the channel you were originally talking on so you can tell the other party to your conversation what channel you should both switch to.

In emergencies, you can jump directly to channel 9 by hitting just one switch or button on CB transceivers from a growing number of manufacturers, including

Johnson 4330 has remote control mike with speaker and channel indicator in separate box.

SBE Key-Com 1000 has built-in microprocessor and a calculator type keyboard channel selector.

Cobra 45XLR combines 40-channel CB with AM/FM/stereo FM.

Texas Instruments' Model SM-172 has remote computer control.

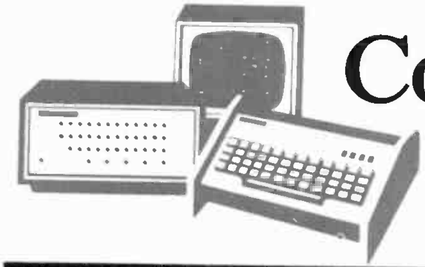
Hy-Gain, Pace, Panasonic, SBE, Sharp, and Superscope "Aircommand." To jump directly to any other station, calculator-type keyboards are used to punch in the number on many rigs: SBE's Key-Com (again), Pace's 8117 base station and the TI units, for example. The latter also have a unique, keyboard-operated selective-call system. Select a 5-digit number and a channel, tell you friends with TI units what your number is, and your receiver section will be silent until they "dial" you. Unlike most selective-call systems that use tones, the TI sets can access up to 100,000 CB "phone numbers" for each AM or SSB channel and store the five most frequently called numbers in a memory, to be recalled at the touch of a key.

Interestingly, there's a move afoot at the Electronic Industries Association to standardize selective calling signals for CB radio use. The purpose is to head off incompatibility among products of different manufacturers.

Rigs That Remember. Memory—another digital feature—is found on many of the latest transceivers. Sharp's IMC and Hy-Gain's 2716 remote models are examples of CB transceivers that remember which channel you last used so you don't have to re-tune to it when you turn the unit on again. The 2716 also remembers other settings when it's in "stand-by" mode. SparkOmatic has a model with a 5-channel memory. You can use its scanning feature or manual tuning to search through all 40 channels or just through the 5 channels you use most in search of activity. Pace's 8047 can scan channel 9, 19 and any other channel you choose and its 8117 base station has a 10-channel memory that can be scanned as does SBE's Key-Com mobile. Both Sharp and Superscope Aircommand have models that monitor channel 9 as well as the channel you're using.

These weren't the only CB products at CES of course; just some of the ones with the most exotic features. Furthermore, not all CB manufacturers exhibited at CES. And at least one who did—Motorola—held off introducing new CB models so that it could show them for the first time a few weeks later at a distributor's convention. Here it introduced a 40-channel base station with an automatic "on-setting" digital clock function (Model 4025) and an under-dash "public safety" monitor mobile (Model 4009) with dual receivers that features a channel 9 crystal that can be replaced by another channel's crystal.

About the only other possible trend observed was the growing number of CB in-dash "entertainment centers" available. That is, CB transceivers combined with AM, stereo FM and a choice of cassette or 8-track tape units. ◇



Computer Bits

By Leslie Solomon

MORE GOOD NEWS FOR THE COMPUTER GROUP

THE NUMBER and variety of hardware and software items available to computer hobbyists continue to increase—with no end in sight at present. Let's take a look, then, at a few of the "goodies" that have come across our desk in the last several weeks. First, the hardware items.

Radio Shack Too! The latest entry into the hobby computer scene is from Radio Shack. Packaged in an attractive and functional plastic case only 16½" by 8" by 3½" are a 53-key ASCII keyboard, a Z80 microprocessor and support logic, a video display unit, 4k of ROM and 4k of RAM (internally expandable to 12k ROM and 16k RAM), and a cassette interface. Soon to be available at most Radio Shack outlets, the wired and tested TRS-80 Microcomputer can be purchased for $399.95. An associated 12" video monitor and cassette recorder package is also available to create a complete personal computing system for $599.95.

The video display is memory mapped with graphics and alphanumerics (upper case) controlled by BASIC commands. Cursor control and automatic scrolling are also featured. Connections to the cassette recorder and the video monitor are made via rear-apron connectors. Also on the rear apron is a small door that, when opened, exposes a bus connector that is used for system expansion. Although the computer can physically hold only 16k of RAM, it has a total memory capacity of 62k by using its bus connector.

The video display is 16 lines of 64 characters but can be software controlled for 32 characters per line. The video graphics are formed on a 128 (horizontal) by 48 (vertical) matrix and both graphics and text can be interspersed in any manner by software.

The BASIC software comes in ROM and features floating point arithmetic; numeric, array, and string variables; video graphic commands; and cassette save and load commands. The software

Radio Shack's TRS-80 microcomputer system.

level is between "tiny" BASIC and "regular" BASIC and includes the special commands used for graphics.

Along with the computer, the customer will be supplied with a free cassette that "plays" blackjack (with graphics) and backgammon. Other available cassettes provide a 15-person payroll program ($19.95), a Math-1 package that teaches multiplication, addition, and subtraction, and includes a teacher's guide ($19.95 for a three cassette portfolio); a kitchen program that covers menus, conversion tables, a computer directory, and a message center ($4.95); and a personal finance program for $14.95 which includes a seven-cassette portfolio.

Radio Shack intends to support its new baby and plans to introduce Extended BASIC (more memory is required), a disc and DOS system, a hardcopy printer, an expansion unit for additional circuit boards (connecting the expandor bus), and a modem.

A number of interesting software packages have also been promised for the near future with the hope of making the TRS-80 a useful hobby and personal computer.

For Fans of the Z80. If you are interested in the Z80 processor, you should be aware of the Martin Research (3336 Commercial Ave., Northbrook, IL 60062; tel: 312-498-5060) MIKE-8 Model 882. It sells assembled for $895. The 882 has 4k of RAM, a 1k monitor program in PROM, and a "console" board with a calculator-type of keypad and six 7-segment LED displays. Besides the usual functions, the monitor offers advanced debug features, RAM test, signal-step, and trap setting. The system also includes a 2708 PROM programmer and a UV erase lamp. The Model 882 is mounted on a base and has its own switching regulator power supply. The firm's Microcomputer Design book fills out the package.

PROM Programming. Oliver Audio Engineering (7330 Laurel Canyon Blvd., North Hollywood, CA 91605; tel: 213-765-8080), which introduced the low-cost optical tape reader some time ago, has now introduced a new PROM programmer, the OAE PP-2708/16. (As a kit, it is $249; wired and tested, it's $299.) Containing address counters, timing and control logic, switching voltage regulator, and a zero-insertion-force socket, this new programmer can handle either the 1k 2708 or the new 2k 2716 PROM's. A simple parallel interface connects the programmer to almost any microcomputer and very little software is required to support the system. You just dump the data via the output port into the PROM. The system comes with one 8-bit I/O port and three switch-programmable status lines, with all lines TTL compatible. A 5-foot, flat ribbon cable is provided.

Cassette Interface. Compatible with the Altair/S-100 bus, the Universal Cassette Recorder Interface (UCRI) is now available from Dajen Electronics (7214 Springleaf Ct., Citrus Heights, CA 95610; tel: 916-723-1050) for $135 in kit form, $175 assembled and tested. Using bi-phase recording and having no adjustments, the UCRI can operate from 520 to 41,000 baud—switch selectable. There is also a switch-selectable board address, and independent selection of transmit and receive data inversion for use with different recorders. A level-indicator light comes on at correct levels, and a sync indicator light shows reception of the sync byte. User selectable sync character, under software control allows Tarbell, KC or other sync character format. Relay options for control of two recorders are available. An independent latched input port can be used for a keyboard. Output connectors for recorder and parallel port, recorder cable, IC sockets, pre-recorded cassette with sync, and a full manual are included.

Super Hobby Terminal. If your dreams include a super hard-copy terminal, take a look at the new Texas Instruments Silent-700 Model 765 Portable Memory Terminal or the Model 763 Memory Send-Receive Terminal. About the size of an office typewriter, the 765 is designed for portable use and includes a

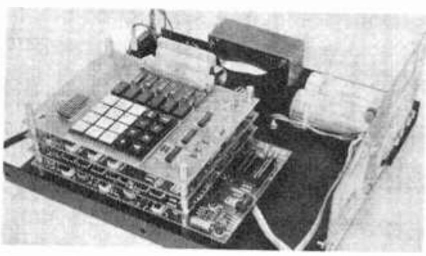
TI's Silent 700 Terminal.

built-in carrying case and a phone coupler. The 763 is for use where portability is not required.

Each of these new terminals comes with 20k characters of nonvolatile bubble memory expandable to 80k. A 9900 processor controls the system. Both units include a keyboard with upper and lower case, a built-in calculator-type numeric keypad cluster, and a quiet 30-character/second nonimpact printer. Both models have file management systems, and an operator command mode to allow the user to select the communications mode, configure memory, and enter or edit text. The Model 765 is $2995 and the 763 is $2695.

Economical Terminal. If you have a computer, the next thing you need is a CRT-type terminal so you can "talk" to your machine. Southwest Technical Products (219 W. Rhapsody, San Antonio, TX 78216), the producer of the CT-1024 terminal, has announced its CT-64 CRT Terminal ($325 in kit form, with assembled CT-VM Video Monitor $175). This new terminal features 16 lines of 32 or 64 characters per line, scrolling or page operation, upper and lower case, reversed character printing, full cursor control, and complete character decoding. The kit includes power supply, keyboard, serial I/O, beeper, chassis, and cover.

6800 Software. Impro Micro Systems (Box 7776, Van Nuys, CA 91409) recently announced its MIKADOS+D (mini instant keyboard assembler, debug, operating system + disassembler) package. The $17.95 software package occupies only 3k of RAM and with 4k bytes, 1k is still left for user programs and the label table. The assembler generates object code for the 72 basic variable-length 6800 instructions with all addressing mode variations—a total of 197 different instructions. The assembler generates object code for user-entered mnemonics, enters them into memory, and outputs formatted object code and address on the same line as user input. Relative addressing for branch instructions with symbolic labels are resolved,



Martin MIKE-8 882 processor.

and a label table is maintained. There are 18 useful directives on line at all times including ASCII character I/O, hex character input formatted hex character output, disassembly of object code into source code with complete instruction mnemonics and absolute branch addresses, label table formatted output, data transfer from one memory area to another, clearing all or part of memory, controlling execution of user programs, setting and clearing breakpoints, and setting and clearing monitor points.

Another 6800 software producer, TSC (Technical Systems Consultants, Box 2574, W. Lafayette, IN 47906) has announced its Text Editing System (stock number SL68-24 at $23.50) which supports many of the standard commands such as PRINT, INSERT, DELETE, FIND, REPLACE, and VERIFY. It also provides file TOP and BOTTOM, an APPEND command allowing any string to be added to any or all lines starting in a specified column, text block COPY and MOVE, and an extensive CHANGE command that allows changing any or all specified occurrence of one string into a second string. Other features include TAB, SET, NUMBERS, EXPAND, NEXT, RENUMBER, STOP, LOG, and OVERLAY that allows line changing by typing over an existing line. There is a HEADER command, a ZONE feature and, for tape users, READ, WRITE, and SAVE.

6502 Software. If you are more concerned with the 6502, you should know that Microcomputer Associates Inc. (2368-C Walsh Ave., Santa Clara, CA 95050; tel: 408-247-8940) has a new 6502 RAP (resident assembler program) and Tiny BASIC on ROM. The two 2k ROM's house the 1.75k resident assembler and the 2.2k Tiny BASIC. RAP is a single-pass resident assembler. Statements are entered either from paper tape or from a terminal keyboard, and RAP generates a listing and places object code into RAM for immediate execution. A minimum of 4k RAM is needed in the user's computer. Tiny BASIC statements include LET, IF, THEN, INPUT, GOTO, GOSUB, RETURN, END, REM, CLEAR, LIST, RUN, RND, and USR (user subroutine). The ROM software has been designed so that most I/O devices can be used. The RAP/Tiny BASIC package (SW101) is $200 with full documentation. Tiny BASIC is available in paper tape format (SW300) for $25, or in nine 1702A PROM's (SW202) for $275.

Altair 680 Doings. If you have an Altair 680b, you should be aware that MITS has introduced the 680b-KCACR Audio Cassette Interface for this machine. Using the KC Standard, the device features a digital demodulator, CMOS logic, motor control for starting and stopping tape motion, test points at all key circuits, and sockets for all IC's. BASIC Version 1.2 is available on cassette and includes all standard functions, plus the capability of storing and loading software through the KCACR.

Three-Dimensional Graphics. Sublogic Co. (Box 3442, Culver City, CA 90230) has a new software package that will provide 3-dimensional graphics for microcomputers. With it, you can view two-dimensional perspective projections of three-dimensional scenes from any location in space. A minimal subset BASIC version of the package, for $22 is for general-purpose, slow-speed graphics on any system. Another version, the 6800, at a slightly higher price, has optimized assembly language with dynamic graphic capabilities for advanced simulation and complex graphics. Driving and flying simulations, artistic projections, design projections, engineering analysis, and advanced games are possible uses. ◇

Bearcat® 210 $289.

The Bearcat® 210 is a sophisticated scanning instrument with the ease of operation and frequency versatility you've dreamed of. Imagine, selecting from any of the public service bands and from all local frequencies by simply pushing a few buttons. No longer are you limited by crystals to a given band and set of frequencies. It's all made possible by *Bearcat* spaceage solid state circuitry. You can forget crystals forever.

Pick the 10 frequencies you want to scan and punch them in on the keyboard. It's incredibly easy. The large decimal display reads out each frequency you've selected. When you want to change frequencies, just enter the new ones.

Automatic search lets you scan any given range of frequencies of your choice within a band. Push-button lockout permits you to selectively skip frequencies not of current interest. The decimal display with its exclusive "rolling zeros" tells you which channels you're monitoring. When the *Bearcat* 210 locks in on an active frequency the decimal display shows the channel and frequency being monitored.

With the patented track-tuning system, the Bearcat 210 automatically aligns itself so that circuits are always "peaked" for any broadcast. Most competitive models peak only at the center of each band, missing the frequencies at the extreme ends of the band.

The Bearcat 210's electronically switched antenna eliminates the need for the long low band antenna. And a quartz crystal filter rejects adjacent stations as well as noise interference.

Call toll-free 800-521-4414 now to place a BankAmericard or Master-charge order. This is our 24 hour phone to our order department and only orders may be processed on this line. To order in Michigan or outside of the U.S. dial 313-994-4441.

Add $5.00 for U.S. shipping or $9.00 for air UPS to west coast. Charge cards or money orders only please. International orders invited. Michigan residents add tax. Please write for quantity pricing.

Bearcat® 210 Features

- **Crystal-less**—Without ever buying a crystal you can select from all local frequencies by simply pushing a few buttons.
- **Decimal Display**—See frequency and channel number—no guessing who's on the air.
- **5-Band Coverage**—Includes Low, High, UHF and UHF "T" public service bands, the 2-meter amateur (Ham) band, plus other UHF frequencies.
- **Deluxe Keyboard**—Makes frequency selection as easy as using a push-button phone. Lets you enter and change frequencies easily . . . try everything there is to hear.
- **Patented Track Tuning**—Receive frequencies across the full band without adjustment. Circuitry is automatically aligned to each frequency monitored.
- **Automatic Search**—Seek and find new, exciting frequencies.
- **Selective Scan Delay**—Adds a two second delay to prevent missing transmissions when "calls" and "answers" are on the same frequency.
- **Automatic Lock-Out**—Locks out channels and "skips" frequencies not of current interest.
- **Simple Programming**—Simply punch in on the keyboard the frequency you wish to monitor.
- **Space Age Circuitry**—Custom integrated circuits . . . a *Bearcat* tradition.
- **UL Listed/FCC Certified**—Assures quality design and manufacture.
- **Rolling Zeros**—This *Bearcat* exclusive tells you which channels your scanner is monitoring.
- **Tone By-Pass**—Scanning is not interrupted by mobile telephone tone signal.
- **Manual Scan Control**—Scan all 10 channels at your own pace.
- **3-Inch Speaker**—Front mounted speaker for more sound with less distortion.
- **Squelch**—Allows user to effectively block out unwanted noise.
- **AC/DC**—Operates at home or in the car.

Bearcat® 210 Specifications

Frequency Reception Range

Low Band	32—50 MHz
"Ham" Band	146—148 MHz
High Band	148—174 MHz
UHF Band	450—470 MHz
"T" Band	470—512 MHz

*Also receives UHF from 416—450 MHz

Size
10⅝" W x 3" H x 7⅝" D

Weight
4 lbs. 8 oz.

Power Requirements
117V ac, 11W; 13.8 Vdc, 6W

Audio Output
2W rms

Antenna
Telescoping (supplied)

Sensitivity
0.6μv for 12 dB SINAD on L & H bands
U bands slightly less

Selectivity
Better than −60 dB @ ± 25 KHz

Scan Rate
20 channels per second

Connectors
External antenna and speaker; AC & DC power

Accessories
Mounting bracket and hardware
DC cord

TM
COMMUNICATIONS ELECTRONICS

Box 1002 Dept. 733
Ann Arbor, Michigan 48106 USA

master charge
THE INTERBANK CARD

VISA

 CIRCLE NO. 67 ON FREE INFORMATION CARD

Electronics Library

BASIC SOFTWARE LIBRARY

by R. W. Brown

Here, in two volumes, are dozens of computer programs in 8½" × 11" page size, all written in BASIC, with a wide variety of applications. Volume I covers business and recreational programs, such as those for true interest rate, mortgage term comparisons, checkers, lunar landing, roulette, tank, horse racing, and computer pictures. Volume II, on engineering and statistics, has programs for solving polynomials, integration by spline fits, and one-way analysis of variances. Memory required to store and execute programs is indicated.

Published by Scientific Research Institute, Box 2096, Ashland, VA 23005. Vol. I, 292 pages. Vol. II, 243 pages. Both soft cover, $24.95 each.

HOBBY/EXPERIMENTER GUIDES

In *Electronic Components* ($5.25, 104 pages), author M.A. Colwell details the different types of electronic components, what they are and what they do, and how to choose the right component for the job. The lineup includes all the commonly used components, including electromechanical and electromagnetic types. The text tells how to recognize faults and how to prevent breakdowns. Photos and drawings help to identify the various components. *Electronic Diagrams* ($4.95, 104 pages), also by Mr. Colwell, takes the reader through the logical steps of building up circuit diagrams from elementary circuit symbols. Illustrations and descriptions explain how to read circuit diagrams, block diagrams, flow charts, graphs, and oscillograms. *Printed Circuit Assembly* ($4.50, 88 pages), by M.J. Hughes and M.A. Colwell, describes the characteristics of the various bases used in printed-circuit systems and guides the reader through the stages of translating diagrams into pc layouts. Image transfer, etching, milling, and trimming methods are described.

Distributed by Hayden Book Co., Inc., 50 Essex St., Rochelle Park, NJ 07662. Soft cover.

ARRL CODE KIT

The new ARRL Code Kit is a follow-up to the League's popular "Tune in the World with Ham Radio" beginner's package. The Code Kit consists of two one-hour tape cassettes and an illustrated manual. The cassettes contain one-half hour sessions of random text at 5, 7½, 10 and 13 wpm. The use of random characters extends the useful life of the cassettes by making the text impossible to anticipate or memorize. Learning tips, receiving and transmitting techniques, a table of commonly used abbreviations and a schematic and pc layouts for a simple practice oscillator are included in the manual.

Published by the American Radio Relay League, 225 Main St., Newington, CT 06111. Two C-60 cassettes and 30-page soft cover manual. $8.00.

DIGITAL PRINCIPLES AND APPLICATIONS (SECOND EDITION)

by A. Malvino and D. Leach

This book introduces the reader to digital electronics through a historical discussion, and examination of logic families, number systems, binary codes, Boolean algebra, arithmetic circuits, and sequential logic. Logic simplification, registers, counters, D/A and A/D converters, I/O devices, and memories are explored. Revisions of the book include new chapters on Karnaugh mapping and computer organization, discussions of TTL, ECL, and CMOS logic, material on discrete, dot- and bar-matrix displays, and standard SSI, MSI and LSI circuits. An understanding of semiconductors and electronics is advised. Summaries, glossaries, review questions and problems appear at the end of each chapter.

Published by McGraw-Hill Book Co., 1221 Ave. of the Americas, New York, NY 10020. 436 pages. $13.95 hard cover.

Operation Assist

If you need information on outdated or rare equipment—a schematic, parts list, etc.—another reader might be able to assist. Simply send a postcard to Operation Assist, POPULAR ELECTRONICS, 1 Park Ave., New York, NY 10016. For those who can help readers, please respond directly to them. They'll appreciate it. (Only those items regarding equipment not available from normal sources are published.)

Paco Model S-50 push-pull oscilloscope. Schematic and/or service calibration data. David N. Tenney, Apt. C, 1528 Lee St., Charleston, WV 25311.

RCA Model 1-MBT-6, S/N RVU-006521 "Strato World" radio. **Chrysler** Model S/N MB 174 auto radio. Schematics needed. Jose Varas, 515 4th St., Union City, NJ 07087.

Heathkit Model OM-3 oscilloscope. Operating and assembly manuals needed. M. Chadwick, 1465 Stuckert Rd., Warrington, PA 18976.

Heathkit Model FMO-1 FM oscillator. Manual needed. C.E. Garrison, Meadowvale Rt 3, Warrenton, VA 22186.

Heathkit DX100 instruction manual and wiring harness hookup information. A.B. Coleman, 3396 Via Arnez, Lompoc, CA 93436.

Knight-Kit wireless broadcaster amplifier. Schematic and/or parts list. John S. Williams, Rt.1 Box 312 E, Zanesville, OH 43701.

Sylvania Model CTR-175W stereo cassette recorder with AM-FM radio. Schematics and operation manual. Stan Pittman, 110 Michigan #115, Lawrence, KS 66044.

Precise Model 30 oscilloscope. Need operating instructions. Anthony Vilale, 5222 9th Ave., Brooklyn, NY 11220.

Stephens "Truphonic" midrange horn system. Need hookup data and parts source. Frank J. Burris, 35640 Avenue F, Yucaipa, CA 92399.

SCM Marchant Model "Cogito" 240 SR calculator. Logic, schematic and wiring diagrams and operating manual. Dan Entingh, 511½ Colorado Ave., La Junta, CO 81050.

Signal Corp. U.S. Army BC-348-P receiver. Operator's manual needed. Owen Scotland, Box 356, Cayman Islands, B.W.I.

Sierra Model 121A wave analyzer. Schematic and/or service manual. Charles H. Scholten, 1313 Marshall St., Manitowoc, WI 54220.

Precision Apparatus Series 10-54 tube and set tester. Operating instructions, schematic and servicing instructions. Martin A. Weiner, 16 Judith Lane, Monsey, NY 10952.

Superior Model 85 tube tester. Tube chart needed. C.A. Harris, Box 20 C, Glasgow A F B, MT 59231.

Radio Apparatus Model M-51A 30-50-MHz receiver. Schematic and/or service manual. David Roe, 631 N.W. 22, Oklahoma City, OK 73103.

Dumont Type 304A oscilloscope. Technical information or instruction manual. Glen A. Kilts, 8214 McClelland Pl., Alexandria, VA 22309.

Kinsman Duchess Model E electronic organ. Need diagram of generator. W.H. Weiss, 1208 Greenhill Dr., Wausau, WI 54401.

Jackson Electronic Model 641-A FM-AM signal generator. Schematic and alignment information. Bob DeVance, Box 13038, Omaha, NB 68113.

Panoramic Model PCA-2 T200 panadaptor. Operator or service manual. **Servo** Model R5200 receiver. Operator or service manual. John W. Schwerdtfeger, 5361 Westminster, Austin, TX 78723.

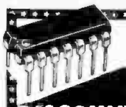
Hallicrafters Model SX-71 shortwave receiver. Operating manual or any available information. Jeff Cherry, 603 S. Cedar, Brea, CA 92621.

Pilot Model R-700 stereo receiver. Tape monitor switch and balance control or schematic. Richard K. Shadduck, 209 Camelford Rd., McMurray, PA 15317.

Hallicrafters Model S-40A receiver. Schematic and manual. John Myers, 138 W. Harrison St., Alliance, OH 44601.

Grundig Model 2220-U AM/FM/SW radio (circa 1955). Schematic needed. Al Cowan, 3101 Lorna Rd., #1824, Birmingham, AL 35216.

(continued on page 120)



DIGI-KEY CORPORATION

Quality Electronic Components

DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

MICROPROCESSORS

Best Values Yet!

8080A	8-BIT CPU, 2 USEC CYCLE	$12.95
8212	8-BIT I/O PORT	$ 3.95
8216	BI-DIRECTIONAL BUS DRIVER	$ 4.25
8224	CLOCK GENERATOR	$ 3.95
8228	SYSTEM CONTROLLER	$ 6.95
8251	COMMUNICATIONS INTERFACE	$12.95
8255	PERIPHERAL INTERFACE	$11.95
1702A	2K EPROM (256x8)	$ 6.95
2708	8K EPROM (1Kx8)	$29.50
2102-1	1K RAM 500 NS	$ 1.79
SC/MP	5 VOLT SC/MP CPU	$ 9.95
2650	MICROPROCESSOR 1.25 MH-2 CLOCK 40 DIL	$24.95

8080A CHIP SET

ONE EACH 8080A, 8212, 8224 and 8228 PLUS SIXTEEN 2102-1's — ALL FOR

$49.95

PRICE BREAKTHROUGH ON 74LS'

74LS00	.28	74LS30	.28	74LS90	.57	74LS157	.75	74LS248	.79
74LS01	.28	74LS32	.33	74LS92	.57	74LS158	.75	74LS249	.79
74LS02	.28	74LS37	.33	74LS93	.57	74LS160	1.02	74LS253	.84
74LS03	.28	74LS38	.33	74LS107	.39	74LS161	1.02	74LS257	.75
74LS04	.29	74LS40	.28	74LS109	.39	74LS162	1.02	74LS258	.75
74LS05	.29	74LS42	.67	74LS112	.39	74LS163	1.02	74LS266	.39
74LS08	.29	74LS47	.79	74LS113	.39	74LS164	1.02	74LS283	.79
74LS09	.29	74LS48	.77	74LS114	.39	74LS168	1.14	74LS290	.65
74LS10	.28	74LS51	.28	74LS125	.49	74LS169	1.14	74LS293	.65
74LS11	.28	74LS54	.28	74LS126	.49	74LS170	1.73	74LS365	.67
74LS12	.28	75LS55	.28	74LS132	.81	74LS173	1.34	74LS366	.67
74LS13	.47	74LS73	.39	74LS136	.39	74LS174	1.06	74LS367	.67
74LS14	1.02	74LS74	.39	74LS138	.73	74LS175	.84	74LS368	.67
74LS15	.28	74LS75	.53	74LS139	.73	74LS190	1.18	74LS386	.39
74LS20	.28	74LS76	.39	74LS151	.75	74LS191	1.18	74LS670	2.34
74LS21	.28	74LS78	.39	74LS153	.75	74LS196	.86	81LS95	.77
74LS22	.28	74LS83	.79	74LS154	1.10	74LS197	.86	81LS96	.77
74LS26	.33	74LS86	.39	74LS155	.75	74LS247	.79	81LS97	.77
74LS27	.33			74LS156	.75			81LS98	.77

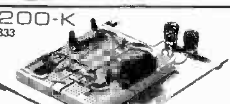
INTEGRATED CIRCUITS
TTL, CMOS, LINEAR

7400	.21	7476	.32	74181	2.15	4012	.23	4520	1.14		
7401	.21	7480	.70	74182	.79	4013	.40	4527	1.68		
7402	.21	7482	.70	74184	2.19	4014	.96	4528	.88		
7403	.21	7483	.70	74185	2.19	4015	.96	4585	1.23		
7404	.21	7485	.89	74188	3.50	4016	.40	2102-1	1.79		
7405	.21	7486	.28	74189	3.50	4017	1.05	8080A	12.95		
7406	.25	7489	2.19	74190	1.23	4018	1.05	CA3046	.75		
7407	.25	7490	.44	74191	1.23	4019	.23	LM2111N	1.25		
7408	.21	7491	.70	74192	.88	4020	1.14	LM309K	1.80		
7409	.21	7492	.44	74193	.88	4021	1.14	LM324A	1.28		
7410	.21	7493	.44	74194	.88	4022	.96	LM340T-5	1.25		
7411	.21	7494	.70	74195	.88	4023	.23	LM340T-6	1.25		
7412	.21	7495	.70	74196	.88	4024	.84	LM340T-8	1.25		
7413	.25	7496	.70	74197	.88	4025	.23	LM340T-12	1.25		
7414	.89	74100	1.28	74198	1.49	4026	1.68	LM340T-15	1.25		
7416	.25	74107	.30	74199	1.49	4027	.40	LM340T-18	1.25		
7417	.25	74109	.33	74251	1.09	4028	.89	LM340T-24	1.25		
7420	.21	74121	.35	74279	.55	4029	1.14	LM3900N	.88		
7421	.25	74122	.44	74365	.67	4030	.23	LM3909N	.69		
7423	.35	74123	.61	74366	.67	4033	1.51	MC1456V	1.00		
7425	.35	74125	.40	74367	.67	4034	3.50	MC1458V	.53		
7426	.25	74126	.40	74368	.67	4035	1.14	MC3302P	1.15		
7427	.33	74132	.70	8093	.40	4040	1.14	NE536T	3.24		
7428	.28	74141	.88	8094	.40	4041	.79	NE540L	2.04		
7430	.21	74145	.70	9095	.67	4042	.79	NE555V	.48		
7432	.25	74147	1.63	8096	.67	4043	.70	NE556A	.88		
7433	.30	74148	1.30	8097	.67	4044	.70	NE560B	3.83		
7437	.25	74150	1.16	8098	.67	4046	1.86	NE561B	3.83		
7438	.25	74151	.70	75150	1.16	4049	.40	NE562B	3.83		
7440	.21	74153	.65	75450	.88	4050	.40	NE565A	1.25		
7442	.53	74154	1.03	75451	.61	4051	1.26	NE566V	1.28		
7443	.63	74155	.70	75452	.61	4052	1.26	NE567V	1.36		
7445	.70	74156	.70	75453	.61	4053	1.26	uA709CV	.44		
7446	.70	74157	.70	75454	.61	4060	1.58	uA710CA	.44		
7447	.70	74160	.88	75491	.81	4066	.79	uA711CA	.53		
7448	.70	74161	.88	75492	.84	4071	.23	uA723CA	.60		
7450	.21	74162	.88	75493	1.09	4072	.23	uA733CA	.75		
7451	.21	74163	.88	75494	1.19	4073	.23	uA741CV	.44		
7453	.21	74164	.96	82S25	2.19	4075	.23	uA747CA	.70		
7454	.21	74165	1.15	4000	.23	4081	.23	uA748CV	.49		
7459	.21	74166	1.26	4001	.23	4082	.23	uA7805CU	1.25		
7460	.21	74170	2.64	4002	.23	4502	.79	uA7806CU	1.25		
7470	.30	74173	1.42	4006	1.23	4510	1.14	uA7808CU	1.25		
7472	.30	74174	.98	4007	.23	4511	1.05	uA7812CU	1.25		
7473	.30	74175	.93	4008	.79	4514	2.80	uA7815CU	1.25		
7474	.30	74176	.79	4009	.44	4515	2.80	uA7818CU	1.25		
7475	.49	74177	.79	4010	.44	4516	1.23	uA7824CU	1.25		
		74180	.70	4011	.23	4518	1.14				

4¼" Length

See Our Catalog For More Diamond Tool

MS54 $6.58



A·C·E 200-K

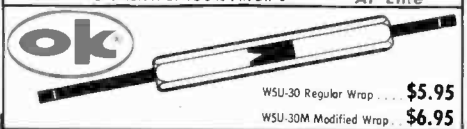
Part No. 923333

$18.95

- Two 5-way binding posts
- Size: 4-9/16" by 5-9/16"
- Kit form — lowest cost

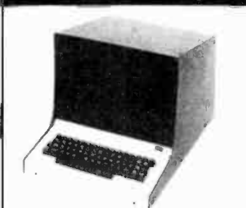
728 SOLDERLESS PLUG-IN TIE POINTS
CAPACITY: *UP TO* 8 16-PIN DIP's

Digi-Key Stocks the Entire AP Line



WSU-30 Regular Wrap	$5.95
WSU-30M Modified Wrap	$6.95

STRIPS — WRAPS — UNWRAPS



TOTALLY ASSEMBLED CRT AT LOWER THAN KIT PRICE

CRT TERMINAL **$895.00**

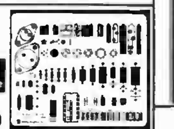
MANUAL ONLY **$2.00**

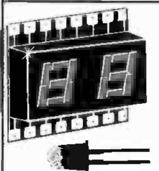
Bishop Graphics 5"x6"

1X Scale PC Design Template

The Digi-Key Catalog features many more quality Bishop Graphics products.

No. 3365 **$12.50**





LED DIGITS and LAMPS

FND357 .375" Single Digit, CC		$1.35
FND500 .5" Single Digit, CC		$1.35
FND507 .5" Single Digit, CA		$1.35
FND800 .8" Single Digit, CC		$2.50
FND807 .8" Single Digit, CA		$2.50
NSN373 .3" Dual Digits, CC		$2.20
NSN374 .3" Dual Digits, CA		$2.20
NSN583 .5" Dual Digits, CC		$2.60
NSN584 .5" Dual Digits, CA		$2.60
NSN783 .7" Dual Digits, CC		$3.00
NSN784 .7" Dual Digits, CA		$3.00
NSL5053 T-1¾ Lamp	$1.80/10	$16.00/100
NSL5056 T-1¾ Lamp	$1.80/10	$16.00/100

SILICON TRANSISTORS

			MPS3640	.16	1.55/10	PN5133	.16	1.55/10
MPS918	.16	1.55/10	MPS3641	.16	1.55/10	PN5134	.16	1.55/10
MPS930	.16	1.55/10	MPS3643	.16	1.55/10	PN5137	.16	1.55/10
MPS2222A	.16	1.55/10	MPS3646	.16	1.55/10	PN5138	.16	1.55/10
MPS2369A	.16	1.55/10	2N3904	.16	1.55/10	PN5139	.16	1.55/10
MPS2712	.16	1.55/10	2N3906	.16	1.55/10	PN5210	.16	1.55/10
MPS2907A	.16	1.55/10	2N4124	.16	1.55/10	DK3055	.68	6.59/10
MPS3392	.16	1.55/10	2N4126	.16	1.55/10	2N3055	.99	9.20/10
MPS3393	.16	1.55/10	2N4401	.16	1.55/10	MJ2955	.99	9.20/10
MPS3394	.16	1.55/10	2N4403	.16	1.55/10	MPF102	.36	3.35/10
MPS3395	.16	1.55/10	2N4410	.16	1.55/10	2N5457	.48	4.50/10
MPS3563	.16	1.55/10	2N5087	.16	1.55/10	MPSA13	.28	2.60/10
MPS3565	.16	1.55/10	2N5089	.16	1.55/10	MJ2955	.99	9.20/10
MPS3638	.16	1.55/10	PN5129	.16	1.55/10	TIP120	.99	9.20/10

SEND FOR OUR FREE CATALOG
WE STOCK A WIDE VARIETY OF PARTS NOT IN THIS AD PLUS MANY SPECIALLY PRICED BARGAINS!

5% CARBON FILM RESISTORS
¼ & ½ WATT SIZE

5 pcs/value **5¢** ea., 100 pcs/value **1.7¢** ea.,
1000 pcs/value **1.2¢** ea.

CLOCK MODULES

The MA1002 and MA1010 series clock modules by National Semiconductor are fully assembled and tested clocks using a 4 digit LED display and an MOS integrated circuit on the same board. Simply connect switches and our special transformer and you have a fully functioning clock.

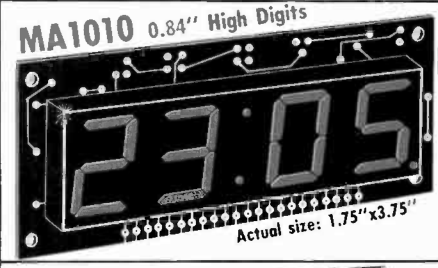
The MA1003 clock module is a fully assembled and tested 12 hour clock using a high brilliance green flourescent display and crystal time base making it perfect for car, boat or other portable use. It operates directly from 12 volts DC so no transformer is needed. Our price includes three push button switches for setting the time.

MA1002A	.5" LED 12 Hour AM-PM Clock Module	$10.50
MA1002A SET	Module with Transformer & Switches	$13.95
MA1002C	.5" LED 24 Hour Clock Module	$10.50
MA1002C SET	Module w/Transformer & Switches	$13.95
MA1003	12 Volt Car Clock with Switches	$24.95
MA1010A	.84" LED 12 Hour AM-PM Clock Module	$13.00
MA1010A SET	Module w/Transformer & Switches	$16.45
MA1010C	.84" LED 24 Hour Clock Module	$13.00
MA1010C SET	Module w/Transformer & Switches	$16.45

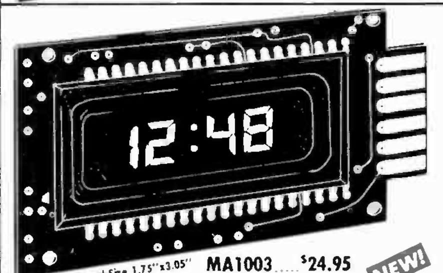
MA1002 0.5'' High Digits

Actual Size: 1.375"x3.05"

MA1010 0.84'' High Digits



Actual size: 1.75"x3.75"



0.3'' Digits Actual Size 1.75"x3.05" **MA1003 $24.95** NEW!

ELECTROLYTIC CAPACITORS

VALUE	RADIAL LEADS		AXIAL LEADS		VALUE	RADIAL LEADS		AXIAL LEADS	
.47/50V	.08	.65/10	.11	.90/10	100/50V	.21	1.17/10	.29	2.30/10
1/50V	.08	.65/10	.11	.90/10	220/10V	.13	1.08/10	.18	1.42/10
2.2/50V	.08	.65/10	.12	.90/10	220/16V	.15	1.16/10	.20	1.55/10
3.3/50V	.08	.65/10	.12	1.00/10	220/25V	.21	1.71/10	.29	2.35/10
4.7/35V	.08	.65/10	.12	.95/10	220/35V	.25	2.03/10	.35	2.79/10
4.7/50V	.08	.68/10	.12	1.00/10	220/50V	.29	2.35/10	.40	3.23/10
10/16V	.08	.65/10	.11	.90/10	330/6V	.14	1.12/10	.19	1.48/10
10/25V	.08	.65/10	.12	1.00/10	330/10V	.15	1.16/10	.21	1.64/10
10/35V	.09	.70/10	.13	1.10/10	330/16V	.22	1.66/10	.31	2.45/10
10/50V	.10	.75/10	.14	1.15/10	330/25V	.23	1.86/10	.38	3.07/10
22/16V	.08	.67/10	.12	1.00/10	330/35V	.33	2.66/10	.43	3.43/10
22/25V	.09	.70/10	.13	1.05/10	330/50V	.54	4.30/10	.60	4.81/10
22/35V	.11	.85/10	.15	1.19/10	470/6V	.15	1.21/10	.20	1.61/10
22/50V	.12	1.00/10	.17	1.32/10	470/10V	.21	1.71/10	.31	2.45/10
33/16V	.09	.75/10	.12	1.00/10	470/16V	.23	1.81/10	.33	2.66/10
33/25V	.10	.81/10	.14	1.15/10	470/25V	.29	2.35/10	.43	3.43/10
33/35V	.13	1.05/10	.17	1.34/10	470/35V	.41	3.27/10	.47	3.78/10
33/50V	.14	1.13/10	.19	1.52/10	470/50V	.54	4.30/10	.75	6.03/10
47/10V	.09	.71/10	.13	1.04/10	1000/6V	.22	1.90/10	.35	2.76/10
47/16V	.10	.81/10	.14	1.15/10	1000/10V	.24	1.96/10	.38	3.07/10
47/25V	.13	1.05/10	.17	1.30/10	1000/16V	.29	2.35/10	.43	3.43/10
47/35V	.14	1.13/10	.19	1.51/10	1000/25V	.42	3.33/10	.68	5.42/10
45/50V	.15	1.21/10	.21	1.71/10	1000/35V	.60	4.81/10	.75	6.03/10
100/10V	.10	.77/10	.14	1.13/10	2200/6V	.36	2.86/10	.43	3.43/10
100/16V	.11	.85/10	.17	1.30/10	2200/10V	.42	3.33/10	.60	4.81/10
100/25V	.13	1.10/10	.20	1.55/10	2200/16V	.54	4.30/10	.68	5.42/10
100/35V	.17	1.41/10	.25	1.93/10					

DATA BOOKS

TTL IC's 595 p.	$4.00
Linear IC's 957 p	$5.00
CMOS 74C 256 p	$3.00
Memory IC's 592 p	$3.00
Interface IC's 464 p	$4.00
Volt. Regs. 128 p.	$3.00
Linear Appl. 1 432 p.	$4.00
Linear Appl. 2 246 p.	$3.00
Audio 196 p	$3.00
MOS/LSI IC's 713 p	$4.00
CMOS 4000 278 p	$3.00
Analog Manual 637 p	$5.95

I.C. SOCKETS

8 Pin Solder	.17	1.60/10
14 Pin Solder	.20	1.90/10
16 Pin Solder	.22	2.10/10
18 Pin Solder	.29	2.75/10
24 Pin Solder	.38	3.60/10
28 Pin Solder	.45	4.25/10
40 Pin Solder	.63	6.00/10
8 Pin W-W	.24	2.30/10
14 Pin W-W	.26	2.50/10
16 Pin W-W	.30	2.85/10
18 Pin W-W	.60	5.70/10
24 Pin W-W	.96	9.10/10
28 Pin W-W	1.12	10.00/10
40 Pin W-W	.92	8.75/10

WIRE WRAPPING WIRE IN BULK

Red or Black 30 ga. Kynar

100' $2.00 500' $8.50 1000' $15.00

MOLEX IC SOCKET PINS

.85/C 8.20/M 38.20/5M 275.00/50M

STRANDED HOOK UP WIRE

20 ga PVC	2.50/100'	10.00/500'
22 ga PVC	2.80/100'	11.25/500'
24 ga PVC	2.10/100'	8.50/500'
26 ga PVC	2.10/100'	8.50/500'

50 VOLT DISCS

100 pf	.40/10	3.50/C
220 pf	.40/10	3.50/C
470 pf	.40/10	3.50/C
.001 uf	.40/10	3.50/C
.0022 uf	.40/10	3.50/C
.0047 uf	.40/10	3.50/C
.01 uf	.45/10	3.65/C
.022 uf	.50/10	4.00/C
.047 uf	.70/10	5.60/C
.1 uf	1.35/10	11.50/C

DOUBLE DIGIT DISCOUNTS SAVE YOU EVEN MORE!

HANDLING CHARGES

$ 0.00-$ 4.99	Add $2.00
$ 5.00-$24.99	Add $0.75
$ 25.00-$49.99	Add $0.50
$ 50.00-$99.99	Add $0.25
$100.00 & Up	No Charge

VOLUME DISCOUNT & HANDLING CHARGE

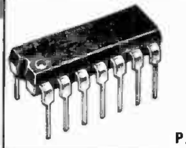
All items, except Bishop Graphics and Economy Terminals may be combined for volume discount. First—total all discountable items and apply the volume discount. Then add to this subtotal the nondiscountable items. Add the handling charge. This is your total cost. We pay all shipping and insurance to addresses in the U.S.A. and Canada.

VOLUME DISCOUNT

$ 0.00-$ 24.99	NET
$ 25.00-$ 99.99	Less 10%
$ 100.00-$499.99	Less 15%
$ 500.00-$999.99	Less 20%
$1000.00 & Up	Less 25%

your BANKAMERICARD welcome

Orders Accepted by Phone or Mail
MasterCharge • Bank-Americard • COD • Check • Money Order
P.O. Box 677, Thief River Falls, Minn. 56701 (218) 681-6674



DIGI-KEY
CORPORATION

Quality Electronic Components

P.O. Box 677 Thief River Falls, MN 56701 (218) 681-6674

PLESSEY SAMPLER

An Assortment of Metalized Polyester Capacitors

300 Caps 18 Values

$26.00

½ WATT ZENER DIODES

1N5226B	3.3v	.15	$11/C
1N5227B	3.6v	.15	$11/C
1N5228B	3.9v	.15	$11/C
1N5229B	4.3v	.15	$11/C
1N5230B	4.7v	.15	$11/C
1N5231B	5.1v	.15	$11/C
1N5232B	5.6v	.15	$11/C
1N5233B	6.0v	.15	$11/C
1N5234B	6.2v	.15	$11/C
1N5235V	6.8v	.15	$11/C
1N5236B	7.5v	.15	$11/C
1N5237B	8.2v	.15	$11/C
1N5238B	8.7v	.15	$11/C
1N5239B	9.1v	.15	$11/C
1N5240B	10v	.15	$11/C
1N5241B	11v	.15	$11/C
1N5242B	12v	.15	$11/C
1N5243B	13v	.15	$11/C
1N5244B	14v	.15	$11/C
1N5245B	15v	.15	$11/C

SILICON DIODES

1N4001	.64/10	5.50/C	$49/M
1N4002	.66/10	5.60/C	$51/M
1N4003	.68/10	5.80/C	$52/M
1N4004	.70/10	5.95/C	$54/M
1N4005	.82/10	7.05/C	$63/M
1N4006	.90/10	7.75/C	$69/M
1N4007	.99/10	8.60/C	$77/M
1N4148	.40/10	3.50/C	$29/M

SLIDE SWITCHES

SPST	.15	1.20/10	10.00/C
SPDT	.19	1.70/10	13.00/C
DPDT	.23	2.00/10	19.00/C

HARDWARE

2-56 1/4 Screw	.99/C	7.20/M
2-56 1/2 Screw	.99/C	7.65/M
4-40 1/4 Screw	.55/C	3.60/M
4-40 1/2 Screw	.60/C	4.05/M
6-32 1/4 Screw	.65/C	4.40/M
6-32 1/2 Screw	.75/C	4.85/M
8-32 3/8 Screw	.90/C	5.85/M
8-32 5/8 Screw	.99/C	7.00/M
2-56 Hex Nut	.55/C	3.60/M
4-40 Hex Nut	.55/C	3.75/M
6-32 Hex Nut	.60/C	4.00/M
8-32 Hex Nut	.60/C	4.15/M
No. 2 Lockwasher	.85/C	5.75/M
No. 4 Lockwasher	.45/C	3.00/M
No. 6 Lockwasher	.45/C	3.00/M
No. 8 Lockwasher	.45/C	3.00/M

MORE THAN 20,000 DIFFERENT COMPONENTS

7400 TTL

7400	.18	7442	1.08	74107	.49
7401	.21	7448	1.15	74121	.55
7402	.21	7450	.26	74122	.49
7404	.21	7451	.27	74123	1.05
7405	.24	7453	.27	74125	.60
7407	.45	7454	.41	74126	.81
7408	.25	7460	.22	74132	3.00
7409	.25	7472	.39	74141	1.15
7410	.20	7473	.45	74150	1.10
7411	.30	7474	.45	74151	1.25
7413	.85	7475	.80	74153	1.35
7416	.43	7482	1.75	74154	1.54
7417	.43	7483	1.15	74157	1.30
7420	.21	7485	1.12	74161	1.45
7422	1.50	7486	.45	74164	1.65
7425	.43	7489	2.49	74165	1.65
7427	.37	7490	.69	74166	1.70
7428	.35	7491	1.20	74174	1.95
7430	.26	7492	.82	74175	1.95
7432	.31	7493	.82	74180	1.05
7437	.47	7494	.91	74181	3.55
7438	.40	7495	.91	74191	1.50
7440	.21	7496	.91	74195	1.00
7441	1.10	74100	1.25	74197	1.00

74L SERIES TTL

74L00	.33	74LS04	.45	74LS113	.98
74L10	.33	74LS10	.39	74LS138	1.89
74L30	.33	74LS20	.39	74LS174	2.50
74L42	1.50	74LS51	.39	74LS386	5.50
74L86	.69	74LS74	.65	74S153	2.25
74LS00	.39	74LS112	.65	74S387	1.95

74H00 TTL

74H00	.33	74H11	.33	74H53	.39
74H01	.33	74H20	.33	74H55	.39
74H04	.33	74H21	.33	74H73	.59
74H05	.35	74H30	.33	74H74	.59
74H10	.33	74H40	.33	74H76	.65

MOTOROLA

MC663P	2.50	MC1460	3.95
MC666P	1.60	MC1469R	2.50
MC670P	1.60	MC1489	4.60
MC679P	2.50	MC1496	1.65
MC725P	1.50	MC1510G	8.00
MC789P	1.50	MC1514L	4.50
MC790P	1.50	MC1595L	6.25
MC817P	1.30	MC1723CL	3.60
MC836P	1.35	MC1741CG	1.20
MC844	1.25	MC1810P	1.25
MC853P	2.25	MC3004L	2.25
MC876P	2.25	MC3007P	2.25
MC1004L	1.25	MC3021L	2.15
MC1010L	1.25	MC3060L	2.65
MC1305	1.95	MC3062L	3.00
MC1352P	1.55	MC4024P	2.20
MC1357	1.70	MC4044P	4.80
MC1371	1.85	MC14507CP	1.25
MC1439	2.65	MC14511CP	2.76
MC1458P	.50	MC14512CP	1.70

C MOS

4001AE	.29	4023AE	.29
4002AE	.29	4024AE	1.50
4007AE	.29	4025AE	.35
4010AE	.58	4028AE	1.60
4011AE	.29	4029AE	2.90
4012AE	.29	4030AE	.65
4015AE	1.25	4037AE	4.50
4016AE	.65	4040AE	2.40
4018AE	1.10	4044AE	1.50
4019AE	.65	4049AE	.75
4020AE	1.75	4050AE	.75
4021AE	1.50		

LINEAR

75450BP	.49	LM301H	.35	LM741CH	.45
75451BP	.39	LM307H	.35	LM747	.90
75452BP	.39	LM309K	1.25	LM748H	.45
75453BP	.39	LM311H	.90	LM1458N	.80
75454BP	.39	LM318N	1.50	N5556V	1.50
75491BP	.79	LM339N	1.85	NE5558	1.00
75492BP	.85	LM351AN	.65	NE555V	.60
CA3005	1.60	LM370N	1.25	NE556	1.50
CA3006	3.50	LM380N	1.45	UA702	.80
CA3018	1.10	LM566	2.25	UA703CH	.45
CA3018A	1.60	LM711CH	.60	UA709CH	.30
CA3026	1.50	LM723H	.75	UA749CH	.45
CA3046	.35	LM741CN	.45		

NEW FROM NEW-TONE

Dry Transfer Patterns for PC Boards, Includes IC pads, donuts, angles, and 3-and 4-connector pads. Over 225 patterns on a 2" x 7¼" sheet **$1.49**

PC BOARDS - MIL GRADE

Glass-epoxy. 2 oz. copper.

6" x 3" $.50 • 6" x 6" $.90 • 6" x 8" $1.20

5400 SERIES

5400	1.00	5475	1.50
5404	1.25	5486	1.90
5410	1.00	5493	2.00
5426	1.25	54100	1.80
5473	1.50	54LS04	1.00

RESISTORS

¼ Watt ±5% Packed 5 of any one value .... $.25
½ Watt ±5% Packed 5 of any one value .... $.30
STANDARD RESISTANCE VALUES

VOLT.REG

LM340K-5	1.95
LM340K-6	1.95
LM340K-8	1.95
LM340K-15	1.95
LM340K-18	1.95
LM340K-24	1.95
LM340T0-5	1.75
LM340T0-6	1.75
LM340T0-8	1.75
LM340T0-12	1.75
LM340T0-15	1.75
LM340T0-18	1.75
LM340T0-24	1.75

MINIMUM ORDER $5.00

All orders add $1.00 Postage and Handling.
Canada $1.50.
N.J. Residents add 5% sales tax

JAPANESE TRANSISTORS

2SA473	.75	2SC373	.70	2SC776	3.00	2SC1306	4.75	2SD180	2.75
2SA484	3.00	2SC374	.70	2SC777	4.00	2SC1307	5.75	2SD187	.80
2SA489	.80	2SC375	.65	2SC778	4.00	2SC1308	4.75	2SD188	.95
2SA495	1.65	2SC380	.70	2SC781	3.00	2SC1317	.60	2SD201	1.95
2SA496	1.15	2SC381	.70	2SC784	.70	2SC1318	.70	2SD213	3.75
2SA497	1.00	2SC382	.70	2SC785	1.00	2SC1327	.70	2SD218	4.75
2SA562	.70	2SC387	.70	2SC788	2.15	2SC1342	.50	2SD223	4.50
2SA564	.50	2SC394	.70	2SC789	1.00	2SC1347	.80	2SD234	1.00
2SA606	4.25	2SC403	.65	2SC790	1.75	2SC1359	.65	2SD235	1.00
2SA628	.65	2SC454	.65	2SC793	2.50	2SC1377	5.50	2SD257	2.00
2SA634	1.25	2SC458	.70	2SC798	3.10	2SC1382	1.00	2SD261	.80
2SA636	1.25	2SC460	.70	2SC799	3.50	2SC1383	.75	2SD287	4.00
2SA643	.85	2SC478	.80	2SC815	.75	2SC1384	.85	2SD288	1.00
2SA673	.85	2SC481	1.85	2SC821	4.00	2SC1447	1.25	2SD291	.85
2SA678	.75	2SC482	1.75	2SC828	.75	2SC1448	1.25	2SD300	2.50
2SA679	3.75	2SC484	3.75	2SC829	.75	2SC1449	1.30	2SD313	1.10
2SA680	3.75	2SC485	3.25	2SC830	1.60	2SC1475	1.50	2SD314	1.10
2SA682	.85	2SC493	2.75	2SC838	.70	2SC1507	1.25	2SD315	.75
2SA683	.90	2SC494	3.50	2SC839	.85	2SC1569	1.25	2SD318	.95
2SA684	.95	2SC495	1.10	2SC853	1.00	2SC1675	1.75	2SD325	1.25
2SA699	1.30	2SC496	1.15	2SC866	5.85	2SC1678	5.50	2SD330	1.50
2SA699A	1.45	2SC497	1.60	2SC871	.70	2SC1679	4.75	2SD331	.90
2SA706	.55	2SC502	1.50	2SC900	.70	2SC1728	2.15	2SD350	3.25
2SA733	.65	2SC509	1.25	2SC922	.55	2SC1730	.60	2SD360	1.50
2SA777	.90	2SC515	.80	2SC929	.70	2SC1756	1.25	2SCF8	3.50
2SB22	.65	2SC517	4.25	2SC930	.65	2SC1760	2.15	2SCF6	1.25
2SB54	.70	2SC535	.75	2SC938	.65	2SC1816	4.50	2SF8	3.00
2SB56	.70	2SC536	.65	2SC945	.65	2SC1908	.70	HEPS3001	3.25
2SB77	.70	2SC537	.70	2SC1000	.65	2SC1909	4.75	JSP7001	.75
2SB175	.55	2SC608	4.90	2SC1013	1.50	2SC1957	1.50	MRF8004	3.00
2SB186	.60	2SC609	4.90	2SC1014	1.50	2SC1964	4.75	MPS8000	1.25
2SB187	.60	2SC614	3.80	2SC1017	1.50	2SC1973	1.50	MPS8001	1.25
2SB324	1.00	2SC619	.70	2SC1018	1.50	2SC1974	4.90	MPSU02	.50
2SB337	1.75	2SC620	.80	2SC1034	3.50	2SC1975	4.90	MPSU31	4.00
2SB367	1.60	2SC627	1.75	2SC1060	.75	2SC2020	2.50	SD1074	19.95
2SB370	.65	2SC634A	.65	2SC1061	1.65	2SC2027	6.00	SD1076	28.95
2SB405	.85	2SC644	.70	2SC1079	3.75	2SC2028	1.10	SK3047	3.75
2SB407	1.65	2SC674	.60	2SC1080	3.75	2SC2029	4.75	SK3048	3.25
2SB415	.85	2SC708	3.00	2SC1096	1.20	2SC2034	3.00	SK3049	4.75
2SB435	.75	2SC710	.70	2SC1098	1.15	2SC2074	3.00	SK3054	1.25
2SB461	1.25	2SC711	.70	2SC1115	2.75	2SC2075	5.50	2SK19	1.75
2SB463	1.65	2SC712	.70	2SC1116	4.00	2SC2091	1.10	2SK30A	1.00
2SB474	1.50	2SC715	.70	2SC1124	1.25	2SC2092	4.75	2SK33	1.20
2SB481	2.10	2SC730	.65	2SC1166	.70	2SC2166	4.75	2SK41	1.75
2SB492	1.25	2SC731	3.00	2SC1170	4.00	2SD45	2.00	3SK22Y	2.75
2SB495	.95	2SC732	.70	2SC1172	4.00	2SD68	.90	3SK40	2.75
2SB507	.90	2SC733	.70	2SC1172B	4.25	2SD72	1.00	3SK45	2.75
2SB511	.70	2SC734	.70	2SC1173	.95	2SD77	1.00	3SK49	2.75
2SC116	3.00	2SC735	.70	2SC1209	.75	2SD81	3.25	4004	3.00
2SC183	1.00	2SC738	.70	2SC1211	.75	2SD88	1.50	4005	3.00
2SC184	1.00	2SC756	3.00	2SC1213	1.00	2SD92	1.50	40080	1.25
2SC281	.65	2SC763	.70	2SC1226A	1.25	2SD118	3.25	40081	1.50
2SC371	.70	2SC774	1.75	2SC1237	4.50	2SD130	1.25	40082	3.00
2SC372	.70	2SC775	2.75	2SC1239	4.00	2SD170	2.00		

IC's ON THE MOVE

BBD BUCKET BRIGADE DEVICE

	MM3001	19.50	MN3002	11.70	MM3003 9.45
HALL IC:	DN834	1.25	DN837	1.50	
	DN835	1.35	DN838 (NEW)		

ZENER DIODES

½ Watt, ± 10% .... $.30 each to 33V
1 Watt, ± 10% .... $.40 each to 33V
Voltages 20 200, and ± 5% available

JAPANESE ICs

AN136	2.90	LA4031P	3.50	TA7055P	5.50	UH1C004	9.00
AN203	3.75	LA4032P	4.50	TA7060P	1.85	UPC16C	2.50
AN208	4.75	LA4051P	4.65	TA7061P	2.25	UPC20C	5.00
AN210	3.10	LA4400FS	3.80	TA7063P	2.25	UPC41C	3.95
AN211	3.30	LA4400FR	3.80	TA7074P	4.90	UPC48C	3.95
AN214	4.90	LD3080	4.00	TA7075P	4.90	UPC554C	3.90
AN217	3.30	LD3120	3.10	TA7076P	4.55	UPC555H	3.00
AN227	5.80	M5112	5.40	TA7089P	2.90	UPC563H2	8.00
AN239	6.50	M5115PR	4.80	TA7120P	2.20	UPC566H	2.25
AN241	3.20	PLL01A	13.50	TA7120P-C	2.20	UPC575C	4.10
AN274	3.95	PLL02A	12.00	TA7122AP	2.30	UPC576	4.10
AN315	3.50	PLL02A-G	12.00	TA7124P	1.85	UPC592H2	3.00
BA511	3.50	SG613	5.40	TA7150P	4.55	UPC595C	3.60
BA521	3.95	STK011	10.50	TA7153P	6.90	UPC596C	3.50
HA1202	3.10	STK015	6.50	TA7201P	6.40	UPC1001H2	5.15
HA1306W	5.20	STK032	14.20	TA7202P	4.50	UPC1008C	6.00
HA1308	4.50	STK050	24.50	TA7203P	7.00	UPC1020H	5.50
HA1312	4.05	STK056	11.35	TA7204P	6.50	UPC1025H	5.50
HA1322	5.20	STK415	8.50	TA7205P	6.50	UPC1156H	6.50
LA1201	4.25	TA7028M	3.50	TC4011P	.55	UPD277C	4.50
LA3301	4.85	TA7045M	3.50	TC5080P	12.00	UPD857C	19.00
LA4000	5.50	TA7051P	3.50	TC5082P	12.00	UPD858C	13.00
LA4030	4.85	TA7054P	3.05	TC9100P	12.00	UPD861C	22.00

ELECTROLYTIC CAPACITORS

2.2MF50	Axial Leads	.15	30MF25	Axial Leads	.18
3.3MF10	Axial Leads	.15	47MF25	Radial Leads	.19
3.3MF10	No Polarity	.15	47MF50	Radial Leads	.24
10MF25	Axial Leads	.15	100MF16	Radial Leads	.19
10MF50	Axial Leads	.16	100MF25	Radial Leads	.24
10MF150	Axial Leads	.20	500MF50	Axial Leads	.60
25MF35	Axial Leads	.18	1000MF35	Axial Leads	.65

MICROPROCESSOR

C1702A	9.95	2708	34.95	8008	19.95
2101	5.75	C5101-3	4.50	8080A	19.95
2102	1.75	MM5013	3.25	8224	10.45

Contact us for all your microprocessor needs.

RECTIFIERS

	10 For	100 For
1N4001	.60	5.00
1N4002	.70	6.00
1N4003	.80	7.00
1N4004	.90	8.00
1N4005	1.00	9.00
1N4006	1.10	10.00
1N4007	1.20	11.00

UNIJUNCTIONS

2N2160	.65	MU4892	.50
2N2646	.45	MU4893	.50
2N2647	.55	MU4894	.50
2N4851	.75	2N6027	.55
2N4852	.75	2N6028	.70
2N4870	.50	D5E37	.35
2N4871	.50	MU10	.35
MU4891	.50	MU20	.40

HARDWARE - SOCKETS

Nylon Screws, Nuts and Rivets - 50 piece assortment		$1.99
MK 20 TO-3 Mounting Kit		5 for $.99
NT-505 Mica and bushing. Specify TO-3, TO-66 or TO-220		10 sets for $.99
IC Socket	14-Pin DIL	$.25 each
IC Socket	16-Pin DIL	$.27 each
Wire Wrap	16-Pin DIL	$.32 each

POPULAR JEDEC TYPES

1N34	.25	2N1540	.90	2N2712	.18	2N3394	.17	2N3856	.20	2N4402	.16
1N60	.25	2N1544	.80	2N2894	.40	2N3414	.17	2N3866	1.25	2N4403	.20
1N270	.25	2N1554	1.25	2N2903	3.30	2N3415	.18	2N3903	.16	2N4409	.20
1N914	.10	2N1560	2.80	2N2904	.25	2N3416	.19	2N3904	.16	2N4410	.16
1N4148	.25	2N1605	1.75	2N2904A	.30	2N3417	.20	2N3905	.16	2N4416	.75
1S1555	.35	2N1613	.50	2N2905	.25	2N3442	1.85	2N3906	.16	2N4441	1.00
		2N1711	.50	2N2905A	.30	2N3553	1.50	2N3954A	3.75	2N4442	1.15
2N173	1.75	2N1907	4.10	2N2906	.25	2N3563	.20	2N3955	2.45	2N4443	1.35
2N338A	1.05	2N2102	.70	2N2906A	.30	2N3565	.20	2N3957	1.25	2N4852	.55
2N404	.75	2N2160	.70	2N2907	.25	2N3638	.20	2N3958	1.20	2N5061	.30
2N443	2.50	2N2218	.25	2N2907A	.30	2N3642	.20	2N4037	.60	2N5064	.50
2N508A	.45	2N2218A	.30	2N2913	.75	2N3643	.20	2N4093	.85	2N5130	.20
2N706	.25	2N2219	.25	2N2914	1.20	2N3645	.20	2N4124	.16	2N5133	.15
2N718	.25	2N2219A	.30	2N3019	1.00	2N3646	.14	2N4126	.16	2N5138	.15
2N718A	.30	2N2221	.25	2N3053	.30	2N3731	3.75	2N4141	.20	2N5294	.50
2N918	.60	2N2221A	.30	2N3054	.70	2N3740	1.00	2N4142	.20	2N5296	.50
2N930	.25	2N2222	.25	2N3055	.75	2N3771	1.75	2N4143	.20	2N5306	.20
2N956	.30	2N2222A	.30	2N3227	1.00	2N3772	1.90	2N4220A	.45	2N5400	.40
2N1302	1.25	2N2270	.40	2N3247	3.40	2N3773	3.00	2N4234	.95	2N5401	.50
2N1305	.75	2N2369	.25	2N3250	.50	2N3819	.40	2N4400	.16	2N5457	.35
2N1420	.20	2N2484	.32	2N3393	.20	2N3823	.70	2N4401	.16	2N5458	.30

ALL PARTS GUARANTEED WRITE FOR FREE CATALOG

nte

NEW-TONE ELECTRONICS

PO BOX 1738A BLOOMFIELD, N.J. 07003
PHONE: (201) 748-6171, 6172, 6173

CIRCLE NO 35 ON FREE INFORMATION CARD

CRYSTALS

THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33/U	$5.95
CY2A	2.000 MHz	HC33/U	$5.95
CY2.01	2.010 MHz	HC33/U	$1.95
CY3A	4.000 MHz	HC18/U	$4.95
CY7A	5.000 MHz	HC18/U	$4.95
CY12A	10.000 MHz	HC18/U	$4.95
CY14A	14.31818 MHz	HC18U	$4.95
CY19A	18.000 MHz	HC18/U	$4.95
CY22A	20.000 MHz	HC18/U	$4.95
CY30B	32.000 MHz	HC18/U	$4.95

XR-2206KB Kit $29.95 **Special** XR-2206KA Kit $19.95

EXAR

WAVEFORM GENERATORS		MISCELLANEOUS		TIMERS	
XR-205	$8.40	XR-2211CP	$6.70	XR-555CP	$ .39
XR-2206CP	4.49	XR-4136	.99	XR-320P	1.55
XR-2207CP	3.85	XR-1468	3.85	XR-556CP	1.85
STEREO DECODERS		XR-1488	5.80	XR-2556CP	3.20
XR-1310CP	$3.20	XR-1489	4.80	XR-2240CP	3.25
XR-1310EP	3.20	XR-2208	5.20	**PHASE LOCKED LOOPS**	
XR-1800P	3.20			XR-210	5.20
XR-2567	2.99			XR-215	6.60
				XR-567CP	1.95
				XR-567CT	1.70

CONNECTORS

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out

Bifurcated Contacts — Fits .054 to .070 P.C. Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100	PINS (Wire Wrap)	$6.95
50/100A (.100 Spacing)	PINS (Wire Wrap)	$6.95

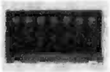
25 PIN-D SUBMINATURE

DB25P	PLUG	$3.25
DB25S	SOCKET	$4.95

HEAT SINKS

205-CB 680-.75A

205-CB	Beryllium Copper w-black finish for TO-5	$ .25
291-.36H	Aluminum for TO-220 Transistors & Regulators	$ .25
680-.75A	Black Anodized Aluminum for TO-3	$1.60
401-A	Black Anodized Aluminum — predrilled mounting holes for TO-3 — 4¾ x 1¼ x 2"	$1.75



DIP SWITCHES SPST Slide Action

#206-4 (8 pin dip)	4 switch unit	$1.75 ea.
#206-7 (14 pin dip)	7 switch unit	$1.95 ea.
#206-8 (16 pin dip)	8 switch unit	$2.25 ea.

Etching Kits (cannot be shipped via air)

32 X A-1	P.C. Etch Materials Kit enough for 5 circuit boards	$29.95 ea.
27 X A-1	Etched Circuit Kit	$ 9.95 ea.
Plugboards	Complete kit — only add water	
3662	6.5 x 4.5 x 1/16 Epoxy glass P-Pattern-44 P.C. Tabs-spaced .156"	$ 6.95 ea.
22/44	Mating connector for plugboard — 22 pin double readout	$ 2.95 ea.
8800V	Universal Microcomputer/Processor plugboard — Epoxy Glass — complete with heatsink and mounting hardware 5.313 X 10 X 1/16 copper clad	$19.95 ea.

Vector

1/16 VECTOR BOARD

	0.1" Hole Spacing Part No.	P-Pattern L	W	Price 1	2-Up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 02XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062	4.50	6.50	2.07	1.86
	84P44 062	4.50	8.50	2.56	2.31
	169P44 062	4.50	17.00	5.04	4.53
	169P84 062	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062C1	4.50	17.00	6.80	6.12

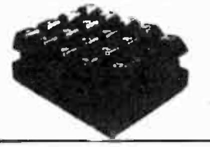
Vector

SLIT-N-WRAP WIRE WRAP TOOL

- Slits and opens insulation exposing bare wire
- No pre-cutting or pre-stripping.
- Comes complete with two - 100 ft spools #28 AWG wire

Model P180 $24.50

HEXADECIMAL ENCODER 19-KEY PAD



- 1 - 0
- ABCDEF
- Return Key
- Optional Key (Period)
- — Key

$10.95 each

63 KEY KEYBOARD $24.95

This keyboard features 63 unencoded SPST keys, unattached to any kind of P.C.B. A very solid molded plastic 13" x 4" base suits most applications.

HD0165 16 LINE TO FOUR BIT PARALLEL KEYBOARD ENCODER CHIP $7.95

TOOLS

A97MS	— Diagonal Cutter - 4" semi-flush cut	$8.50 ea.
A11DMS	— Chain Nose Pliers - 4¾" long	7.50 ea.
T-6	— Wire Stripper - #16 to #26 gauge	3.75 ea.
55B	— Wire Stripper - #10 to #20 gauge	2.50 ea.
CS-8	— Cutter-Crimper Tool - 8¼" long	8.50 ea.
Nibbing Tool	— Cuts, Trims or Notches Metal up to #18 gauge	6.95 ea.
Nibbling Tool Replacement Punch		3.75 ea.

PERMACEL® P-29 PLUS Electrical Tape - All Weather • ¾" wide x 66 ft. • Black vinyl

1-9 Rolls $.79 each 10-up Rolls $6.95/10 roll package

MICROPROCESSOR COMPONENTS

8080A	CPU	$19.95	8228	System Controller - Bus Driver	$10.95
8212	8 Bit Input/Output	4.95	MC6800	8 Bit MPU	22.50
8214	Priority Interrupt Control	15.95	MC6820	Periph. Interface Adapter	15.00
8216	Bi-Directional Bus Driver	6.95	MC6810AP1	128 x 8 Static RAM	6.00
8224	Clock Generator/Driver	10.95	MC6830L8	1024 x 8 Bit RDM	18.00
CDP1802	- with user manual	39.95	Z80	CPU	49.95

CPU'S

8080	Super 8008	24.95
8080A	Super 8008	19.95
2650	8 BIT MPU	26.50

SR'S

2504	1024 Dynamic	$ 3.95
2518	Hex 32 BIT	7.00
2519	Hex 40 BIT	4.00
2524	512 Dynamic	2.49
2525	1024 Dynamic	6.00
2527	Dual 256 BIT	3.95
2529	Dual 512 BIT	4.00
2532	Quad 80 BIT	3.95
2533	1024 Static	Special 5.95
3341	Fifo	6.95
74LS670	16 x 4 Reg	3.95

UART'S

AY-5-1013	30K Baud	$5.95

ROM'S

2513(2140)	Char. Gen. upper case	$ 9.95
2513(3021)	Char. Gen. lower case	9.95
2516	Char. Gen.	10.95

RAM'S

1101	256 x 1	Static	$ 1.49
2101	256 x 4	Static	5.95
2102	1024 x 1	Static	1.75
2107/5280	4096 x 1	Dynamic	4.95
2111	256 x 4	Static	6.95
7489	16 x 4	Static	2.49
8101	256 x 4	Static	6.95
8111	256 x 4	Static	6.95
8599	16 x 4	Static	3.49
91L02	1024 x 1	Static	2.25
74200	256 x 1	Static	6.95
93421	256 x 1	Static	2.95
MM5262	2K x 1	Dynamic	2 for 1.00

PROMS

1702A	2048	Famos	$ 9.95
5203	2048	Famos	14.95
82523	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	5.00
74S287	1024	Static	7.95
3601	256 x 4	Fast	3.95
2708	8K	Eprom	29.95
6301-1	1024	Tri-State Bipolar	3.49
6330-1	256	Open Collector Bipolar	2.95
6331-1	256	Tri-State Bipolar	2.95

SPECIAL REQUESTED ITEMS

FCM3817	$ 5.00					4N33	3.95
						8T20	7.50
AY-3-8500-1	$13.95	AY-5-2376	14.95	9374	1.95	8T97	2.00
MC3061P	3.50	CD4508	6.75	82S115	25.00	3341	6.95
MC4016P (74416)	7.50	CD4515	6.50	5841	9.95	9368	3.95
MC14583	3.50	CD4520	2.70	MK50240	17.50	MC14C8L7	9.95
MC14562	14.50	MCM6571	17.50	11C90	19.95	LD110/LD111	25.00/set
CD4059	9.95	MCM6574	17.50	DS0026CH	3.75	AY-5-8100	17.50 ea.
CD4070	.95	MCM6575	17.50	TIL308	10.50	95H90	11.95
MC14409	14.95	MC14419	14.95	ICM7208	22.00	ICM7209	7.50
MC14410	14.95	ICM7045	24.95	ICM7207	7.50	HD0165	7.95

PARATRONICS

ALLOW 1 TO 3 WEEKS DELIVERY

Featured on February's Front Cover of Popular Electronics

Logic Analyzer Kit

MODEL 100A $229.00/Kit

- Analyzes any type of digital system
- Checks data rates In excess of 8 million words per second
- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
- Displays 16 logic states up to 8 digits wide
- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

Some applications are:

- — Troubleshooting microprocessor address, instruction, and data flow
- — Examine contents of ROMS
- — Tracing operation of control logic
- — Checking counter and shift register operation
- — Monitoring I/O sequences
- — Verifying proper system operations during testing

PARATRONICS TRIGGER EXPANDER - Model 10

Adds 16 additional bits. Provides digital delay and qualification of input clock and 24-bit trigger word. — Connects direct to Model 100A for Integrated unit). **Model 10 — $229.00** Baseplate — $6.95

BUGBOOK®

Continuing Education Series

BUGBOOK I & II	- Basic concepts of TTL Logic — over 90 experiments	$17.00/set
BUGBOOK IIa	- Introduces UART — recommended for RTTY enthusiast	$5.00/book
BUGBOOK III	- Explores 8080 chip — introduces Mark 80 Microcomputer	$15.00/book
555 TIMER APPLICATIONS SOURCEBOOK WITH EXPERIMENTS	— over 100 design techniques	$6.95/book
CMOS-M-DESIGNERS PRIMER AND HANDBOOK	a complete CMOS instruction manual	$6.00
INSTRUCTORS MANUAL	Necessary for instruction on Bugbook I and II.	$3.00

Introductory Offer — all 6 books (worth $49.95) (does not include Instructors Manual) **SPECIAL - $42.95**

CONTINENTAL SPECIALTIES

PROTO BOARD 6 *SPECIAL* **$15.95** (6" long X 4" wide)

Other CS Proto Boards

PB100 - 4.5" x 6"	$ 17.95
PB101 - 5.8" x 4.5"	29.95
PB102 - 7" x 4.5"	39.95
PB103 - 9" x 6"	59.95
PB104 - 9.5" x 8"	79.95
PB203 - 9.75 x 6½ x 2¾	75.00
PB203A - 9.75 x 6½ x 2¾ (includes power supply)	120.00

PROTO CLIPS

14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50

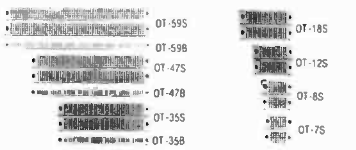
DESIGN MATES

DM1 - Circuit Designer	54.95
DM2 - Function Generator	69.95
DM3 - RC Bridge	59.95

MAX-100 Frequency Counter 20 MHz-100MHz — 8 digit — .6" LED Available September 15, 1977 $134.95

Logic Monitor $84.95 for DTL, HTL, TTL or CMOS Devices

QT PROTO STRIPS



QT type	#holes	price
QT-59S	590	12.50
QT-59B	bus strip	2.50
QT-47S	470	10.00
QT-47B	bus strip	2.25
QT-35S	350	8.50
QT-35B	bus strip	2.00
QT-18S	180	4.75
QT-12S	120	3.75
QT-8S	80	3.25
QT-7S	70	3.00

Experimentor 300	$ 9.95
Experimentor 500	$10.95

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1977A Catalog
Dealer Information Available

NOW OPEN SATURDAYS

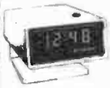
James ELECTRONICS

1021-A HOWARD AVE., SAN CARLOS, CA. 94070
PHONE ORDERS WELCOME — (415) 592-8097
All Advertised Prices Good Thru October

Timeband

A Trademark of Fairchild Camera and Instrument Corporation

Digital Alarm Clocks



- 24-hour alarm
- Doze Button
- 100% Solid State
- Large Red Led Display (.8" high)
- AM/PM indicator
- Seconds display at touch of button
- Power failure indicator
- One year factory warranty

C-500 - Ivory Case
C-500B - Ebony Case
$16.95

C-8211 Woodgrain Case **$19.95**

Timeband™ by FAIRCHILD

LAMP CLOCK

- 24 hour alarm
- Doze button
- Alarm-on indicator
- .8" high Red LED Display
- AM/PM Indicator
- High intensity lamp
- Lamp shuts off when collapsed

Model C-590 (Ivory) $29.95

ERC AM/FM 8-Track Stereo Receiver With BSR Changer

- PLL System
- BSR Record Changer
- Slide Controls
- Automatic AFC Control
- 4 Speaker Output
- Walnut finish vinyl covered wood veneer with smoke dust cover

Size: 20"W x 9⅜"H x 15¼"D

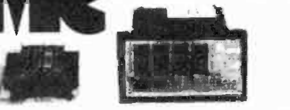
Model 8365 $149.95

DIGITAL STOPWATCH

- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One: Times Single Event — Split & Taylor
- Size 4.5" x 2.15" x .90" (4½ ounces)
- Uses 3 Penlite Cells

Kit —	$39.95
Assembled —	$49.95
Heavy Duty Carry Case	$5.95
Stop Watch Chip Only (7205)	$19.95

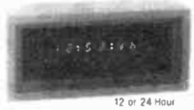
IMC 3½ DIGIT DVM KIT



This 0-2 VDC .05 per cent digital voltmeter features the Motorola 3½ digit DVM chip set. It has a .4" LED display and operates from a single +5V power supply. The unit is provided complete with an injection molded black plastic case complete with Bezel. An optional power supply is available which fits into the same case as the 0-2V DVM allowing 117 VAC operation.

A. 0-2V DVM with Case	$49.95
B. 5V Power Supply	$14.95

JE700 CLOCK



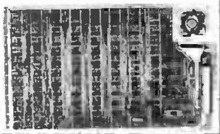
12 or 24 Hour

The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout, and the MM5314 clock chip.

115 VAC *KIT ONLY* **$17.95**

Rejected ATARI GAME BOARDS

Over 60 Reusable IC's, misc. transistors, resistors, diodes, caps, crystals, switch, etc. (8½" x 16"). Limited Quantity.



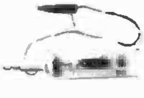
$4.95 ea.

INSTRUMENT/CLOCK CASE

Injection molded unit. Complete with red bezal. 4½" x 4" x 1-9/16".

$3.95 ea.

JE803 PROBE



The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols: (HI) - 1 (LOW) - 0 (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.

$9.95 Per Kit

printed circuit board

T²L 5V 1A Supply

This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only **$9.95 Per Kit**

7400N TTL

SN7400N*	.16	SN7459A	.25		
SN7401N	.16	SN7460N	.22	SN74154N	1.00
SN7402N	.21	SN7470N	.45	SN74155N	.99
SN7403N	.16	SN7472N	.39	SN74156N	.99
SN7404N	.18	SN7473N	.37	SN74157N	.99
SN7405N	.24	SN7474N	.32	SN74160N	1.25
SN7406N	.20	SN7475N	.50	SN74161N	.99
SN7407N	.29	SN7476N	.32	SN74163N	.99
SN7408N	.25	SN7479N	5.00	SN74164N	1.10
SN7409N	.25	SN7480N	.50	SN74165N	1.10
SN7410N	.18	SN7482N	.98	SN74166N	1.25
SN7411N	.30	SN7483N	.70	SN74167N	5.50
SN7412N	.33	SN7485N	.89	SN74170N	2.10
SN7413N	.45	SN7486N	.39	SN74172N	8.95
SN7414N	.70	SN7488N	3.50	SN74173N	1.50
SN7416N	.35	SN7489N	2.49	SN74174N	1.25
SN7417N	.35	SN7490N	.45	SN74175N	.99
SN7420N	.21	SN7491N	.75	SN74176N	.90
SN7421N	.33	SN7492N	.45	SN74177N	.90
SN7422N	.49	SN7493N	.49	SN74180N	.99
SN7423N	.37	SN7494N	.79	SN74181N	2.49
SN7425N	.29	SN7495N	.79	SN74182N	.95
SN7426N	.29	SN7496N	.89	SN74184N	1.95
SN7427N	.37	SN7497N	4.00	SN74185N	2.20
SN7429N	.42	SN74100N	1.00	SN74186N	15.00
SN7430N	.26	SN74107N	.39	SN74187N	6.00
SN7432N	.31	SN74121N	.39	SN74188N	3.95
SN7437N	.27	SN74122N	.39	SN74190N	1.19
SN7438N	.27	SN74123N	.50	SN74191N	1.25
SN7439N	.25	SN74125N	.60	SN74192N	.89
SN7440N	.15	SN74126N	.60	SN74193N	.89
SN7441N	.89	SN74132N	1.09	SN74194N	1.25
SN7442N	.59	SN74136N	.95	SN74195N	.75
SN7443N	.75	SN74141N	1.15	SN74196N	1.25
SN7444N	.75	SN74142N	4.00	SN74197N	.75
SN7445N	.75	SN74143N	4.50	SN74198N	1.75
SN7446N	.81	SN74144N	4.50	SN74199N	1.75
SN7447N	.69	SN74145N	1.15	SN74200N	5.59
SN7448N	.79	SN74147N	2.35	SN74279N	.90
SN7450N	.26	SN74148N	2.00	SN74251N	1.79
SN7451N	.27	SN74150N	1.00	SN74284N	6.00
SN7453N	.27	SN74151N	.79	SN74285N	6.00
SN7454N	.20	SN74153N	.89	SN74367N	.75

20% Discount for 100 Combined 7400's

CMOS

CD4000	.25	CD4040	2.45	74C00N	.39
CD4001	.25	CD4042	1.90	74C02N	.55
CD4002	.25	CD4044	1.50	74C04N	.75
CD4006	2.50	CD4046	2.51	74C10N	.65
CD4007	.25	CD4047	2.75	74C20N	.65
CD4009	.59	CD4049	.79	74C30N	.65
CD4010	.59	CD4050	.79	74C42N	2.15
CD4011	.25	CD4051	2.95	74C73N	1.50
CD4012	.25	CD4053	2.95	74C74	1.15
CD4013	.47	CD4059	9.95	74C90N	3.00
CD4016	.56	CD4060	3.25	74C95N	2.00
CD4017	1.35	CD4066	1.75	74C107N	1.25
CD4019	.55	CD4069	.45	74C151	2.90
CD4020	1.49	CD4070	.95	74C154	4.00
CD4022	1.25	CD4071	.45	74C157	2.15
CD4023	.25	CD4081	.45	74C160	3.25
CD4024	1.50	CD4508	6.75	74C161	3.25
CD4025	.25	CD4511	2.50	74C163	3.00
CD4026	$3.95	CD4515	6.50	74C164	3.25
CD4027	.69	CD4518	2.50	74C173	2.60
CD4028	1.65	CD4520	2.70	74C193	2.75
CD4029	2.90	MC14566	3.00	74C195	2.75
CD4030	.65			MC4044	4.50
CD4035	1.85			MC14016	.56

LINEAR

LM300H	.80	78MG	1.75	LM1458C	.65
LM301H	.35	LM370N	1.15	LM1496N	.95
LM301CN	.35	LM373N	3.25	LM1556V	1.85
LM302H	.75	LM377N	4.00	LM1812N	6.95
LM304H	1.00	LM380N	1.39	LM2111N	1.95
LM305H	.95	LM380CN	1.05	LM2901N	2.95
LM307CN	.35	LM381N	1.79	LM3053	1.50
LM308H	1.00	LM382N	1.79	LM3065N	.69
LM308CN	1.00	NE501K	8.00	LM3900N	.55
LM309H	1.10	NE510A	6.00	LM3905N	1.75
LM309K	.99	NE531H	3.00	LM3909	1.25
LM310CN	2.95	NE536T	6.00	LM5556N	1.85
LM311H	.90	NE540L	6.00	MC5558V	1.00
LM311N	.90	NE550N	.79	LM7525N	.90
LM317K	6.50	NE555V	.39	LM7535N	1.25
LM318CN	1.50	NE560B	5.00	8038B	4.95
LM319N	1.30	NE561B	5.00	LM75450	.49
LM320K-5	1.35	NE562B	5.00	75451CN	.39
LM320K-5.2	1.35	NE565H	1.25	75452CN	.39
LM320K-12	1.35	NE565N	1.75	75453CN	.39
LM320K-15	1.35	NE566CN	1.25	75454CN	.39
LM320T-5	1.75	NE567H	1.95	75491CN	.79
LM320T-5.2	1.75	NE567V	1.50	75492CN	.89
LM320T-8	1.75	LM703CN	.45	75494CN	.89
LM320T-12	1.75	LM709H	.29	RCA LINEAR	
LM320T-15	1.75	LM709N	.29	CA3013	2.15
LM320T-18	1.75	LM710N	.79	CA3023	2.56
LM320T-24	1.75	LM711N	.39	CA3035	2.48
LM323K-5	9.95	LM723H	.55	CA3039	1.35
LM324N	1.80	LM723N	.55	CA3046	1.30
LM339N	1.70	LM733N	1.00	CA3053	1.50
LM340K-5	1.95	LM739N	1.00	CA3059	3.25
LM340K-6	1.95	LM741CH	.35	CA3060	3.25
LM340K-8	1.95	LM741CN	.35	CA3080	.85
LM340K-12	1.95	LM741-14N	.39	CA3081	2.00
LM340K-15	1.95	LM747H	.79	CA3082	2.00
LM340K-18	1.95	LM747N	.79	CA3083	1.60
LM340K-24	1.95	LM748H	.39	CA3086	.85
LM340T-5	1.75	LM748N	.39	CA3089	3.75
LM340T-6	1.75	LM1303N	.90	CA3091	10.20
LM340T-8	1.75	LM1304N	1.19	CA3053	1.50
LM340T-12	1.75	LM1305N	1.40	CA3102	2.95
LM340T-15	1.75	LM1307N	.85	CA3123	2.15
LM340T-18	1.75	LM1310N	2.95	CA3130	1.39
LM340T-24	1.75	LM1351N	1.65	CA3140	1.25
LM350N	1.00	LM1414N	1.75	CA3600	1.75
LM351CN	.65			RC4194	5.95
				RC4195	3.25

74LS00 TTL

74LS00	.29			74LS139	1.95
74LS02	.29	74LS74	.49	74LS151	1.55
74LS03	.29	74LS75	.69	74LS153	1.89
74LS04	.35	74LS76	.49	74LS157	1.55
74LS05	.35	74LS83	1.75	74LS162	2.25
74LS08	.29	74LS85	2.49	74LS163	2.25
74LS10	.29	74LS86	.49	74LS164	1.95
74LS13	.69	74LS90	1.25	74LS175	1.95
74LS14	1.75	74LS92	1.25	74LS181	3.69
74LS20	.29	74LS93	1.25	74LS190	2.85
74LS26	.39	74LS95	1.95	74LS191	2.85
74LS27	.39	74LS96	1.89	74LS192	2.85
74LS28	.39	74LS107	.59	74LS193	2.85
74LS30	.29	74LS109	.59	74LS194	1.89
74LS32	.39	74LS112	.59	74LS195	1.89
74LS40	.39	74LS132	1.25	74LS257	1.75
74LS51	.29	74LS136	.59	74LS260	.55
74LS55	.29	74LS138	1.89	74LS279	.79
74LS73	.49			74LS670	3.95

CLOCK CHIPS

MM5309	6 Digit, BCD Outputs, Reset PIN	$9.95
MM5311	6 Digit, BCD Outputs, 12 or 24 Hour	4.95
MM5312	4 Digit, BCD Outputs, 1 PPS Output	4.95
MM5314	6 Digit, 12 or 24 Hour, 50 or 60 Hz	4.95
MM5316	4 Digit, Alarm, 1 PPS Output	6.95
MM5318	Video Clock Chip, For Use With (MM5841 - $9.95)	9.95
CT7001	6 Digit, Calendar, Alarm, 12 or 24 Hour	5.95

Timeband by FAIRCHILD — Watches —

T249 White w/bracelet $19.95
T248 Yellow w/bracelet $22.95
LED

Ladies LCD

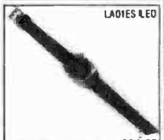
TC625 White w/strap $29.95
TC624 Yellow w/strap $34.95
LCD

Men's & Ladies

- Solid State
- Displays hour, minute, second, month & day
- Free set of replacement batteries
- Choose LED or LCD styles
- One year factory warranty

T237 White w/bracelet $22.95
T238 Yellow w/bracelet $25.95
LED

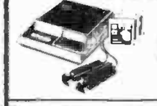
TC437 White w/bracelet $29.95
TC438 Yellow w/bracelet $34.95
LCD



LADIES LED

T325 White w/strap $24.95
T324 Yellow w/strap $27.95

CHANNEL F™ FAIRCHILD VIDEO ENTERTAINMENT SYSTEM



$159.95

- Freeze Action • Speed Option
- Automatic time and scorekeeping
- Battery-free AC operation
- Dual controls with 8-way action
- Built-in Pro Hockey and Tennis games
- Easy hook-up on any B/W or Color TV
- Factory warranty

Channel F — additional cartridges — $17.95 ea.

0811 — Tic-Tac-Toe/Shooting Gallery Quadra-doodle/Doodle/
0812 — Desert Fox/Shooting Gallery
0813 — Blackjack (1 or 2 players)
0814 — Spitfire (1 or 2 players)
0815 — Spacewar (2 players)
0818 — Magic Numbers (computer logic)
0819 — Drag strip (1 or 2 players)
0820 — Maze (2 players)
0822 — Baseball (2 players)

DISCRETE LEDS

.125" dia.			.190" dia.		
XC209	Red	10/$1	XC111	Red	10/$1
XC209	Green	4/$1	XC111	Green	4/$1
XC209	Orange	4/$1	XC111	Yellow	4/$1
XC209	Yellow	4/$1	XC111	Orange	4/$1

.200" dia			.185" dia.			.200" dia.		
XC22	Red	10/$1	XC526	Red	5/$1	XC556	Red	5/$1
XC22	Green	4/$1	XC526	Green	4/$1	XC556	Green	4/$1
XC22	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Yellow	4/$1
XC22	Orange	4/$1	XC526	Orange	4/$1	XC556	Orange	4/$1
SSL-22	RT	4/$1	XC526	Clear	4/$1	XC556	Clear	7/$1

.085" dia. MV50 - Red - 6/$1

INFRA-RED LED ¼ x ¼ x 1/16 Flat 5/$1.00

DISPLAY LEDS

DL707 DL33B

TYPE	POLARITY	HT		TYPE	POLARITY	HT	
MAN 1	Common Anode	270	2.95	MAN 3640	Common Cathode-orange	300	1.75
MAN 2	5 x 7 Dot Matrix	300	4.95	MAN 4710	Common Anode-Red	400	1.95
MAN 3	Common Cathode	125	3/1.00	DL701	Common Anode-red ±	300	.99
MAN 4	Common Cathode	187	1.95	DL704	Common Cathode	300	.99
MAN 7	Common Anode	300	1.25	DL707	Common Anode	300	.99
MAN 7G	Common Anode-green	300	1.55	MAN 4740	Common Anode-Red	400	.99
MAN TY	Common Anode-yellow	300	1.95	DL741	Common Anode	600	1.50
MAN 52	Common Anode-green	300	.99	DL 747	Common Anode	600	2.25
MAN 64	Common Anode-red	400	.99	DL 750	Common Cathode	600	2.49
MAN 74	Common Cathode	300	1.50	DL 338	Common Cathode	110	.50
MAN 82	Common Anode-yellow	300	.99	FND70	Common Cathode	250	.75
MAN 84	Common Cathode-yellow	300	.99	FND503	Common Cathode	500	1.00
MAN 3620	Common Anode -orange	300	1.75	FND507	Common Anode	500	1.00

FCS 8000A — 3½ Digit — .8" Display

NEW! 25 Pin Version with colon & am/pm indicator

FRONT VIEW - FSC8000

SPECIAL $4.95 EA.

- MAXIMUM FORWARD CURRENT — 25 mA.
- Connects almost one for one with 3817, 3817A or D. (3817 available at $5.00 each).
- Typical segment current 8mA except colon, 10 hrs. b & c and 10 min. a & d which are 16 mA.
- Forward voltage drop 1.5 volts

HP 5082-7300 Series — Multi-Digit

- ⅛" ht. • Common Cathode Red
- 3-5 volts @ 5 mils/second
- 7 segment Monolithic
- Dip Package

		10 or more
2 Digit	$ .79	.69
3 Digit	.89	.79
4 Digit	.99	.89
5 Digit	1.19	.99

TV GAME CHIP SET — $14.95

Includes AY-3-8500-1 Chip and 2.010 mhz crystal (2.010 crystal — $1.95 ea/AY-3-8500-1 chip — $13.95 ea.)

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	.16	.15	24 pin	$.38	.37	.36
14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin	$.27	.25	.24	28 pin	$ .99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.59	1.45	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
10 pin	$.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM 27 OHM	12 OHM 33 OHM	15 OHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM	1/4 WATT 5% = 50 PCS.
ASST. 2	5 ea.	68 OHM 180 OHM	82 OHM 220 OHM	100 OHM 270 OHM	120 OHM 330 OHM	150 OHM 390 OHM	1/4 WATT 5% = 50 PCS.
ASST. 3	5 ea.	470 OHM 1.2K	560 OHM 1.5K	680 OHM 1.8K	820 OHM 2.2K	1K 2.7K	1/4 WATT 5% = 50 PCS.
ASST. 4	5 ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	1/4 WATT 5% = 50 PCS.
ASST. 5	5 ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	1/4 WATT 5% = 50 PCS.
ASST. 6	5 ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	1/4 WATT 5% = 50 PCS.
ASST. 7	5 ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	1/4 WATT 5% = 50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$10.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1977A Catalog
Dealer Information Available

NOW OPEN SATURDAYS

James ELECTRONICS

1021-A HOWARD AVE., SAN CARLOS, CA. 94070
PHONE ORDERS WELCOME — (415) 592-8097
All Advertised Prices Good Thru October

WIRE WRAP CENTER

HOBBY-WRAP TOOL-BW-630

$34.95 (batteries not included)

- Battery Operated (Size C)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)
- Complete with built-in bit and sleeve

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$11.95

WIRE WRAP TOOL WSU-30

WRAP • STRIP • UNWRAP - $5.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.45 ea.**
- Cuts wire to desired length
- Strips 1" of Insulation **Specify** — Blue-Yellow-White-Red

B&K PRECISION New 3½-Digit Portable DMM

- Overload Protected • .3" high LED Display
- Battery or AC operation • Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution • Overange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage: ±0-1000V/AC Voltage: 0-1000V
Freq. Response: 50-400 HZ/DC-AC Current: 0-1000mA
Resistance: 0-10 meg ohm
Size: 6.4" x 4.4" x 2"

Comes with test leads, operating manual and spare fuse.

Model 2800	$99.95
AC Adapter BC-28	8.00
Rechangeable Batteries BP-28	20.00
Carrying Case LC-28	6.00

DATA HANDBOOKS

7400	Pin-out & Description of 5400/7400 ICS	$2.95
CMOS	Pin-out & Description of 4000 Series ICS	$2.95
Linear	Pin-out & Functional Description	$2.95

ALL THREE HANDBOOKS $6.95

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400mm	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N456	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
1N485A	180	10m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.50
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 200V	SCR	1.95
2N2328	1.6A @ 200V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPSA05	5/$1.00	PN3567	3/$1.00	PN4249	4/$1.00
MPSA06	5/$1.00	PN3568	4/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN3569	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	2N3704	5/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	2N3705	5/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3706	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3707	5/$1.00	2N4409	5/$1.00
2N2484	4/$1.00	2N3711	5/$1.00	2N5086	4/$1.00
2N2906A	4/$1.00	2N3724	$ .65	2N5087	4/$1.00
2N2907A	5/$1.00	2N3725	$1.00	2N5088	4/$1.00
2N2925	5/$1.00	2N3903	5/$1.00	2N5089	4/$1.00
2N3053	2/$1.00	2N3904	4/$1.00	2N5129	5/$1.00
2N3055	$ .89	2N3905	4/$1.00	2N5138	5/$1.00
MJE3055	$1.00	2N3906	4/$1.00	2N5139	5/$1.00
MJE2955	$1.25	2N4013	3/$1.00	2N5209	5/$1.00
2N3392	5/$1.00	2N4014	3/$1.00	2N5951	5/$1.00
2N3398	5/$1.00	2N4123	10/$1.00	C106B1SCR	2/$1.00
				2N5432	$2.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

CIRCLE NO. 27 ON FREE INFORMATION CARD

HOT NEWS!

FEATURING THE BARGAINS OF THE MONTH!!!!

POLY PAKS® IS THE WORLD'S LARGEST ELECTRONIC DISCOUNT **SUPERMARKET**

OCT. 77 - POP. ELECTRONICS SPECIALS

RCA High quality "POCKET" VOM

- 1000 ohms per volt

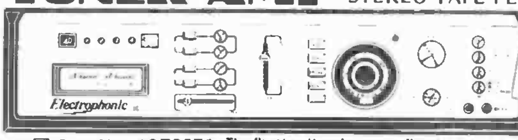
Model WV-539A. Features 1% precision, movements diode protected against burnout. Measures DC volts 0-15-150-1000; AC volts 0-15-150-1000; DC current 0-150ma; resistance X1000. Sensitivity 1000 ohms/volt AC-DC. Uses penlite cell, not included. Size 2⅝ x 3½ x 1¾". Wt. 5 ozs. Cat. No. 10E3921

$8.88 ☐

QUAD AM-FM-MPX TUNER AMP

BUILT-IN QUAD STEREO TAPE PLAYER

Save $10 Now



For 2 and 4 spkrs.

☐ Cat. No. 10E3971

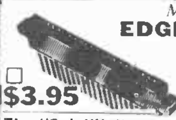
This Month Only... **69.95**

Reg. $79.95 at Poly Paks!

- 5 watts per channel x 4 RMS, 20W total.
- Psychedelic panel lighting effect.
- Brushed aluminum Streamlined styling.

The finest unit we've ever offered. The "SYMPHONY" plays quad 8-track tapes in full dimension quad. Also features Matrix-Quad, derives quad sound from stereo records, tapes and FM.36" phono input cables and has outputs for 4 speakers, jacks for "Quad tape-output", and terminals for external FM antenna. Fits easily into wall, console, or cabinet of your own design. FM stereo indicator. Pushbutton switches select stereo, matrix, 4D discrete, power On/Off. Bass and treble slide control. Additional multifunction switch selects AM, FM, FM-MPX, phono, tape; blue panel lights indicate these functions. Master slide volume control with individual balance controls for each channel. Output jacks for quad headphones. Tape deck panel light indicates when a quad tape is inserted. Other lamps indicate the track being played. 115 VAC. Size: 22 x 5 x 6" deep. Wt. 9 lbs.

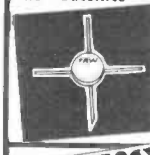
MOTHERBOARD EDGE CONNECTOR



106 pins (53 each side). Use with IMSAI & ALTAIR! 0.125" pin ctrs, goldplated ⅝" wire wrap leads. Open ends, fit wide PC boards. 8 ozs. Cat. No. 10E3987

☐ $3.95

The "Satellite" TRW 900 MHz UHF POWER TRANSISTOR



2 for $9. NPN! CB'ers, Hams take note! Replaces many transmitter driver and output transistors. TO-131 case, ¾" dia. with ½" leads. Two emitter leads. Bvceo 25V, Hfe (beta) 30-60, Ic max 1.25 amps.

☐ No. 10E3942 $4.95

☐ $5.50 TV GAME & HI-FI JOY STICK

- Includes four 100K pots

For TV & computer games, and quadrophonic balancing! 1½ x 1½ x 1". With 1" handle. Wt. 6 ozs. Cat. No. 10E3808

NOISE-CANCELLING CB-HAM MIKE

Cuts noise of machinery, highway for clear transmission!

- Fits virtually all rigs, everywhere!

Lo-impedance, freq. resp: 300-5000 Hz. With 6' coiled cord. Includes instructions for 100's of CBs. Wt. 20 ozs. No. 10E3902

☐ $6.66

EECO 10-POSITION BCD THUMBWHEEL SWITCH

1-2-4-8 BCD encoding; Positions labeled 0-7, F, L (F coded for 8, L coded for 9). White numerals on a black background. Eeco 800 series. 1¼ x 1¼ x ½". Cat. No. 10E3846

3 for $4. ☐ $1.49

GE NI-CAD POWER PAKS

AA penlite cells, ganged in series! 1.25V each cell. Rechargeable! Wt. 2 oz. per cell.

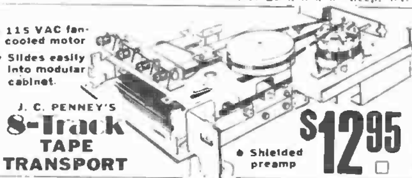
No.	Cells	Volts	Sale
☐ 10E3688	2	2.5	$2.50
☐ 10E3689	3	3.75	3.50
☐ 10E3690	4	5.	4.50

POLY PAKS "RAMS" 2102-1 PRICES

New from top U.S.A. makers. Tested for 500 nsec. speed. Cat. No. 10E3548

8 ☐ FOR $9.95

J. C. PENNEY'S 8-Track TAPE TRANSPORT



- 115 VAC fan-cooled motor
- Slides easily into modular cabinet
- Shielded preamp

$12.95 ☐

Excellent replacement or design your own quality tape system! Automatic or manual track selection with program indicator lights. Player shuts off automatically when tape is removed. Built-in low-distortion preamp and wow free motor. With input & output cables. Requires external power supply. With instructions. Size 9 x 6 x 3½". Wt. 4 lbs. Cat. No. 10E3010

1-AMP REGULATED POWER SUPPLY

- In 5-12-15 volts!

Your choice $8.88 kit ea.

New! Easy to assemble! Uses LM340K positive voltage regulator. Reverse leads for a negative supply. Buy 2 for a ± power supply! With transformer, regulator, PC board & all components. Complete kit, nothing else to buy. Wt. 1 lbs.

	Cat. No.	Volts
2 for $15.95	☐ 10E3854	5
	☐ 10E3857	12
	☐ 10E3858	15

DUAL 6-WATT STEREO AMP

$4.95

LM-379 . . . for AM-FM's, phonos, tape recorders, & more!! 6 watts x 2 RMS into 8 ohms, 5% THD, AVO 90 db type, 75 db channel separation. Supply 10-35 VDC. With specs. Cat. No. 10E3447 ☐ 2 for $9

TTL'S

We know we have the lowest prices!!

BUY 10 15% OFF
BUY 100 25% OFF

Order by Cat. No. 10E1981 & Type No

Type	Sale	Type	Sale	Type	Sale
☐ SN7400	$0.14	☐ SN7460	.20	☐ SN74141	.92
☐ SN7401	.14	☐ SN7462	.14	☐ SN74145	.89
☐ SN7403	.14	☐ SN7464	.14	☐ SN74148	1.25
☐ SN7404	.17	☐ SN7465	.14	☐ SN74153	.63
☐ SN7405	.18	☐ SN7470	.28	☐ SN74154	.99
☐ SN7406	.19	☐ SN7471	.69	☐ SN74155	.78
☐ SN4707	.24	☐ SN7472	.26	☐ SN74156	.68
☐ SN7410	.14	☐ SN7473	.31	☐ SN74157	.64
☐ SN7411	.19	☐ SN7474	.31	☐ SN74160	.89
☐ SN7413	.39	☐ SN7475	.48	☐ SN74161	.87
☐ SN7414	.61	☐ SN7476	.33	☐ SN74163	.87
☐ SN7416	.24	☐ SN7478	.79	☐ SN74164	.95
☐ SN7417	.24	☐ SN7480	.33	☐ SN74165	.95
☐ SN7420	.14	☐ SN7482	.59	☐ SN74166	1.15
☐ SN7423	.26	☐ SN7483	.69	☐ SN74173	1.19
☐ SN7427	.26	☐ SN7485	.88	☐ SN74174	.93
☐ SN7430	.14	☐ SN7486	.29	☐ SN74175	.88
☐ SN7432	.24	☐ SN7488	2.95	☐ SN74177	.77
☐ SN7437	.24	☐ SN7490	.69	☐ SN74179	1.49
☐ SN7438	.24	☐ SN7491	.63	☐ SN74180	.69
☐ SN7440	.14	☐ SN7492	.45	☐ SN74181	1.95
☐ SN7441	.79	☐ SN7493	.45	☐ SN74182	.69
☐ SN7442	.49	☐ SN7494	.69	☐ SN74190	1.15
☐ SN7443	.61	☐ SN7495	.69	☐ SN74191	.99
☐ SN7444	.61	☐ SN7496	.69	☐ SN74192	.83
☐ SN7445	.69	☐ SN7498	.69	☐ SN74193	.83
☐ SN7447	.69	☐ SN74107	.29	☐ SN74194	.83
☐ SN7450	.14	☐ SN74112	.19	☐ SN74195	.75
☐ SN7451	.14	☐ SN74113	.19	☐ SN74197	.75
☐ SN7453	.14	☐ SN74114	.19	☐ SN74199	1.69
☐ SN7454	.14	☐ SN74121	.31	☐ SN74200	5.50
☐ SN7455	.14	☐ SN74123	.49	☐ SN74251	1.39
		☐ SN74125	.39	☐ SN74284	4.25
		☐ SN74126	.39	☐ SN74285	4.25
		☐ SN74132	.83		
		☐ SN74140	1.00		

BARREL KITS

TEST 'EM YOURSELF 'N SAVE!

EXCLUSIVE!!!

GUARANTEED 50% YIELD ON UNTESTED......

Buy 10 BARREL KITS AND CHOOSE THE 11TH KIT Free

BARREL KIT #264 PRE-CUT'N'TINNED HOOKUP WIRE — 200 lengths* $1.98. Breadboarders' note. #22 wire, precut into 4" to 8" lengths. Asst. color plastic jackets. Wt. 12 ozs. *200 ft. approx. No. 10E3959

BARREL KIT #221 IC SOCKETS — 8 for $1.98 hobby. Mfr unloads! Four 14-pin, four 18-pin. Solder tail, lo-profile. No. 10E3621

BARREL KIT #203 CALCULATOR KEYBOARDS — 10 for $1.98. It's true! 20-key, 4 function keyboards at ridiculous give-away. Wt. 12 ozs. Cat. No. 10E3524

BARREL KIT #253 LINE CORDS — 8 for $1.98. 100's of AC power uses! Heavy-duty, 6-ft. long, 18 gage. White vinyl insulation & molded plug. Wt. 8 ozs. Cat. No. 10E3843

BARREL KIT #200 6 DIGIT READOUT MODULES — 5 for $1.98. Barrels and barrels and no time to test. Calculator and driver, chips beneath epoxy on back. Wt. 6 ozs 10E3515

BARREL KIT #244 HOBBY 1702A ROMS — 3 for $1.98. Hobby fallouts of the famous eraseable programmable ROM. 2048 bit. Cat. No. 10E3729

BARREL KIT #239 SHIELDED CABLE — 40-ft. $1.98. For mikes, stereos; 1-cond. plus shield, 22 ga. vinyl jacket. Wt. 1 lb. Cat. No. 10E3577

BARREL KIT #225 SOUND TRIGGERS — 3 for $1.98. "Hand clap" sensitizes crystal mike amplifier, triggers SCR. Use for alarms, etc! Wt. 6 ozs. No. 10E3625

BARREL KIT #205 MINI BLOCK CAPACITORS — 50 for $1.98. Unbelievable! Worth $50. High precision subminiature caps for all applications. Wt. 3 ozs. No. 10E3528

BARREL KIT #201 6V INDICATORS w/leads — 15 for $1.98. Test lamp manufacturer dumps inventory! Worth 69¢ ea. Like grain-o-wheat. Cat. No. 10E3526 hobby

BARREL KIT #194 10 AMP INLINE BRIDGES — 20 for $1.98. Factory dumped in barrels. We can't test 'em, but for the price you can't go wrong. Hobby. Wt. 8 ozs. Cat. No. 10E3475

BARREL KIT #188 400 PARTS — $1.98. Includes resistors, caps, diodes, IC's, for PC work, some on PC boards. Dumped into barrels by factories! 100% material. Wt. 12 ozs. Cat. No. 10E3401

BARREL KIT #184 ½-WATT METAL FILM — 150 for $1.98. 100% metal film resistors. Long leads. 10E3413

BARREL KIT #182 JUMBO RED LEDS — 15 for $1.98. 100% material, user cancellation from factory dumps, 3V 10 mils. For 100's of projects, red lens. Cat. No. 10E3369

BARREL KIT #163 MINI TRIM POTS — 30 for $1.98 1 oz. Asst. values 100 to 1 meg. What a buy. Single turn. ¼ W. Wt. 6 oz. 10E3345

BARREL KIT #161 'POP' PLASTIC TRANSISTORS — 25 for $1.98. Calculator maker dumps 2N3904's with some 2N3906's of 100% material. TO-92. Preformed. Cat. No. 10E3343

BARREL KIT #160 HOBBY VOLTAGE REGULATORS — 10 for $1.98. LM-309K TO-3 barreled, but by the pound, but who wants to check 'em? Your gain. Wt. 20 ozs. No. 10E3330

BARREL KIT #138 PANEL SWITCHES — 30 for $1.98 9 ozs. Did you hear of OAK? Another eqpt maker barrelled all types of rotaries, electric, slides, etc. 10E3268

BARREL KIT #128 MINI-DIP IC'S — 100 for $1.98. 741's, LM380, 703, 567, 555, who knows? Factory mixed, you test. Untested and hobby. Wt. 1 lb. Cat. No. 10E3245

BARREL KIT #127 AXIAL ELECTROS — 40 for $1.98. Asst. capacities and voltages. Cat. No. 10E3227

BARREL KIT #126 UPRIGHT ELECTROS — 40 for $1.98. 1mf to 300mf in mixture of voltages. 100% marked 'n good. 10E3226

BARREL KIT #115 MOLEX SOCKETS — 150 for $1.98 100% good! Cat. No. 10E3144. Calculator maker dump! We got a zillion of 'em.

BARREL KIT #109 TERMINAL STRIPS — 100 for $1.98. Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat. No 10E3136

BARREL KIT #104 SLIDE VOLUME CONTROLS — 10 for $1.98. Cat. No. 10E3057

BARREL KIT #101 RESISTOR SPECIAL — 200 for $1.98. Includes: ⅛, ¼, ½, 1, 2-watters, carbon. 8 oz. 100% good. 10E3054

BARREL KIT #99 PHOTO ELECTRIC CELLS — 10 for $1.98. Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat. No. 10E3052

BARREL KIT #93 HALF WATTERS — 200 for $1.98. Resistor factory tried to fool us by mixing 100% color-coded resistors in barrel. But value is there. 4 oz 10E3046 Untested

BARREL KIT #87 NAT. IC BONANZA — 100 for $1.98. Hobby and untested, factory mixed in barrels. Linears, 7400's, ROMS, DTL'S, registers, clock and calculator chips and more. Wt. 12 ozs. Cat. No. 10E2860

BARREL KIT #86 HOBBY LEDS — 40 for $1.98. WOW! Top U.S.A. maker dumps discretes in barrels. Hobby and untested. Useable yield 50% or better! Wt. 4 ozs. Cat. No 10E2859

BARREL KIT #83 LM-340T VOLTAGE REGULATORS — 15 for $1.98. Factory rejects, hobby, cosmetic rejects. May include 5, 6, 12, 15, 18 or 24 volts. TO-220 power tab. Wt. 4 ozs. Cat. 10E2635

BARREL KIT #71 CAPACITOR SPECIAL — 100 pcs. $1.98. micas, moldeds, plastics, ceramics, discs, etc. Nifty 100% good Cat. No 10E2738

BARREL KIT #68 2 WATTERS — 100 for $1.98 100% good. Suppliers throw 'em in the barrel. It's a li'l gold mine. All marked Cat. No. 10E2735

BARREL KIT #61 POLYSTYRENE CAPS — 100 for $1.98. Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat. No. 10E2729

BARREL KIT #58 SLIDE SWITCHES — 30 for $1.98. All shapes, sizes, spst, spdt, momentaries, etc. Tremendous shop pak for 100's of switching projects. Cat. No. 10E2726 100% good

BARREL KIT #40 HOBBY PNP POWER TRANSISTORS — 15 for $1.98. Popular germanium and silicon TO-3's, factory "off-spec" and fallouts. 100% hobby, no opens, no shorts! Wt. 16 ozs. Cat. 10E2618

BARREL KIT #39 HOBBY NPN POWER TRANSISTORS — 15 for $1.98. Factory fallouts and "off spec" TO-3 powers. 100% hobby, no opens, no shorts. Wt. 1 lb. Cat. No. 10E2617

BARREL KIT #31 METALLIC RESISTORS — 100 for $1.98. Made mostly by Corning, the finest resistor made. Mostly ½ watters, 1% to 5% tol. & a barrel of values. Cat. No. 10E2609

BARREL KIT #30 PREFORMED RESISTORS — 200 for $1.98. We got barrels of ¼ and ½" watters for pc use. 100: ¼, 100 ½" watters. No. 10E2608 100% good

BARREL KIT #27 PREFORMED DISCS — 150 for $1.98. Hi-Fi mfr's shelf inventory but he dumped 'em in barrels. Preformed, for PC use. Mixed values too! 10E2605

BARREL KIT #26 PLASTIC TRANSISTORS — 100 for $1.98. Untested and hobby transistors, TO-92 (TO-18), asst. 2N numbers, asst. manufacturers. Wt. 8 ozs. 10E2604

BARREL KIT #24 HIGH VOLTAGE RECTIFIERS — 200 for $1.98. Up to 12,000 volts, 1 mils, epoxy, axial leads. Cat. No. 10E2602

BARREL KIT #20 LONG LEAD DISCS — 100 for $1.98. "auction sale". Prime, marked only. Long leads. Cat. 10E2598 100% good

BARREL KIT #19 DIPPED MYLARS — 60 for $1.98. Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. Cat. No 10E2597 100% good

BARREL KIT #14 PRECISION RESISTORS — 200 for $1.98. Marked and unmarked ¼, ½, 2 watts. No 10E2428

BARREL KIT #7 VOLUME CONTROL — 30 for $1.98 100% good. Singles, duals, variety of values, styles, big ones — small ones. Cat. 10E2421

BARREL KIT #3 1N4148/914 SWITCHING DIODES — 100 for $1.98. Imagine famous switching diodes at these prices! Cat. No. 10E2418 Untested.

BARREL KIT #1 SN7400 DIP IC'S — 75 for $1.98. Marked 14 and 16 pin dips, may include gates, flip-flops, registers, counters, who knows? Untested, hobby. Wt. 14 ozs. 10E2415

Terms: Add postage Rated: net 30
Phone: Wakefield, Mass. (617) 245-3829
Retail: 16-18 Del Carmine St., Wakefield,

POLY PAKS

P.O. BOX 942E LYNNFIELD, MA. 01940

SALE ☐ Send for FREE Fall-Winter CATALOG

C.O.D.'s MAY BE PHONED

CIRCLE NO 42 ON FREE INFORMATION CARD

MINIMUM ORDER — $6.00

Radio Hut

Money back guarantee. NO COD'S. Texas residents add 5% sales tax. Add 5% of order for postage and handling. Orders under $15.00 add 75 cents. Foreign orders add 10% for postage.

For your convenience, call your BankAmericard or Master Charge orders in on our Toll Free Watts Line: 1-800-527-2304. Texas residents call collect: 1-214-271-8423.

master charge THE INTERBANK CARD

P. O. Box 38323P
Dallas, Texas 75238

your BANKAMERICARD welcome here

Memorex computer boards with IC's, diodes, transistor, etc. 5 Boards containing 100 – 200 IC's

ONLY $ 4.25

BRIDGE RECTIFIERS

6 Amp	50V	1.10
10 Amp	50V	1.25
25 Amp	50V	1.39

RESISTORS

Over 50,000,000 in stock

*330 ohm	22K ohm
470 ohm	27K ohm
**680 ohm	33K ohm
1K ohm	39K ohm
1.2K ohm	43K ohm*
2.2K ohm	47K ohm
3.3K ohm	82K ohm
4.7K ohm	100K ohm
6.8K ohm	150K ohm
10K ohm	220K ohm
20K ohm	

*1/8 W only
**1/2 W only

All resistors are P.C. Lead but are not pull offs.
100 min order for each value

NO MIX 100/.99

MK 5005

4 digit counter/latch decoder; 7 segment output only. 24 pin dip with specs.

$ 8.00 EACH

UNSCRAMBLER KIT

for all Scanners

- Tunes easily
- Full instructions included
- Easy to install
- 3½" x 3½" x 1½"

Only $19.95

PLASMA DISPLAY KIT

Kit Includes: 12 digit display .4" Character Power supply for display above Complete specs for hookup.

Line cord Not Included. **ONLY $ 3.95**

SPECIAL DEVICES

82S23	2.19
2513	10.00
2102-1	.99
1101A	.75
1103A	1.10
8T13	1.50
8T97	1.25
MM5233	1.50
300KC xtal	1.50

REGULATORS

7805	7818
7806	7824
7808	7905
7812	7912
7815	7915

Your Choice $ .95

READOUTS

Best Value!

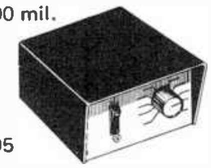
FND70 .4"C.C.	.59
FND800 .8"C.C.	1.69
TI 6 digit array C.C.	3/1.00
MAN 8 .3"CA Yellow	.89
LT767 .7" C.C. 4 digit stick	$ 3.95

WATERGATE SPECIAL

Telephone Relay automatically starts and stops tape recorder. No batteries required. Kit complete with drilled P.C. Board. Parts and Case **ONLY $ 10.95**

VARIABLE POWER SUPPLY KIT NO. 1

*Continously variable from 5V to 20V
*Excellent regulation up to 500 mil.
*4400 Mfd of filtering
*Drilled fiberglass PC Board
*One hour assembly
*Kit includes all components
*Case Included



ONLY $10.95

VARIABLE POWER SUPPLY KIT NO. 2

Same as above but with 1 amp output, also with case.

ONLY $13.95

Ni-Cad Batteries

4 Brand New Size "AA" Ni-Cads **ONLY $4.50**

CLOCK KIT

Kit includes
- LT701 clock module
- Power Supply
- Punched Case
- 12 hour operation only

Complete except for line cord

ONLY $ 14.95

LT701E	12 hour clock
LT701G	24 hour clock

BATTERY CLIPS

Standard 9V battery clip with 4-1/2" tinned leads. 25/$1.00

TRANSISTORS DIODES

*MJE1103	3/1.00
MJ3001	1.30
2N2222	6/1.00
2N2369	6/1.00
2N2905	4/1.00
*2N2907	15/1.00
2N3906	6/1.00
2N4400	6/1.00
2N4443 SCR	3/1.00
1N4004	15/1.00
1N4007	10/1.00
1N4148 (1N914)	20/1.00
3N201 VHF Pre amp	.80
D40C1 Power Darl -	8/1.00
EN930	.20
IN746	.25

*House numbered and P.C. Lead

PC BOARDS

4 digit PCB for FND800 or 807	2.50
6 digit PCB for FND800 or 807	3 50
4 digit PCB for DL707	1.50
6 digit PCB for DL707	2 00
4 digit PCB for FND503 or 510	2.00
6 digit PCB for FND503 or 510	3.00
4 digit PCB for DL747	2.50
6 digit PCB for DL747	3.00
4 digit PCB for DL727 or 728	2 00
6 digit PCB for DL727 or 728	3.00
4 digit PCB for FND359 or 70	1.75

NOTE: All PC Boards are multiplexed for adding additional digits.

SOCKETS

14 pin	.22
16 pin	.25
18 pin	.25
24 pin (ww only)	.95
28 pin	.35
40 pin	.50

L S

74LS00	.26	74LS145	1.00
74LS02	.26	74LS151	.70
74LS03	.26	74LS153	.70
74LS04	.30	74LS155	.69
74LS05	.32	74LS156	.76
74LS08	.26	74LS157	.95
74LS09	.26	74LS158	.85
74LS10	.26	74LS160	.85
74LS11	.35	74LS161	.85
74LS13	.58	74LS162	.85
74LS14	1.05	74LS163	.85
74LS15	.26	74LS168	.85
74LS20	.24	74LS169	.85
74LS21	.35	74LS170	2.00
74LS22	.35	74LS173	1.10
74LS26	.35	74LS174	1.00
74LS27	.35	74LS175	1.00
74LS30	.34	74LS190	.95
74LS32	.35	74LS191	.95
74LS37	.33	74LS192	.95
74LS38	.38	74LS193	.95
74LS40	.34	74LS194	.95
74LS42	.80	74LS195	.95
74LS51	.26	74LS196	.85
74LS54	.26	74LS197	.85
74LS55	.26	74LS251	.85
74LS73	.75	74LS253	.85
74LS74	.49	74LS257	.85
74LS76	.49	74LS258	.85
74LS86	.45	74LS260	.26
74LS90	.85	74LS266	.26
74LS92	1.00	74LS279	.55
74LS93	1.00	74LS290	.75
74LS109	.49	74LS293	.75
74LS112	.49	74LS295	.95
74LS113	.40	74LS298	.95
74LS114	.40	74LS365	.55
74LS125	.55	74LS366	.55
74LS126	.65	74LS367	.55
74LS132	1.00	74LS368	.55
74LS133	.35	74LS390	1.75
74LS136	.39	74LS393	1.45
74LS138	.85	74LS670	3.25
74LS139	.85		

CMOS SALE

CD4000	.16
CD4001	.16
CD4002	.16
CD4007	.16
CD4009	.45
CD4010	.45
CD4011	.16
CD4012	.16
CD4013	.29
CD4014	.75
CD4015	.75
CD4016	.29
CD4017	.80
CD4018	.80
CD4019	.39
CD4020	.85
CD4021	.90
CD4022	.90
CD4024	.70
CD4025	.19
CD4027	.39
CD4028	.75
CD4029	.99
CD4030	.16
CD4034	2.30
CD4035	.99
CD4040	1.00
CD4041	.69
CD4042	.59
CD4043	.60
CD4044	.59
CD4046	.90
CD4047	.59
CD4049	.35
CD4050	.35
CD4051	.90
CD4053	.90
CD4056	1.00
CD4058	.90
CD4060	1.00
CD4066	.69
CD4069	.30
CD4071	.16
CD4076	.99
74C04	.29
74C107	.29
CD4116	.39
CD4507	.40
CD4512	.50
CD4516	.85
CD4518	.85
CD4520	.85

T T L

7400	.17	7473	.21
7401	.17	74H74	.45
7402	.17	7474	.35
7403	.17	7475	.55
74H04	.25	7476	.35
74S04	.30	7480	.45
7404	.17	7483	.76
7406	.25	7485	.89
7408	.17	7486	.35
7409	.17	7490	.71
7410	.17	7491	.71
7411	.25	7492	.71
7413	.45	7493	.67
7420	.17	7494	.90
7421	.17	7495	.71
7423	.35	7496	.85
7425	.27	74100	.96
7426	.25	74121	.31
7427	.17	74123	.61
7430	.25	74125	.44
7432	.30	74141	.71
7437	.35	74145	.97
7438	.35	74151	.71
7440	.17	74153	.81
7442	.60	74154	.97
7443	.60	74161	.91
7444	.65	74163	1.05
7446	.85	74164	1.05
74L47	1.75	74174	.91
7447	.81	74175	1.40
7448	.81	74180	.76
7450	.20	74181	2.25
7451	.17	74191	1.20
7453	.17	74192	1.20
7454	.17	74193	.95
7470	.35	74S195	1.05
7472	.21	74195	.65

LINEARS

LM301	30
LM307	30
LM309K	95
LM311	85
LM377	1 85
LM380 (8 pin)	75
LM3900	30
LM710	25
LM711	25
LM723	40
LM741	25
LM748	25
NE553	1 95
NE555	.40
NE556	95
NE565	95
NE566	95
NE567	1 10
1458	49
RCA3043	75
75491	.30
75492	.30

---

60 Hz ═ L(•)(•)K ═

Crystal Time Base Kit – Kit enables a MOS clock circuit to operate from a DC power source. Ideal for car, camper, van, boat, etc.

60Hz output with an accuracy of .005% (typ.) Low power consumption 2.5 ma (typ.). Small size will fit most any enclosure. Single MOS IC oscillator/divider chip 5-15 volts DC operation.

ONLY $ 5.95

2 for $10.00

ORDER BY PHONE. Charge your order to BankAmericard or Master Charge.

USE OUR TOLL FREE WATTS

1-800-527-2304

NOW! For the Dallas Area Residents.

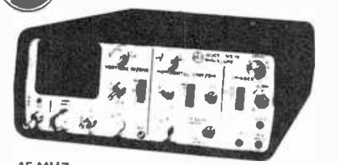
Come Visit Our Retail Store.
3717 Lincoln Court, Garland, Texas

Tues. – Fri.	10 AM to 6 PM
Sat.	10 AM to 3 PM

CLOSED MONDAY

CIRCLE NO 44 ON FREE INFORMATION CARD

NON-LINEAR SYSTEMS, INC.



15 MHZ OSCILLOSCOPE $289.00

Case $30.00
Probe 24.50

MICROPROCESSOR CRYSTALS

FREQ (MHz)	CASE	P/N	PRICE	FREQ (MHz)	CASE	P/N	PRICE
1 00	HC33	CY1A	$8.55	10.00	HC18	CY12A	$4 35
2.00	HC33	CY2A	6.75	14 31818	HC18	CY14A	4 35
3.2768	HC33	CY3B	4 80	15 00	HC18	CY15A	4.35
4.00	HC18	CY3A	4 80	18 00	HC18	CY19A	4.35
4 434	HC18	CY4C	4 80	20.00	HC18	CY22A	7.20
5 00	HC18	CY7A	4.80	23.684	HC18	CY23B	4.36
5 068	HC18	CY5B	4.80	27.00	HC18	CY27A	4 35
5.7143	HC18	CB5C	4.80	32 00	HC18	CY30B	4 35
6 00	HC18	CY6B	4 80				

MICROPROCESSOR & SUPPORT CIRCUITS

P8080A	17 50	AM8238PC	8 20	MH0026CN	5 00
C8080A	19 50	C8251	14 30	MH0026CH	5 50
C1702A	13 40	C8255	13 50	P2101	2 90
C2708	33 50	P2405	9 90	P2101 1	4 20
P8212	4 10	2512K	4 30	P2102	1 70
P8214	8 95	2524V	4 00	P2102 1	3 45
P8216	3 90	2525V	2 40	P2111	3 70
AM8224PC	6 20	2533V	4 90	P2111 1	3 70
P8226	3 90	N8T26B	3 10	P2112	2 90
AM8228PC	8 20	N8T97	1 60	P2112 2	3 70

MOTOROLA'S EDUCATOR II MICROCOMPUTER HEP KIT

- Motorola M6800 Technology
- Test-as you build in easy steps — normally one evening assembly
- Completely self-contained with all parts, cabinet and instructional manual

Get started in the fascinating world of Micro Computers for only $169.95

EDUCATOR II POWER SUPPLY KIT

- 5 V @ 1.0 Amps
- Designed specifically for Educator II Microcomputer Kit
- Complete Kit — all parts, cabinet and construction manual

$29.95

DIP SOCKETS

LOW PROFILE, SOLDER, TIN

	1-24	25-49	50 UP
8 Pin	16	15	14
14 Pin	19	18	17
16 Pin	21	20	19
18 Pin	28	27	26
20 Pin	34	33	32
22 Pin	36	35	34
24 Pin	37	36	35
28 Pin	44	43	42
36 Pin	59	58	57
40 Pin	62	61	60

STANDARD, SOLDER, TIN

8 Pin	25	23	22
14 Pin	27	25	24
16 Pin	30	27	25
18 Pin	35	32	30
22 Pin	70	65	60
24 Pin	49	45	42
28 Pin	99	90	81
36 Pin	1 39	1 26	1 15
40 Pin	1 59	1 45	1 30

STANDARD, SOLDER, GOLD

8 Pin	30	27	24
14 Pin	35	32	29
16 Pin	38	35	32
18 Pin	52	47	43
22 Pin	70	63	57
24 Pin	70	63	57
28 Pin	1 10	1 00	90
36 Pin	1 75	1 40	1 26
40 Pin	1 75	1 59	1 45

WIREWRAP GOLD (Level No. 3)

10 Pin	45	41	37
14 Pin	39	38	37
16 Pin	43	42	41
18 Pin	75	68	62
24 Pin	1 05	95	85
28 Pin	1 40	1 25	1 10
36 Pin	1 59	1 45	1 30
40 Pin	1 75	1 55	1 40

★ E-Z-HOOK ★

E-Z Hooks have been designed and field tested through the industry to save time and money in commercial electronic production and servicing. The spring-loaded hook attaches firmly, yet so gently it will not damage component — frees hands while testing. Durably constructed and fully insulated to a single contact point assuring true readings. Meets exacting laboratory and space age computer technology requirements. AVAILABLE IN 10 RETMA COLORS: Red, black, blue, green, oragne, yellow, white, violet, brown or gray.

MICRO HOOK

XM Micro Hook 11.75" long <1 gram) for difficult IC Testing Permits hookups to delicate wires where weight and leverage may damage component . . . . . $.80 ea.

Specify color. ORDER P/N XM

Jumper with XM Micro Hooks

Order No.	Length	Price
204XM 12"	12"	$1.70
204XM-24"	24"	1.70

Specify color

XM-S MICRO HOOK SET (includes 1 ea. red, black, blue, green, orange, yellow, white, brown, violet and gray Micro Hook). At this low price you can afford more than one set.

COMPLETE SET (10) MICRO HOOKS $7.95

MINI HOOK

X100W Mini Hook (2.25" long) combines rugged construction, miniature size and Finger-eze Hypo Action for all the best test connections. Hook is large enough for component leads, yet small enough to get into tight places . . . . $.75 ea.

Specify color ORDER P/N X100W

Jumper with X-100W Mini Hooks

Order No.	Length	Price
204-12W	12"	$1.60
204-24W	24"	1.60

Specify color.

Jumper X-100W Mini Hook to Stacking Banana Plug

Order No.	Length	Price
201W	32"	$1.35

Specify color.

Jumper with X-100W Mini Hook

Order No. 201XM, Length 32", Price $1.40

EXTRA LONG MINI HOOK

XL 1 Mini Hook (5.0" long) combines all the proven features of the X100W with an extra long body. It will make safe, short-free test connections in card racks and through deep wiring nest up to 4". ORDER P/N XL-1

Specify color. $1 25

JUMPER, XL-1 MINI HOOK TO STACKING BANANA PLUG

Order No. 201XL-1, Length 32"

Specify color. Price $1.95

AUDIO POWER AMPLIFIERS 5.5 WATT AN315

Designed for mobile radios, tape players, etc. Easy to use. High Gain — 53 dB (Closed Circuit). $3.90 ea.

SPECIAL FAIRCHILD LM74"PC 3 for $1.00

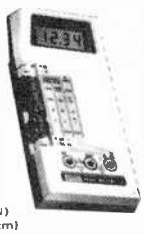
INTERSIL 8038 PRECISION WAVEFORM GENERATOR AND VCO

For simultaneous sine, square and triangular wave-forms <.001 Hz to 1 MHz.

PART NO. 8038CCPD $3.90

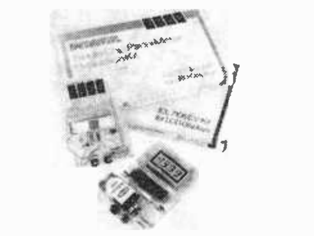
NEW from FLUKE · MODEL 8020A

THE DMM FOR THE PROFESSIONAL



- 200 Hr Battery Life
- 26 Ranges for 7 Functions
- 2000 Count Resolution
- High-Low Power Ohms
- Autozero and Auto-polarity
- MOV-protected to 6000V against hidden transients and overload protection to 300 V AC
- Diode Test Function
- Conductance Function checks leakage resistance to 10,000 meg ohms
- Size: HWL (7.1x3.4x1.8 IN) (18.0x8.6x4.5 cm)
- Weight: 13 oz.

ONLY $169.00



BUILD A WORKING DPM IN 1/2 HOUR WITH THESE COMPLETE EVALUATION KITS.

Test these new parts for yourself with Intersil's low-cost prototyping kits, complete with A/D converter and LCD display (for the 7106) or LED display (for the 7107). Kits provide all materials, including PC board, for a functioning panel meter.

ICL7106EV (LCD) $29.95
ICL7107EV (LED) $24.95

RCA

COSMAC MICROPROCESSOR IC CDP1802CD
4-6 Volt $29.50

CAPACITORS

50V CERAMIC DISC $1.00 Per Package

5pf	9/pkg	300pf	7/pkg	.0047mfd	9/pkg
15pf	9/pkg	330pf	7/pkg	.005mfd	9/pkg
25pf	9/pkg	390pf	7/pkg	.01mfd	9/pkg
27pf	9/pkg	470pf	7/pkg	.015mfd	8/pkg
47pf	8/pkg	560pf	7/pkg	02mfd	8/pkg
68pf	8/pkg	680pf	7/pkg	.022mfd	8/pkg
100pf	8/pkg	.001mfd	9/pkg	.03mfd	8/pkg
150pf	8/pkg	.0015mfd	9/pkg	.039mfd	7/pkg
220pf	8/pkg	.0022mfd	9/pkg	.047mfd	7/pkg
270pf	7/pkg	.003mfd	9/pkg	.1mfd	6/pkg

PLESSEY POLYESTER MINI BOX

MF	V	$	MF	V	$	MF	V	$
001	1000	14	.012	630	14	15	100	.20
0012	1000	14	.015	400	15	18	100	.21
0015	1000	14	018	400	15	22	100	23
.0018	1000	14	022	400	15	27	100	.26
0022	1000	14	027	400	.15	33	100	30
0027	1000	14	033	250	15	39	100	.33
.0033	1000	.14	.039	250	.15	47	100	.36
0039	630	.14	047	250	15	56	100	.44
0047	630	14	056	250	15	.68	100	.47
0056	630	14	.068	250	.15	82	100	54
0068	630	14	082	250	.17	1 0	100	60
.0082	630	14	1	100	17			
01	630	14	12	100	18			

MATSUO DIPPED TANTALUM

MF	V	$	MF	V	$	MF	V	$
1	35	33	2 2	20	33	10 0	35	90
15	35	33	2 2	35	40	15 0	20	45
22	35	33	3 3	35	42	15 0	35	1.32
33	35	33	4 7	35	45	22 0	16	.45
47	35	33	6 8	16	40	33 0	20	1 32
68	35	33	6.8	35	45	47 0	20	1 53
1.0	35	33	10 0	16	42	68 0	16	1 62
1 5	35	40	10 0	25	45			

1% MICA 500V

51 PF	.29	220 PF	.41	1500 PF	.60
62 PF	.29	240 PF	.46	2000 PF	.90
75 PF	.29	300 PF	.50	2200 PF	.94
82 PF	.29	390 PF	.50	4700 PF	1.80
100 PF	.30	470 PF	.50	5100 PF	1.80
120 PF	32	620 PF	.52	10000 PF	3.60
150 PF	.35	820 PF	.53		
180 PF	.41	1000 PF	.60		

ALUMINUM ELECTROLYTIC (RADIAL LEAD)

MF	V	$	MF	V	$	MF	V	$	MF	V	$	MF	V	$
1	10	12	10	16	15	33	25	22	100	35	30	330	50	55
1	16	13	10	25	18	33	35	24	100	50	35	470	10	35
1	25	14	10	35	22	33	50	30	220	10	23	470	16	40
1	35	15	10	50	26	47	10	17	220	16	25	470	25	45
1	50	16	22	10	15	47	16	18	220	25	35	470	35	60
5	10	13	22	16	16	47	25	24	220	35	40	470	50	80
5	16	14	22	25	21	47	35	25	220	50	50	1000	25	65
5	25	17	22	35	23	47	50	32	330	10	30	1000	35	80
5	35	20	22	50	28	100	10	18	330	16	33	1000	50	1 20
5	50	.24	33	10	16	100	16	20	330	25	40	2200	25	1 30
10	10	14	33	16	17	100	25	26	330	35	45	2200	35	1 60
												2200	50	2 50

RESISTOR KITS 5% CARBON FILM RESISTORS

COMPLETE WITH STORAGE BIN

1/4 WATT KIT
42 Different Values (68Ω to 4.7 MΩ)
20 Each Value

1/2 WATT KIT
42 Different Values (68Ω to 4.7 MΩ)
20 Each Value

1/4W — $24.90 PER KIT
1/2W — $25.90 PER KIT

CARBON FILM RESISTORS (5%)

Only in Multiples of 100 pcs per value (ohms)
¼W . . . $1.69 per 100
½W . . . $1.79 per 100

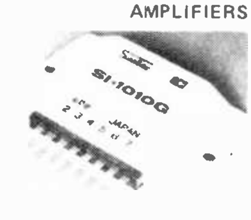
10	100	1.0K	10K	100K	1.0M
11	110	1.1K	11K	110K	1.1M
12	120	1.2K	12K	120K	1.2M
13	130	1.3K	13K	130K	1.3M
15	150	1.5K	15K	150K	1.5M
16	160	1.6K	16K	160K	1.6M
18	180	1.8K	18K	180K	1.8M
20	200	2.0K	20K	200K	2.0M
22	220	2.2K	22K	220K	2.2M
24	240	2.4K	24K	240K	2.4M
27	270	2.7K	27K	270K	2.7M
30	300	3.0K	30K	300K	3.0M
33	330	3.3K	33K	330K	3.3M
36	360	3.6K	36K	360K	3.6M
39	390	3.9K	39K	390K	3.9M
43	430	4.3K	43K	430K	4.3M
47	470	4.7K	47K	470K	4.7M
51	510	5 1K	51K	510K	5.1M
56	560	5.6K	56K	560K	5.6M
62	620	6.2K	62K	620K	6.2M
68	680	6.8K	68K	680K	6.8M
75	750	7 5K	75K	750K	7.5M
82	820	8.2K	82K	820K	8.2M
91	910	9.1K	91K	910K	9.1M

RESISTOR ASSORTMENTS

Each assortment contains 5 pcs each of 10 different values
Values included are shown in (Ohms)
¼W,5% (50 pcs total). . .$1.75 / ½W,5% (50 pcs total). . .$1.85

Asst.1: 10, 12, 15, 18, 22 27, 33, 39, 47, 56 ohm
Asst.2. 68, 82, 100, 120, 150, 180, 220, 270, 330, 390 ohm
Asst.3: 470, 560, 680, 820 ohm, 1K 1 2K, 1 5K, 1 8K, 2 2K,2 7K
Asst.4. 3 3K, 3 9K 4 7K 5 6K 6 8K, 8 2K, 10K 12K, 15K 18K
Asst.5: 22K, 27K, 33K, 39K, 47K, 56K, 68K, 82K, 100K, 120K
Asst.6: 150K, 180K, 220K 270K, 330K 390K 470K 560K,680K 820K
Asst.7: 1M 1 2M,1.5M,1 8M,2 2M,2 7M 3 3M 3 9M 4 7M,5 6M
(½W Assortment No 7 doesn't include 5 6M)
Asst.8R.(All seven assortments above)
¼W 5% 350 pcs total $10.95 ½W 5% 350 pcs total $11.55

SanKen HYBRID AUDIO POWER AMPLIFIERS



SANKEN Series SI-1000G amplifiers are self-contained power hybrid amplifiers designed for Hi-Fi, stereo, musical instruments, public address systems and other audio applications. The amplifiers have quasi-complementary class B output. The circuit employs flip-chip transistors with high reliability and passivated chip power transistors with excellent secondary breakdown strength. Built-in current limiting is provided for SI-1050G and all devices can be operated from a single or split power supply.

SI-1010G (10W output) . . . $ 6.90
SI-1020G (20W output) . . . $13.95
SI-1030G (30W output) . . . $19.00
SI-1050G (50W output) . . . $26.80

Data Sheet Application Notes — $0.50

74L'S

		74LS83N	1 36	74LS181N	4 92
		74LS85N	1 40	74LS190N	1 50
74LS00N	.36	74LS86N	46	74LS191N	1 50
74LS01N	.44	74LS90N	84	74LS192N	1 20
74LS02N	32	74LS92N	.86	74LS193N	1 21
74LS03N	.32	74LS93N	.86	74LS194N	1 32
74LS04N	36	74LS95N	1 00	74LS195N	99
74LS05N	33	74LS96N	1 24	74LS196N	2 76
74LS08N	.36	74LS107N	.46	74LS197N	2 84
74LS09N	.44	74LS109N	46	74LS221N	1 76
74LS10N	32	74LS112N	64	74LS241N	3.00
74LS11N	32	74LS113N	64	74LS251N	1 10
74LS15N	44	74LS114N	92	74LS253N	1 10
74LS20N	.32	74LS123N	1 10	74LS257N	.95
74LS21N	.44	74LS125N	60	74LS258N	1 10
74LS22N	.44	74LS132N	1 44	74LS260N	44
74LS26N	.33	74LS136N	.74	74LS261N	1.90
74LS27N	44	74LS138N	99	74LS266N	.72
74LS28N	33	74LS139N	99	74LS273N	2.66
74LS30N	32	74LS145N	1 64	74LS281N	7 60
74LS32N	36	74LS148N	3 45	74LS283N	2 00
74LS33N	56	74LS151N	88	74LS290N	1 76
74LS37N	50	74LS153N	88	74LS293N	1.76
74LS38N	58	74LS155N	1.50	74LS299N	6 14
74LS40N	44	74LS157N	88	74LS365N	70
74LS42N	92	74LS158N	99	74LS367N	70
74LS51N	44	74LS160N	1 25	74LS374N	3 21
74LS54N	44	74LS161N	1 25	74LS375N	82
74LS55N	44	74LS162N	1 25	74LS378N	1 60
74LS73N	46	74LS163N	1 25	74LS381N	4 56
74LS74N	46	74LS164N	1 50	74LS386N	72
74LS75N	.70	74LS170N	3 20	74LS399N	2 15
74LS76N	56	74LS174N	.80	74LS670N	3 95
74LS78N	92	74LS175N	.80		

NEW ANCRONA DISCOUNT POLICY FOR ALL 7400 SERIES TTL IC'S

BUY 10 PER TYPE . . . 5% DISCOUNT
BUY 25 PER TYPE . . . 10% DISCOUNT
BUY 100 MIXED (10 PER TYPE) 15% DISCOUNT
BUY 1000 MIXED (25 PER TYPE) .20% DISCOUNT

USE LAST MONTH'S AD FOR 7400 SERIES PRICES

No. 101
250 page INFORMATION BOOKLET
Only $4.95

ANCRONA

MAIL ORDER ADDRESS — P.O. Box 2208P, Culver City, CA 90230. Send check or money order, COD, Master Charge and BankAmericard welcomed. Minimum Order: $10.00. Add $1.00 to cover postage and handling. California residents add 6% sales tax.
TELEPHONE ORDERS: Call (213) 641-4064.

ANCRONA STORES DO NOT ACCEPT MAIL OR TELEPHONE ORDERS

CALIFORNIA ANCRONA	CALIFORNIA ANCRONA	ARIZONA ANCRONA	OREGON ANCRONA	GEORGIA ANCRONA	TEXAS ANCRONA	CANADA, B.C. ANCRONA
11080 Jefferson Blvd.	1300 E. Edinger Ave.	4518 E. Broadway	1125 N.E. 82nd Ave.	3330 Piedmont Rd., NE	2649 Richmond	Vancouver, B.C.
Culver City, CA 90230	Santa Ana, CA 92705	Tucson, AZ 85711	Portland, OR 97220	Atlanta, GA 30305	Houston, TX 77098	V5 W2V4
(213) 390-3595	(714) 547-8424	(602) 881-2348	(503) 254-5541	(404) 261-7100	(713) 529-3489	(604) 324-0707

CIRCLE NO. 7 ON FREE INFORMATION CARD

S.D. SALES CO. P.O. BOX 28810 -D DALLAS, TEXAS 75228

★ Imsai - Altair "A" Compatible Kits ★

Dealer inquiries welcome on these items:

Z-80 CPU BOARD

From the same people who brought you the $89.95 4K RAM KIT. We were not the first to introduce an Imsai/Altair compatible Z-80 Card, but we do feel that ours has the best design and quality for the lowest price! The advance features of the Z-80 such as an expanded set of 158 instructions, 8080A software compatibility, and operation from a single 5VDC supply, are all well known. What makes our card different is the extra care we took in the hardware design. The CPU card will always stop on an M1 state. We also generate TRUE SYNC on card, to insure that the rest of our system functions properly. Dynamic memory refresh and NMI are bought out for your use. Believe it or not, not all of our competitors have gone to the extra trouble of doing this. As always this kit includes all parts, all sockets, and complete instructions for ease of assembly. Because of our past experience with our 4K kit we suggest that you order early. All orders will be shipped on a strict first come first served basis. Kit includes Zilog Manual and all parts. Kit shipped with 2 MHZ crystals.

Z–80 Chip & Manual – $49.95; Add $5.00 for Z–80A
Z–80 Manual – $7.50 Separately.

Complete kit - $149.

4K LOW POWER RAM

IMSAI AND ALTAIR 8080 PLUG IN COMPATIBLE. USES LOW POWER STATIC 21L02 – 1 500ns. RAM's. FULLY BUFFERED, DRASTICALLY REDUCED POWER CONSUMPTION, ON BOARD REGULATED, ALL SOCKETS AND PARTS INCLUDED. QUALITY PLATED THROUGH PC BOARD. For 250 ns RAM's add $10.

THE WHOLE WORKS **$89.95 kit**

NEW! DESIGN CONSOLETTE KIT - $89.95

S.D. Sales announces the inexpensive way to beat the wire wrap jungle. Our latest kit gives you 124 solderless quick connect terminals, enough for eight 16 pin IC's and provides 50 x 8 common buss matrix. Has regulated +5VDC and +/– 15VDC, all at 1 AMP. Voltage regulation at 100%. Also includes a pulse generator variable from 10hz to 50mhz and .01 sec. to 100 nano seconds. Generator output is +5V. In kit form only and includes all parts, sockets; front panel measures 7¼"x8¼", and hardware, case not available.

CAR/BOAT KIT **$34.95** *New Item!* *Music to your Ears!*

MUSICAL HORN

Musical Horn kit for car, boat or home. Plays any tune from Mozart to Led Zeppelin. Change tunes in seconds; complete solid state electronics. Standard or custom tunes available at $6.95 each. (You supply the sheet music – we supply electronics for your favorite tune.) One song supplied with original order. Standard tunes available: DIXIE – EYES OF TEXAS – ON WISCONSIN – YANKEE DOODLE DANDY – NOTRE DAME FIGHT SONG – PINK PANTHER – AGGIE WAR SONG – ANCHORS AWAY – NEVER ON SUNDAY – BRIDGE OVER RIVER QUI – CANDY MAN– Standard 2 inch 8 ohm speaker supplied. Power horn available for car/boat kit.

HOME KIT **$26.90**

Kit includes speaker which operates from your door bell. When door bell is pushed your favorite tune is played. Car/boat kit includes speaker which operates from car/boat horn ring. Allow 4 weeks delivery on both kits.

Limited Quantity! **$9.95 kit**

6 DIGIT ALARM CLOCK KIT

We made a fantastic kit even better. Redesigned to take advantage of the latest advances in IC technology. Features: Litronix Dual ½" displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). For P.C. board add $3.00; AC XFMR add $1.50. Do not confuse with Non-Alarm kits sold by our competition! Eliminate the hassle – avoid the 5314!

NEW! WITH JUMBO LED READOUTS!

1000 MFD Filter Caps	SLIDE SWITCH Assortment	POWER RESISTOR	RESISTOR ASSORTMENT	P.C. LEAD DIODES	THERMISTORS	DISC CAP ASSORTMENT
Rated 35 WVDC Upright style with PC leads. Most popular value for hobbyists.	Our best seller. Includes miniature and standard sizes, single and multi-position units. All new.	15 OHM 25W BY CLAROSTAT	¼W 5% & 10% PC leads. A good mix of values! Special!	1N4148/1N914 100/$2. 1N4002 1A 100 PIV	MEPCO – NEW! 1.5K OHM	P.C. Leads. At least 10 different values. Includes .001, .01, .05 plus other standard values.
4/$1.00	12/$1.00	75¢ ea.	200/$2.	40/$1.	5/$1.00	60/$1.00

AMD-1702A

Huge Factory Purchase

FACTORY PRIME UNITS! BRAND NEW!
1.5 Micro-Seconds Access Time.
10/$40. $4.95 ea.

★ Special! ★

3.579545 MHZ Time Base Crystal $1.25	11,000 MFD 50WVDC Computer Grade Cap $3.00 each
28 PIN SOCKETS 3 for $1.00	39 MFD 16 V Mallory Electrolytic 15 for $1.00

FACTORY PRIME! 21L02-1

Not only are our RAM'S faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02-1 Low Power and Super Fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off!

500ns 8/$12.95
250ns 8/$15.95

IC's from XEROX

IC's REMOVED FROM PC BOARDS ALL TESTED; FULL SPEC.

Great Buy!

1402 A Shift Regulator – 50c
MH0025CN – 55c

7400 – 9c	7430 – 9c	7493 – 26c
7402 – 9c	7440 – 9c	74121 – 22c
7404 – 9c	7437 – 10c	74123 – 32c
7406 – 11c	7438 – 10c	74151 – 9c
7407 – 11c	7451 – 9c	74155 – 22c
7410 – 9c	7474 – 16c	74193 – 35c
7416 – 13c	7475 – 24c	8233 – 35c
7420 – 9c	7486 – 16c	Intel – 1302 – 45c

MK50397–$8.95

S.D. Sales Exclusive! Elapsed time IC. Specially modified six digit counter circuit to measure 59 min., 59 sec., 99/100 sec. Perfect for dark room timers, chess timers or any timing applications. Supplied with data sheet and applications.

MOS 6 Digit Up/Down Counter

40 PIN DIP. Everything you ever wanted in a counter chip. Features: Direct LED segment drive, single power supply (12 VDC TYPE), six decades up/down, pre-loadable counter, separate pre loadable compare register with compare out-put. BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking. 1MHZ. count input frequency.

$12.95

CALL IN YOUR BANKAMERICARD OR MASTER CHARGE ORDER IN ON OUR CONTINENTAL UNITED STATES TOLL FREE WATTS LINE: ⟹ ⟹ 1-800-527-3460

Texas Residents Call Collect:
214/271-0022

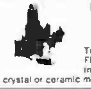
TERMS: *Money Back Guarantee!*

NO COD'S. TEXAS RESIDENTS ADD 5% SALES TAX. ADD 5% OF ORDER FOR POSTAGE & HANDLING. ORDERS UNDER $10.00 ADD 75c. FOREIGN ORDERS – U.S. FUNDS ONLY!

Orders over $15. - Choose $1. FREE MERCHANDISE!

CIRCLE NO 49 ON FREE INFORMATION CARD

MINI-KITS



FM WIRELESS MIKE KIT
FM-1 $2.95
Transmit up to 300' to any FM radio. Sensitive mike input requires dynamic, crystal or ceramic mike. Runs on 3 to 9 volts.

TONE DECODER KIT
A complete tone decoder on a single PC Board. Features: 400 to 5000 Hz adjustable frequency range, voltage regulation 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.
Complete Kit, TD-1 .... $4.95

LED BLINKY KIT

A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons or warning type panel lights.
Complete Kit, BL-1 .... $2.95

SUPER-SNOOP AMPLIFIER
A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.
Complete Kit, BN-9 .... $4.95

MUSIC LIGHTS KIT
See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.
Complete Kit, ML-1 .... $7.95

SIREN KIT
Produces upward and downward wail characteristic of police siren. 200mw audio output, runs on 3-9 volts, uses 8-45 ohm speaker.
Complete Kit, SM-3 .... $2.95

CODE OSCILLATOR KIT
Powerful 1 watt audio oscillator of approx. 1 kHz, good for many uses. Great for warning alarm, battery checker, voltage indicator and code oscillator.
Complete Kit, CPD-1 .... $2.50

POWER SUPPLY KIT
Complete triple regulated power supply provides variable ±15 volts at 200ma and +5 volts at 1 amp. 50mv load regulation, good filtering and small size. Kit less transformers. Requires 6-8V at 1 amp and 18 to 30VCT.
Complete Kit, PS-3LT $6.95

DECADE COUNTER PARTS KIT
Includes: 7490A 33 MHz counter, 7475 latch, 7447 LED driver, LED readout, current limit resistors, hook up details and instructions on how to build an easy low cost freq. counter.
Kit of Parts, DCU-1 .... $3.50

NEW

Frequency Counter
$79.95 KIT

You've requested it, and now it's here! The CT-50 Frequency Counter Kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 VDC as it does on 110 VAC. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $79.95. Order yours today!

CT-50, 60MHz Counter Kit $79.95
CT-50WT, 60 MHz counter, wired and tested $159.95
CT-600, 600 MHz prescaler option for CT-50, add .. $29.95

UTILIZES NEW MOS-LSI CIRCUITRY

SPECIFICATIONS

Sensitivity: less than 25MV
Frequency range: 5Hz to 60MHz, typically 65MHz
Gate time: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 10 ppm, .001 ppm with TV time base!
Input: BNC, 1 meg ohm direct, 50 ohm with prescale option
Power: 110 VAC 5 watts or 12 VDC @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case
Color burst adapter for .001 ppm accuracy available in 6 weeks. CB-1, Kit $14.95

VIDEO TERMINAL KIT $149.95

A compact 5 x 10-inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard-operated cursor and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block-type see-thru cursor. Keyboard/computer control backspaces, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit $149.95
TH3216, Assembled and Tested $239.95
VD-1, Video to RF Modulator Kit .... $ 6.95

600 mHz Prescaler

Fully assembled and tested.
Extend the range of your counter to 10 times higher in frequency. Works with any counter. High sensitivity input with built-in on-chip pre-amp.
PS-1B,—10 .... $59.95

SIX DIGIT 12/24 HR CLOCK KIT

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits, Polaroid lens filter, extruded aliminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, blue and bronze (specify).

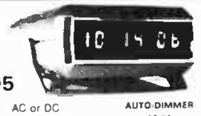
Clock Kit, DC-5 .... $22.95
Alarm Clock, DC-8, 12 hr. only $24.95
DC-5 with 10 min. ID timer........... $25.95
Mobile Version, DC-7 .... $25.95
Assembled and tested clocks available, add $10.00 to kit price.

741 MINI DIP, house marked .... 10/$2.00

Phone orders welcome

Satisfaction guaranteed or money refunded. Orders under $10 add 75c. COD add $1.00. NY add 7% sales tax.

CAR CLOCK KIT $27.95



12/24-Hour 12-Volt AC or DC
- High Accuracy (1 minute/month)
- 6 jumbo 4" LED readouts
- Easy, no-polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super Instructions

Complete Kit, DC-11 .... $27.95

AUTO-DIMMER $2.50
Automatically adjusts display brightness according to ambient light level. For DC-11 Car Clock.

LINEAR		REGS		TRANSISTORS	
555	.50	309K	.99	NPN 2N3904 type	10/$1.00
556	.75	340K-12	.99	PNP 2N3906 type	10/$1.00
566	1.49	7805	.99	NPN Power Tab 40W	3/$1.00
567	1.49	7812	.99	PNP Power Tab 40W	3/$1.00
324	1.49	7815	.99	FET MPF-102 type	3/$2.00
1458	.49	78MG	1.50	UJT 2N2646 type	3/$2.00
380	1.49	723	.49	2N3055 NPN Power	.75

ramsey electronics
BOX 4072A ROCHESTER, NY 14610 (716) 271-6487

CIRCLE NO. 47 ON FREE INFORMATION CARD

TTL PLASTIC DUAL-IN-LINE I.C.

SN7400N	.12	SN7453N	.14	SN74132N	.69	SN74186N	7.50
SN7401N	.14	SN7454N	.14	SN74136N	.59	SN74S188AN	1.85
SN7402N	.14	SN7460N	.14	SN74141N	.88	SN74190N	1.04
SN7403N	.14	SN7470N	.26	SN74142N	3.70	SN74191N	1.04
SN7404N	.17	SN7472N	.25	SN74143N	3.98	SN74192N	.84
SN7405N	.17	SN7473N	.29	SN74144N	3.98	SN74193N	.84
SN7406N	.25	SN7474N	.28	SN74145N	.69	SN74194N	.89
SN7407N	.25	SN7475N	.46	SN74147N	1.58	SN74195N	.54
SN7408N	.17	SN7476N	.30	SN74148N	1.19	SN74196N	.87
SN7409N	.17	SN7480N	.35	SN74150N	.94	SN74197N	.73
SN7410N	.14	SN7481AN	.95	SN74151N	.61	SN74198N	1.64
SN7411N	.20	SN7482N	.55	SN74152N	3.45	SN74199N	1.64
SN7412N	.21	SN7483AN	.65	SN74153N	.61	SN74221N	1.14
SN7413N	.39	SN7484AN	1.50	SN74154N	.95	SN74246N	1.95
SN7414N	.62	SN7485N	.84	SN74155N	.70	SN74247N	1.70
SN7416N	.24	SN7486N	.30	SN74156N	.64	SN74248N	1.75
SN7417N	.29	SN7489N	1.85	SN74157N	.59	SN74249N	1.75
SN7420N	.14	SN7490AN	.43	SN74159N	2.50	SN74251N	1.05
SN7421N	.20	SN7491AN	.59	SN74160N	85	SN74259N	1.35
SN7422N	.20	SN7492AN	.44	SN74161N	.85	SN74265N	.85
SN7423N	.25	SN7493AN	.44	SN74162N	.85	SN74273N	1.35
SN7425N	.25	SN7494N	.69	SN74163N	.85	SN74276N	.75
SN7426N	.22	SN7495AN	.67	SN74164N	.98	SN74278N	1.99
SN7427N	.25	SN7496N	.65	SN74165N	.97	SN74279N	.57
SN7428N	.28	SN7497N	2.50	SN74166N	1.09	SN74283N	1.39
SN7430N	.14	SN74100N	.97	SN74167N	2.75	SN74284N	4.50
SN7432N	.23	SN74104N	.42	SN74170N	1.69	SN74285N	4.50
SN7433N	.30	SN74105N	.42	SN74172N	8.75	SN74290N	.85
SN7437N	.21	SN74107N	.28	SN74173N	1.24	SN74293N	.83
SN7438N	.21	SN74109N	.47	SN74174N	.94	SN74298N	1.64
SN7440N	.14	SN74110N	.52	SN74175N	.84	SN74351N	1.92
SN7442N	.37	SN74111N	.69	SN74176N	.77	SN74365N	.65
SN7443N	.68	SN74116N	1.50	SN74177N	.76	SN74366N	.65
SN7444N	.85	SN74120N	1.40	SN74178N	1.19	SN74367N	.65
SN7445N	.65	SN74121N	.34	SN74179N	1.49	SN74368N	.65
SN7446AN	.70	SN74122N	.38	SN74180N	.67	SN74376N	.75
SN7447AN	.59	SN74123N	.48	SN74181N	1.94	SN74390N	1.40
SN7448N	.69	SN74125N	.40	SN74182N	.59	SN74393N	1.40
SN7450N	.14	SN74126N	.40	SN74184N	1.75	SN74426N	.45
SN7451N	.14	SN74128N	.59	SN74185AN	1.74	SN74490N	1.90

CMOS		CMOS	
CD4000BE	.13	CD4052BE	1.15
CD4001BE	.16	CD4053BE	.89
CD4002BE	.16	CD4055BE	1.29
CD4006BE	.99	CD4060BE	.99
CD4007BE	.16	CD4066BE	.59
CD4008BE	.80	CD4068BE	.24
CD4009BE	.37	CD4069BE	.24
CD4010BE	.37	CD4070BE	.24
CD4011BE	.16	CD4071BE	.24
CD4012BE	.16	CD4072BE	.29
CD4013BE	.29	CD4073BE	.29
CD4014BE	.74	CD4075BE	.29
CD4015BE	.74	CD4076BE	.98
CD4016BE	.29	CD4078BE	.24
CD4017BE	.79	CD4081BE	.24
CD4018BE	.79	CD4082BE	.29
CD4019BE	.38	CD4085BE	.75
CD4020BE	.84	CD4086BE	.75
CD4021BE	.89	CD4502BE	1.15
CD4022BE	.89	CD4507BE	.39
CD4023BE	.16	CD4510BE	1.05
CD4024BE	.67	CD4511BE	1.25
CD4025BE	.16	CD4512BE	.69
CD4026BE	1.39	CD4514BE	2.50
CD4027BE	.38	CD4515BE	2.50
CD4028BE	.74	CD4516BE	.84
CD4029BE	.78	CD4518BE	.84
CD4030BE	.37	CD4519BE	.79
CD4033BE	1.60	CD4520BE	.79
CD4034BE	2.95	CD4522BE	1.98
CD4035BE	.98	CD4526BE	1.50
CD4040BE	.99	CD4527BE	1.50
CD4041BE	.67	CD4528BE	1.20
CD4042BE	.58	CD4531BE	1.25
CD4043BE	.45	CD4539BE	1.20
CD4044BE	.45	CD4555BE	.75
CD4046BE	2.45	CD4556BE	.75
CD4047BE	2.45	CD4581BE	2.25
CD4049BE	.34	CD4582BE	.95
CD4050BE	.34	CD4585BE	1.80
CD4051BE	.89		

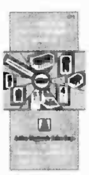
CMOS	
74C14/40014PC	.75
74C85/40085PC	1.20
80C97/40097PC	.65
80C98/40098PC	.65
74C160/40160PC	1.50
74C161/40161PC	1.50
74C162/40162PC	1.50
74C163/40163PC	1.50
74C174/40174PC	1.40
74C175/40175PC	1.40
74C192/40192PC	1.50
74C193/40193PC	1.50
74C194/40194PC	1.40
74C195/40195PC	1.40

TEXAS INSTRUMENTS I.C. SOCKETS
(Low Profile Solder Tail)

Description		Unit Price
8 Pin DIL	(C840802)	.15
14 Pin DIL	(C841402)	.18
16 Pin DIL	(C841602)	.19
18 Pin DIL	(C841802)	.29
20 Pin DIL	(C842002)	.35
22 Pin DIL	(C842202)	.34
24 Pin DIL	(C842402)	.34
28 Pin DIL	(C842802)	.45
40 Pin DIL	(C844002)	.65

VOLTAGE REGULATORS

SG3501AT	3.60	±5V Dual Tracking Regulator
SG3524J	7.25	Switching Regulator Converter
SG4501T	1.80	±15V Dual Tracking Regulator
RC4194TK	3.95	Variable Dual Tracking Regulator ±35V ±9.5V
RC4195T	2.35	Fixed ±15V Dual Tracking Regulator T05
RC4195TK	3.15	Fixed ±15V Dual Tracking Regulator T066
78H05KC	6.35	5 Amp 5 Volt Positive Regulator T03
7800 Series TO-220 / LM340T	.99	Positive Voltage Regulators (Plastic) 1 amp 5, 6, 8, 12, 15, 18, 24 Volts
78M00 Series TO-5 / LM340H	1.39	Positive Voltage Regulator 1/2 Amp 5, 6, 8, 12, 15, 18, 24 Volts
7800 Series TO-3 / LM340K	1.49	Positive Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
78L00 AWC Series TO-92	.29	Positive Voltage Regulator 100 MA 2.6, 5, 6.2, 8.2, 12, 15 Volts
7900 Series TO-220 / LM320T	1.25	Negative Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
79M00 Series TO-5 / LM320H	1.35	Negative Voltage Regulator 1/2 Amp 5, 6, 8, 12, 15, 20, 24 Volts
7900 Series TO-3 / LM320K	1.75	Negative Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
78MGT2C	1.20	Dual In Line Adjustable 4 Terminal Positive Voltage Regulator
79MGT2C	1.20	Dual In Line Adjustable 4 Terminal Negative Voltage Regulator
78GU1 TO-220	1.45	1 Amp Adjustable Positive Voltage Regulator
79GU1 TO-220	1.25	1 Amp Adjustable Negative Voltage Regulator
78GKC TO-3	1.80	1 Amp Adjustable Positive Voltage Regulator
79GKC TO-3	2.10	1 Amp Adjustable Negative Voltage Regulator



Our new comprehensive 1977/1978 Catalogue, listing complete descriptions, illustrations and special monolithic pricing on over 10,000 items, is now available on request.

Active Electronic Sales Corp.

P.O. BOX 1035 FRAMINGHAM, MASSACHUSETTS 01701
Telephone Orders & Enquiries (617) 879-0077 New Catalogue available on request

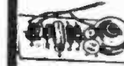
NOW IN CANADA 2 Locations Montreal, Quebec Rexdale, Ontario

MINIMUM ORDER $10.00 ★ ADD $1.00 TO COVER POSTAGE & HANDLING ★ Canadian customers add 30% for duty and handling. All federal and provincial taxes extra

CIRCLE NO. 3 ON FREE INFORMATION CARD

EDI

VOICE ACTIVATED SOLID STATE SWITCH



Locks on when activated and opens when circuit is momentarily disconnected. Features sensitivity adjustment.

S-45 Special .88

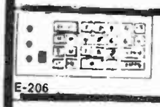
5CP1 OSCILLOSCOPE TUBE

Limited Quantity

- New Dumont 5CP1 Scope Tube
- Use In Many Older Test Bench Oscilloscopes
- Stock One Now If Your Oscilloscope Uses One

N-189 $44.00 Value 4.88

24-KEY DESK CALCULATOR KEYBOARD

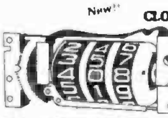


*Touch tone type contacts • Complete on circuit board • Frame holds keys and 4 slide switches • 7 5/8"S x 3 11/16"D x 1 3/4" Highest point • 1 1/4" Lowest point • Shipping wt 1 lb

E-206 .99

DIGITAL CLOCK MOVEMENT

New!



- Flip Strip Numerals .5" High
- Made By Shinoru Seiki Mod # LTP 408
- 120V AC 60Hz
- Size 4 3/8 W x 1 3/4 H x 3 D
- Shipping Wt 1 Lb

G-87 2.99

4-DIGIT ITT GENERAL CONTROL RESETTABLE COUNTER

- 120 Volt, 60 Hz
- Model # CE40AS402
- Minimum Make Time .050 Second, Break Time .050 Second
- Enclosed In Tamperproof Case
- Shipping Wt 1 Lb

N-98 1.99 3/6.50

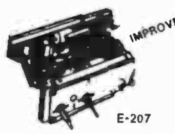
2" PANEL METER 50-0-50 UA DC MICROAMMETER

- Wide View Panel Meters
- 2-3/8" x 1-13/16" Face
- Mounts In 1 1/2" Hole

F-20 1.99

4-RANGE DIGITAL READOUT INTERVAL TIMER KIT

IMPROVED!



• 4 time functions: 1-9.9 Sec., 1-99 Sec., 1-9.9 Min., 1-99 Min. • 1/2" High Nixie Tube Readouts • For darkroom use in both processing & enlarging processes • As a timer for sport & contest events (stop switch) • Provides timed 120V AC outlet and S.P. NO contact to trigger buzzer alarm or visual signals. • Full Wiring Instructions Included — No Cabinet Or Case Available For Timer.

E-207

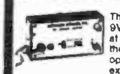
100.00 VALUE • Accurate to 1/10 of 1% • LED for Visual Timing SPECIAL 19.99

DYNAMIC DIGITAL TRANSISTOR CHECKER

Tests transistors in circuit or out of circuit. The Dynamic Transistor Checker lets you match transistors in working circuits to improve the operation. It will test Go and No Go at currents from 5ma to 50ma, and will show current gain, electrical open and short circuits. Tests low, medium and high power transistors both PNP and NPN types. Complete with transistor socket test clips and leads. Uses VM2 or C1 ¾V battery. Size of case: 6¼" x 3¾" x 2"

E-144 9.99

DC POWER SUPPLY



This DC power supply will deliver four ranges of DC voltages 4.5V, 6V, 9V and 12V. It will supply a fully filtered output of one of these voltages at 150 milliampere capacity. Can be used for any DC power supply within the voltage range and capacity such as: operating a small battery radio; operating a small calculator, or powering miscellaneous laboratory experiments. Uses standard 117V 60C AC power. Output binding posts accepts wire or banana plugs. With 4½ Ft cord and plug. Size of case: 5" x 2-5/8" x 1-5/8"

15.88 Value

F-145 5.99

TRANSISTORIZED SIGNAL TRACER

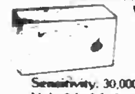
EDI Special!!

This transistorized signal tracer can be used by technicians and service men to audibly trace signals of RF and IF and audio circuits from the antenna to the speaker stage by stage. An ideal tool for servicing audio equipment; amplifiers, tuners, receivers, turntables, etc. Has 2" speaker and test leads. Uses N556 9V transistor battery. Size of case 5" x 2-5/8" x 1-5/8". Leads and instructions included.

Was 17.88

F-171 7.77

22-RANGE BENCH STYLE MULTI-TESTER WITH DECIBEL SCALE



• Taut-Band Suspension Meter • Extra Wide Two Color Mirrored Scale Assures Accurate Readings

SPECIFICATIONS:
Sensitivity: 30,000 Ohm Volt DC 10,000 Ohm Volt AC, DC Volt: 0.5 2.5 5 15 50 250 500 1,000 2,500 AC Volt: 15 50 150 500 1,000 DC Current: 50ua 5ma 50ma 150ma 500ma 5 Amp. Ohm: RX1 RX100 RX10K Decibel: 20 to +62db Size: 4½" x 8"W x 3½"D.

Was 39.88

F-496 26.88

SEND FOR FREE CATALOG with hundreds of electronic items

[illegible]

EDI

Dept. PE1, 4900 Elston, Chicago, IL 60630 • Tel.: 312-283-4800

CIRCLE NO. 17 ON FREE INFORMATION CARD

PLANNING TO MOVE?

Let us know 8 weeks in advance so that you won't miss a single issue of POPULAR ELECTRONICS.
Attach old label where indicated and print new address in space provided. Also include your mailing label whenever you write concerning your subscription. It helps us serve you promptly.
Write to: P.O. Box 2774, Boulder, CO 80322 giving the following information:

☐ Change address only ☐ Extend my subscription

ENTER NEW SUBSCRIPTION

☐ 1 year $12.00 ☐ Payment enclosed (1 extra BONUS issue)
Allow 30-60 days for delivery. ☐ Bill me later

AFFIX OLD LABEL
If you have no label handy, print OLD address here.
Name ________ please print
Address ________
City ________
State ________ Zip ________

NEW ADDRESS HERE 0211

Name ________ please print
Address ________ Apt. ____
City ________
State ________ Zip ________

Additional postage on foreign orders: add $3 a year for Canada, $5 a year for all other countries outside the U.S. and its possessions. Cash only on foreign orders, payable in U.S. currency.

ADVANCED COMPUTER PRODUCTS

MOTOROLA EXORCISER & MEK D1 & MEK D2 COMPATIBLE MODULES

MEK6800D2 — 6800 KIT ONLY $235.00

9601 16 Slot Mother Bd.	$175.00
9602 16 Slot Card Cage	72.00
9610 Proto Board	36.00
9615 4K EPROM Module (1702A)	350.00
9615K 4K EPROM Kit Module	275.00
9620 16 Port Parallel I/O	375.00
9626 8K Static RAM Module	350.00
9626K 8K Static RAM Kit	275.00
9650 8 Port Duplex Asyn Serial I/O	395.00
Connectors	56.50 16/72.00

All assembled & tested not Kits

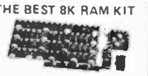
PLUS MOTOROLA TV MONITORS — PRIME
Model M3000 100 12" display $218.95
Model M2000 155 9" display $199.95
Add $10.00 for shipping

IC MARKET PLACE

MICROPROCESSORS / PROM'S / 7400TTL / 74LS00 TTL / 74S & 74L / 4000 CMOS / LINEAR / DISPLAYS/LEDS / SHIFT REGISTERS / TRANSISTORS / DIVIDERS / CRYSTALS / SOCKETS / CONNECTORS / EXAR / NEW CTS DIPSWITCHES / EVK 99 6800 MICRO SYS / RAM'S / PLESSEY

[illegible]

LOGOS I THE BEST 8K RAM KIT



Assembled & Tested $199.95
Kit Price Only $179.95

Features:
Lowpower 21L02, 450ns, Dip Switch Selectable addressing down to 256 Byte blocks. No wait states, fully buffered, battery back up.

Plus the first 32K Static Memory Board Uses 2114 4K RAMS

16K	$569.99
24K	859.98
32K	999.99

LOWEST PRICES YET

2708 EPROM	$21.95
2716 EPROM	$59.95
Z-80A 4MH	$49.95
Z-80 2.5MH	$29.95
INTEL 3404 6 bit latch	$7.95
INTEL 3205 driver	$1.95
MK4116 16K RAM	$44.95
2114 4K RAM	$12.95
4200A 4K RAM	$12.95

COMPUTER KITS

MOT MEK6800 D2	235.00
KIM I 6502 Kit	245.00
AMI EVK 99 Kit	133.00
Intercept JR 6100 Kit	281.00
Iasis Computerbook	450.00
NSC Scamp Kit	99.00
NSC Keyboard Kit	95.00
IMSAI 8080A w/22	751.00
PIC 8 Priority	125.00
SIO Kit	125.00
Cromemco Z-2	595.00
Byte Saver	145.00
Bytesaver w/PROM	195.00
Dazzler	215.00
D + 7A	145.00
JS-1 Joystick	65.00
8K EPROM/RAM Kit	124.95
ZPU Kit	295.00

CHAR GEN/ENCODERS/UARTS

S1883	6.95	S2350 USRT	
1602B	5.50	1671B Astros	29.95
AY51013A	5.50	1482	13.95
AY51015A	9.95	1472	13.95

MM5320 TV Synch Gen	7.95
MM5369 Prescaler	3.95
MM5376 Calc Chip	2.95
CT5001 Calc Chip	2.95
CT7001 Clock Chip	5.95
MM5314 Clock Chip	4.95
MM5316 Clock Chip	4.95
MM5375 Clock Chip	4.95
R032513 Lower Case	10.95
R032513 Uppercase	9.95
AY52376 Keyboard Encoder	14.95
AY53600 Keyboard Encoder	14.95
MM6571 Char gen	14.95
MM6574 Char gen	14.95
MM6575 Char gen	14.95

DATA BOOKS

NSC Digital	$3.95
NSC Linear	4.95
NSC Linear A/N Vol I	2.95
NSC Linear A/N Vol II	2.95
NSC CMOS	2.95
NSC Audio	2.95
NSC Voltage Reg	2.95
NSC Memory	3.95
Intel Data Book	4.95
NSC Special Functions	3.25
NSC MOS/LSI	4.25
NSC Transistors	6.95
Iasis Microprocessor Handbook	7.95
Iasis Complete up Learning Course	99.50
Intel MCS80 Manual	4.95
Intel MCS40 Manual	4.95
Intel MCS8 Manual	4.95
Raytheon Linear	2.95
Raytheon Quads/Duals	1.95
New GI mos	4.95
Osborne Introto Micropuler Vol I	7.50
Osborne Introto Micropuler Vol II	12.50
Osborne 8080 Programming for Logic Design	7.50
Osborne 6800 Programming	7.50

SPECIALS

2708 price war $21.95

8K Ram Kit $179.95

[illegible]

Plus huge backup inventory with special pricing for VOLUME requirements. Call for a quotation.

[illegible]

All Shipments FCM or UPS. Orders under $100.00 add 5% handling and postage. Orders over $100.00 add 2.5% handling & postage. Mastercharge/Bankamericard/DOD accepted w/25% deposit. California Residents add 6% tax. Foreign Orders add 8% handling. All parts prime factory tested guaranteed. Same day shipment. Add 25 cents for Data.

SPECIALTY CHIPS

34702 Baud Rate Gen	$15.95
upD372 Floppy Controller	55.00
upD371 Mag Tape Controller	49.95
App Notes for 372 Floppy	6.95
WD1771 Floppy Controller	59.95
AY5 3550 4½ DVM Chip	24.95
MK5007 Counter	6.95
AY5 3507 DVM Chip	12.95
WD1941 Dual Baud Gen	9.95
ICM7208IPI Cir Disp. Driver	16.95
ICM7045IPI Stop Watch Chip	18.95
MC14411 Baud Rate Gen	12.95
CW300 Saw Fcn. Gen.	1.50
RF Modulator	8.95
8500-1 TV Game Chip	24.95
MM57100 Game Chip	16.95
MM53104 Clock	3.75
LM1889 Modulator	3.95

Retail pricing may vary from Mail Order Pricing

ADVANCED COMPUTER PRODUCTS
P. O. BOX 17329
Irvine, California 92713
New Phone (714) 558-8813

NOW Our First Store Open
1310 B Edinger
Santa Ana, CA 92705

CIRCLE NO. 6 ON FREE INFORMATION CARD

SOLID STATE *(Continued from page 87)*

signed for operation at 68 to 88 MHz and 148 to 174 MHz, respectively. Each module will deliver better than 18 watts when driven with less than 150 mW at a supply voltage of 12.5 volts.

Motorola Semiconductor Products, Inc. (P.O. Box 20294, Phonenix, AZ 85036) has introduced its own line of wideband r-f amplifier modules. Designed for radio and cable communication systems as well as r-f instrumentation, the Motorola units have a source and load impedance range of 50 to 100 ohms and offer a typical power gain of 36 dB. Types MHW590 and MHW592 are designed for operation on 24-volt dc power sources and cover the ranges of 10 to 400 MHz and 1.0 to 250 MHz, respectively. Types MHW591 and MHW593 require 13.6-volt dc supplies and cover the ranges of 1.0 to 250 MHz and 10 to 400 MHz, respectively. All four modules are designed for operation with a bar-type heatsink for optimum thermal charteristics.

Motorola has entered the solar energy field with a line of semiconductor photovoltaic panels. Initial products are 48-cell and 36-cell arrays. Consisting of interconnected 3-inch silicon wafers, they are available in a variety of series-parallel arrangements to provide various voltage/current output combinations. The panels are suitable for powering remote, unattended equipment, such as microwave relays, navigational aids, cathode protection systems, forestry equipment, and other systems. Energy storage, if required, is provided by batteries. Featuring a unique textured surface consisting of a dense population of microscopic pyramids to provide maximum light absorption, each solar cell is capable of producing in excess of one half-watt of peak power at 25°C. ◇

ABOUT YOUR SUBSCRIPTION

Your subscription to POPULAR ELECTRONICS is maintained on one of the world's most modern, efficient computer systems, and if you're like 99% of our subscribers, you'll never have any reason to complain about your subscription service.

We have found that when complaints do arise, the majority of them occur because people have written their names or addresses differently at different times. For example, if your subscription were listed under "William Jones, Cedar Lane, Middletown, Arizona," and you were to renew it as "Bill Jones, Cedar Lane, Middletown, Arizona," our computer would think that two separate subscriptions were involved, and it would start sending you two copies of POPULAR ELECTRONICS each month. Other examples of combinations of names that would confuse the computer would include: John Henry Smith and Henry Smith; and Mrs. Joseph Jones and Mary Jones. Minor differences in addresses can also lead to difficulties. For example, to the computer, 100 Second St. is not the same as 100 2nd St.

So, please, when you write us about your subscription, be sure to enclose the mailing label from the cover of the magazine—or else copy your name and address exactly as they appear on the mailing label. This will greatly reduce any chance of error, and we will be able to service your request much more quickly.

OPERATION ASSIST (continued from page 103)

Hallicrafters Model SX-28 "Super Skyrider" receiver. All available information. Matthew Isaacs, 150 Santa Margarita, San Clemente, CA 92672.

Philco Model 39-35 radio. Need schematic, parts list and operating instructions. J.M. Dubiel, 1129 Marion St., Peckville, PA 18452.

Lincoln Model L 2000A, Class D CB transceiver. Schematic and any available information. E.O. Kirkwood, Sr., 137 Snow Hill Dr., Charleston, WV 25311.

Heathkit Model MW-33 CB transceiver. Schematics or manual. Fred J. Winkler, 315 Nashua Dr., Port Richey, FL 33568.

Knight Model T-60 transmitter. Schematic and operators manual. Richard L. Schaut, 1218 Marshall Ave., Green Bay, WI 54301.

Fluke Model 102 VAW meter and **Tektronix** Model 536 oscilloscope. Need service manuals. Bernard Budny, 434 E. Wilbur Ave., Milwaukee, WI 53207.

Scott "Philharmonic" receiver. Schematic, operating instructions and any available restoration information. Douglas Lake, Box 5101 Station F, Baseline Rd., Ottawa, Ontario, Canada K2C 3H4.

Hallicrafters Model S-107. Manual and/or service information. **Hart** Model 75 shortwave receiver. Schematic and manual and/or service information. Daniel W. Kelly, Box P, Middleton, MA 01949.

Lafayette Model HE-10 or KT-200 receiver. Need alignment procedure information. P. Kaeding, 3917 Kipling Ave. So., St. Louis Park, MN 55416.

Wurlitzer Model 2910 phonograph juke box. Need technical manual. J. Chadek, 2609 River Hills Rd., Two Rivers, WI 54241.

Hammarlund Model HQ-110. Schematics and any available information. Steve Ruten, 3513 57th, Lubbock, TX 79413.

Commercial Trades Institute Model SC30 oscilloscope. Built from a kit as part of electronics course. Schematics or other available information. Ronald M. Kardos, 2703 Parkland Dr., Brighton, MI 48116.

Precise Model 300B oscilloscope. Schematic and manual. Frank Doering, 6878 S.E. Division, Portland, OR 77206.

LLoyd Model 9M39W-94A solid-state FM multiplex stereo. Need schematic. Dan Viscogliosi, 32 Cresthill Rd., Brighton, MA 02135.

National Model NC-303 receiver. Need instructions and/or schematic. **Dumont** Model 208-B oscilloscope. Schematic or any available information. Brian Matheny, 7933 Russell Rd., Alexandria, VA 22309.

Dumont Type 274 oscilloscope. Need schematic, service manual and/or operating manual. Stacey Marsella, 27 Hudson Hill Rd., Cranston, RI 02905.

U.S. Navy Type CV-57 teletype demodulator. Operators manual or schematic. Mark A. Vargas, 260 Ft. Wash Ave., New York, NY 10032.

Grand Model FP 1211-G 5-band radio. Need dial stringing

Instructions or diagram. Bernard Grupe, 3012 Highland Dr., Cary, IL 60013.

ET/D Tekfax. Diagrams wanted, prior to #1294 (May 1970). Donald R. Hicke, 11381 Bootes St., San Diego, CA 92126.

Knight-Kit Model 83 YZ 945 lab oscilloscope. Operation manual and/or schematic. P.J. Strimple, Rt. 1, Box 1091, Bay City, TX 77414.

Precision Model E200-C signal generator. Schematic needed. Harold McCann, 803 South Oak, 3D, Ottawa, KS 66067.

Hammarlund Model BC779 general coverage receiver. Schematic and owner's manual and/or alignment information. Daniel Ginsberg, Box 163, Albion, CA 95410.

Philco Model 37-630. Need schematic diagram. Danny Tovar, 4700 Rockmoore Ln, Fort Worth, TX 76116.

Sears Model 562-41920101 portable color television. Need service manual. George Comber, 122 Maine Ave., Cherry Hill, NJ 08002.

Motorola Model DS9660-B Conelrad receiver. Operating manual, schematics and crystal. D. Smith, 1369 Tree Garden Place, Concord, CA 94518.

Zenith Model 7G605 5-band shortwave radio. Need any information. Bruce Kahn, 2034 Ramlow Place, St. Paul, MN 55116.

Motorola Model HI3-11AH SP2 "Handie-Talkie." Schematic and operations manual. Also plug-in modules for unit. David Moody, 4305 S. 8th St., Terre Haute, IN 47802.

U.S. Navy Surplus signal generator, military designation TS-413C/U. Covers 10 kHz to 40 MHz. Schematic, tech manual, or any other available information. Jack Rutherford, Box 3124, Burlington, NC 27215.

Philco Models 16; 37-62; PT-38; 46-132; 40; 120 radios. Schematics or any available information. Martin Nevers, 850 Main St., Oxford, FL, 32684.

Lago Model C86 (serial no. C860001110) desk calculator. Schematic, parts list and manual. Charles Dawson, 10503 Kibbee Ave., Whittier, CA 90603.

CIRCLE NO. 14 ON FREE INFORMATION CARD

CIRCLE NO. 53 ON FREE INFORMATION CARD

Popular Electronics

OCTOBER 1977 ADVERTISERS INDEX

Electronics Classified

REGULAR CLASSIFIED: COMMERCIAL RATE: For firms or individuals offering commercial products or services, $2.25 per word. Minimum order $33.75. **EXPAND-AD CLASSIFIED RATE:** $3.35 per word. Minimum order $50.25. Frequency discount; 5% for 6 months; 10% for 12 months paid in advance. **READER RATE:** For individuals with a personal item to buy or sell, $1.35 per word. No minimum! **DISPLAY CLASSIFIED:** 1" by 1 column (2-1/4" wide), $260.00. 2" by 1 column, $520.00. 3" by 1 column, $780.00. Advertiser to supply film positives. For frequency rates, please inquire.
GENERAL INFORMATION: Payment must accompany copy except when ads are placed by accredited advertising agencies. First word in all ads set in caps. All copy subject to publisher's approval. All advertisers using Post Office Boxes in their addresses **MUST** supply publisher with permanent address and telephone number before ad can be run. Advertisements will not be published which advertise or promote the use of devices for the surreptitious interception of communications. Ads are not acknowledged. They will appear in first issue to go to press after closing date. Closing Date: 1st of the 2nd month preceding cover date (for example, March issue closes January 1st. Send order and remittance to **POPULAR ELECTRONICS**, One Park Avenue, New York, New York 10016. Attention: Hal Cymes

FOR SALE

FREE! Bargain Catalog—I.C.'s, LED's, readouts, fiber optics, calculators parts & kits, semiconductors, parts. Poly Paks, Box 942PE, Lynnfield, Mass. 01940.

GOVERNMENT and industrial surplus receivers, transmitters, snooperscopes, electronic parts, Picture Catalog 25 cents. Meshna, Nahant, Mass. 01908.

LOWEST Prices Electronic Parts. Confidential Catalog Free. KNAPP, 3174 8th Ave. S.W., Largo, Fla. 33540.

ELECTRONIC PARTS, semiconductors, kits. FREE FLYER. Large catalog $1.00 deposit. BIGELOW ELECTRONICS, Bluffton, Ohio 45817.

RADIO—T.V. Tubes—36 cents each. Send for free catalog. Cornell, 4213 University, San Diego, Calif. 92105.

AMATEUR SCIENTISTS, Electronics Experimenters, Science Fair Students... Construction plans—Complete, including drawings, schematics, parts list with prices and sources... Robot Man — Psychedelic shows — Lasers — Emotion/Lie Detector — Touch Tone Dial — Quadraphonic Adapter — Transistorized Ignition — Burglar Alarm — Sound Meter... over 60 items. Send 50 cents coin (no stamps) for complete catalog. Technical Writers Group, Box 5994, University Station, Raleigh, N.C. 27607.

METERS—Surplus, new, used, panel or portable. Send for list. Hanchett, Box 5577, Riverside, CA 92507.

MECHANICAL, ELECTRONIC devices catalog 10 cents. Greatest Values — Lowest Prices. Fertik's, 5249 "D", Philadelphia, Pa. 19120.

SOUND SYNTHESIZER KITS—Surf $12.95, Wind $12.95, Wind Chimes $17.95, Electronic Songbird $6.95, Musical Accessories, many more. Catalog free. PAIA Electronics, Box J14359, Oklahoma City, OK 73114.

BUGGED??? New locator finds them fast. Write, Clifton, 11500-L N.W. 7th Avenue, Miami, Florida 33168.

YOU WILL SAVE BIG MONEY! Surplus, Clearouts, Bankruptcy, Inventory, Deals. Catalog $1 (redeemable). ETCOA Electronics, Box 741, Montreal, H3C 2V2. U.S. Inquiries.

HEAR POLICE / FIRE Dispatchers! Catalog shows exclusive directories of "confidential" channels, scanners. Send postage stamp. Communications, Box 56-PE, Commack, N.Y. 11725.

UNSCRAMBLERS: Fits any scanner or monitor, easily adjusts to all scrambled frequencies. Only 4" square $29.95, fully guaranteed. Dealer inquiries welcomed. PDQ Electronics, Box 841, North Little Rock, Arkansas 72115.

RECONDITIONED Test Equipment. $0.50 for catalog. Walter's Test Equipment, 2697 Nickel, San Pablo, CA 94806.

POLICE/Fire scanners, large stock scanner crystals, antennas. Also CBs. Harvey Park Radio, Box 19224, Denver, CO 80219.

TELETYPE EQUIPMENT for sale for beginners and experienced computer enthusiast. Teletype machines, parts, supplies. Catalogue $1.00 to: ATLANTIC SALES, 3730 Nautilus Ave., Brooklyn, NY 11224. Tel: (212) 372-0349.

BREAKERLESS ELECTRONIC ignition: Auburn Sparkplugs, Synthetic Lubricants, Wheel Stabilizers. Information 26 cents. Anderson Engineering, Epsom, N.H. 03234.

WHOLESALE C.B., Scanners, Antennas, Catalog 25 cents. Crystals: Special cut, $4.95, Monitor $3.95. Send make, model, frequency. G. Enterprises, Box 461P, Clearfield, UT 84015.

COMPUTER HOBBYISTS—classified advertising newsletter. $3.75/year. Free Sample. ON_LINE, 24695 Santa Cruz Hwy., Los Gatos, CA 95030.

NAME BRAND Digital/Analog Test Equipment. Discount prices. Free catalog. Salen Electronics, Box 82, Skokie, Illinois 60076.

YES, YOU CAN BUILD AN ELECTRONIC ORGAN

That has a PIPE ORGAN SOUND

With DEVTRONIX easy to build assemblies. Own the ultimate in organ design & sound at 1/3 the cost of commercial organs.

BROCHURE AND DEMO RECORD $1.00

Devtronix ORGANS, INC.
Dept. C
5872 Amapola Dr.
San Jose, CA 95129

BUILD AND SAVE. TELEPHONES, TELEVISION, DETECTIVE. BROADCAST Electronics. We sell construction plans with an Engineering Service. Speakerphones, Answering Machines, Carphones, Phonevision, Dialers, Color TV Converters, VTR, Games, $25 TV Camera, Electron Microscope, Special Effects Generator, Time Base Corrector, Chroma Key. Engineering Courses in Telephone, Integrated Circuits, Detective Electronics. PLUS MUCH MORE. NEW Super Hobby Catalog PLUS year's subscription to Electronic News Letter, $1.00. Don Britton Enterprises, 6200 Wilshire Blvd., Los Angeles, Calif. 90048.

SURPLUS COMPONENTS, Communication and test equipment. Illustrated catalog 25 cents. E. French, P.O. Box 249, Aurora, Illinois 60505.

TELEPHONES UNLIMITED, Equipment, Supplies, All types, Regular, Keyed, Modular. Catalog 50 cents. Box 1147E, San Diego, California 92112.

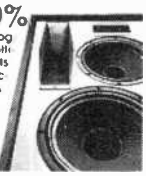
POWERFUL, ADJUSTABLE, REGULATED, THREE OUTPUT POWER SUPPLY and 900 easily removable parts in complete CARTRIVISION television recorder electronic assembly with documentation. Perfect for MICROPROCESSOR, IC, transistor, television, CB radio applications. $24.95 total. Free brochure. BankAmericard, Master Charge. MADISON ELECTRONICS, INCORPORATED, 369, D55, Madison, Alabama 35758. SATISFACTION GUARANTEED.

CARBON FILM RESISTORS 1/4W, 1/2W - 1.7 cents each. FREE sample / specifications. Other components. COMPONENTS CENTER, Box 134P, New York, N.Y. 10038.

BUILD YOUR OWN SPEAKERS AND SAVE UP TO 50%

Send for our free fact-packed 44 page catalog manual and learn how to assemble your own multi element stereo speakers from scratch or from kits. Our catalog includes chapters on design construction x-overs enclosures midranges woofers tweeters and horns. Write us today

SPEAKERLAB
Dept. PE-A, 5500 35th N E
Seattle, Washington 98105



PROFESSIONAL UNSCRAMBLERS — several models that fit any scanner. Free information. Capri Electronics, 8753T Windom, St. Louis, MO 63114.

UNSCRAMBLE CODED MESSAGES from Police, Fire and Medical Channels. Same day service. Satisfaction guaranteed. Don Nobles Electronics, Inc., Rt. 7, Box 265B, Hot Springs, Arkansas 71901. (501) 623-6027.

ANYTHING ELECTRONIC — we've got it. Catalog $1.00. Razoo, Box 1224, Cupertino, Calif.

SEEKING ORIGINAL JAPANESE TRANSISTORS FOR CB REPAIR? Request complete list. Compare 1 to 9 prices. 2SC710, 59 cents; 2SC517, $3.95; 2SC799, $3.60; 2SC1306, $4.40; 2SC1678, $2.25; TA7205P, $3.90; BA521, $3.70, BA511, $3.40. Fuji-Svea Enterprises, Dept. P, Box 40325, Cincinnati, OH 45240.

UNBELIEVABLE Goldmine of Electronic Schematics. Over 200, Useful, Novel, and Amazing Projects. Only $9.99! Money Back Guarantee. Send for Free project list. Spacetech, Box 182, Gillette, N.J. 07933.

USED TEST EQUIPMENT — Tektronix, HP, GR. Write: PTI, Box 8699, White Bear Lake, MN 55110. Phone: (612) 429-2975.

DIGITAL TACHOMETER 4-6-8 cylinder two digit display. Complete $59.95. Cosmos Electronics, P.O. Box 33278, Seattle, WA 98133.

AMAZINGLY Low component prices! Ask for free flyer. Write: EEP, 11 Revere Place, Tappan, NY 10983.

WEATHER MAP RECORDERS: Copy Satellite Photographs, National-Local Weather Maps. Learn How! $1.00. Atlantic Sales, 3730 Nautilus Ave., Brooklyn, N.Y. 11224. Tel: (212) 372-0349.

AUDIO EXPERIMENTERS, Serious Music Synthesizer Stuff: literature, kits, components, circuits and more. Send SASE for FREE INFO. CFR Associates, POB F, Newton, NH 03858.

UNSCRAMBLER SUPER SALE: Our famous Code-Breaker works with all scanners and tunes all scramble frequencies only $29.95. COD's (501) 273-5340. Mail orders to: KRYSTAL KITS, BOX 445, BENTONVILLE, AR 72712.

PROMS PROGRAMMED — New low prices — 13 cents stamp brings information. Or send $1 check for program cards, specs, PROM postage credit. RBH Enterprises, Box 12344, Wichita, KS 67277.

PC BOARDS from your art. Send SASE for information. ASSEMBLY SYSTEMS, Box 221, Wadsworth, OH 44281.

CARTRIVISION OWNERS! Sony Color Tuner/Modulator plugs into Cartrivision. Record off channels not viewed. Record without TV on. Play into any TV without interfacing. $250.00. (Specify channel 3/4). D.H.V., Inc., Box 12, Langhorne, Pennsylvania 19047.

WHY WORRY about leaving car lights on? ALARM ALERTS, with pulsing tone. $11.75. INFORMATION AVAILABLE. CFL Enterprises, Box 415, Export, PA 15632.

PHONO preamplifier for headphones. Inexpensive, high performance. Plans $3.00. Paul Meyer, 1-60 CalTech, Pasadena, CA 91126.

BUILD YOUR OWN TV CAMERA!
— Ideal for home & business —

THE ECONOMICAL ANSWER TO HOME MONITORING OF NURSERIES, ENTRANCES, DRIVEWAYS...BUSINESS and INDUSTRIAL SURVEILLANCE...ITV...AMATEUR TV PLUS HUNDREDS OF OTHER APPLICATIONS. MODEL XT-1A, SERIES D - KIT FORM $185; ASSEMBLED $275. SOLID-STATE. WORKS ON ANY TV SET. OPTIONAL SOUND KIT $28.95.

PHONE or WRITE for catalog. Dial 402-987-3771

1301 BROADWAY **ATV Research** DAKOTA CITY, NE. 68731

TURN THOSE Old (possibly broken?) transistor radios (AM or FM) into a variety of fascinating and useful devices. A potpourri of ideas. $1.00 plus stamp. Retro, Box 143, Hatboro, PA 19040.

FREE CATALOG. Solar Cells, Nicads, Kits, Calculators, Digital Watch Modules, Ultrasonics, Strobes, LEDS, Transistors, IC's, Unique Components. Chaney's, Box 27038, Denver, Colorado 80227.

CIRCUIT BOARDS. Circuit Boards made to order from your designs and drawings. Ten-Tec equipment enclosures — Custom Digital Designing — Hickok Test Equipment — Consumer Wire and Cable products — Complete line of CB Products — Electronic Parts. All products sold below suggested retail prices. Write today for your free catalog. R-S Electronics, 1019 East Clay, Decatur, Illinois 62521.

CALCULATOR STAND

Are you using your hand calculator without a stand? Yes? Then you need a Cal Pal. Cal Pal allows you to operate your calculator with one hand and makes the calculator display easier to see. Order now. Just $1.50 each postpaid. Utah residents please add sales tax.

Platform. Metric conversion table. Walnut woodgrain finish. Size: 3-1/4W X 5-1/2L

GEMAR SPECIALTIES
Dept. PE1, P.O. Box 706
Clearfield, Utah 84015

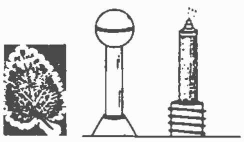
8K BYTE EPROM BOARD KIT (less 2708's), S-100: $49.95; 2107A: $4.50; 2513, 32wd, 9BIT FIFO: $6.50; NE 526: 65 cents; NE553: $2.10; Electroluminescent Panel, glows green, 115VAC: 95 cents; 20MHZ Crystal: $4.50; 24PIN Socket: 40 cents; 8 position DIP Switch: $2.25; coming soon (S-100 compatible): Phase Encoded Cassette Interface, Programmable Serial Port, Dual Recorder, Tarbell or K-C; 2708 Programmer. SASE for info. ELECTRONIC DISCOUNT SALES, 138 N 81st Street, Mesa, Arizona 85207.

TEN POUNDS fantastic variety capacitors, resistors, ICs, transistors, more: $10. FIFTEEN Western Electric relays/two foot rack: $9.75. Postpaid. Satisfaction guaranteed! Computron, Box 18160-E, Cleveland, OH 44118.

PC BOARD design-fabrication, also electronics, plexiglas and more, free list. Chemlab, Box 41472M, Chicago, Ill. 60641.

HARDCOPY. Attachments to convert Smith-Corona, IBM Selectric, and IBM Executive typewriters into microcomputer printers. Free Brochure. Tim Stout Microcomputer Products, Box 1573, Fremont, CA 94538.

HIGH VOLTAGE PROJECT MANUAL



- Van de Graaff Gen.
- Kirlian Photography
- H.V. Piezoelectrics
- Tesla Coils, etc.

$5.00 ppd.
THE LISL COMPANY
2124 Kentucky
Lawrence, Ks. 66044

EXPERIMENTERS—Stop Buying Special Transformers—New Concept—Universal transformer alterable in minutes, any number of windings at any voltage (Max 50VA). Imagine winding SV at 5A plus two 12C at 1A and 15V at .4A today then changing tomorrow! Only $16.50 — 30 day refund — other models available. ETS, 398 Sound Beach Ave., Old Greenwich, CT 06870.

X MARKS THE SPOT where you will find top quality parts. Free catalog. U.S., Canada. Brand X, Rt 3, Box 223, Ontario, OR 97914.

WEAK HEAD DEMAGNETIZERS—are generally ineffective. The Han-D-Mag readily demagnetizes ALL tape transport components. Write for "Demagnetizing Notes" & literature. R. B. Annis Company, 1105 N. Delaware, Indianapolis 46202.

MODULAR PHONE CORDS, Jacks, etc. Free catalog of telephones and supplies. Flemco Sales, 20272 37th Ave., N.E., Seattle, WA 98155.

PRINTED CIRCUIT BOARDS manufactured from artwork, prototypes and production quantities. OMEGA ENTERPRISES, Box 48239, Niles, Ill. 60648.

TV GAME LIQUIDATION—$10. Some need adjustment. Sold as is with wiring diagram. No COD. California residents add 6% sales tax. Dept. TVCO, 1100 West Walnut, Compton, Calif. 90220.

SEE WHAT YOU WANT—(including home movies)—when you want—on your TV—with cartridge television! Free fascinating facts. Video, 5835 Herma, San Jose, California 95123.

MICROCOMPUTER SYSTEMS. Troubleshooting Techniques-Digital Gate Decode Chart, both $5.00. Micro Info Assoc., Box 849, Castroville, Calif. 95012. Calif. residents add 6% tax.

QUALITY KITS, Test Equipment, Tools, Books, IC's, Components, Hobbyist Services, Newsletter, over 7000 schematics and plans. $1 (refundable), brings big value packed catalog. Bargains! Tek-Devices, Box 19154A, Honolulu, HI 96817.

PROTECT YOUR CB! Invisible antenna—installs minutes—no tools! Free information. Sensor, 87 Lambert, Central City, Pennsylvania 15926.

ALL TOP QUALITY BRANDS COMPONENTS. No down payment. 36 hour delivery anywhere in U.S. No-Lemon Guarantee. Altec, Bose, Cerwin-Vega, DBX, Infinity, Lux, Micro-Acoustics, OHM, Phase-Linear, others. International Hi-Fi Distributors, Moravia Center Industrial Park, Balto., Maryland 21206. Phone: (301) 488-9600.

HEAR WHISPERS 250 Yards Away! Amazing new project. Unique, Box 534-P, Nitro, W.V. 25143.

CB RADIOS, radar detectors, antennas, monitors, monitor crystals, crystalless monitors. Southland, Box 3591-B, Baytown, Texas 77520.

DIAGRAMS, Servicing Information, Radio-Television, $3.50. Specify make, model. Beitman, 1760 Balsam, Highland Park, IL 60035.

500 MHZ COUNTER. 8 digit; two ppm TCXO time base kit, $249.95. Immediate delivery. Call toll free: 1-800-828-7422. Davis Electronics, 636 Sheridan Dr., Tonawanda, N.Y. 14150.

SCIENCE SUPPLIES send 25 cents for catalog. Schubel & Son, Dept. C, Box 214848, Sacramento, CA 95821.

NRI OSCILLOSCOPE with probes, $115.00; ATR 20A Power Supply, $50.00; NRI Tuned Signal Tracer, $40.00; Heathkit 50W Audio Amplifier, $85.00; GE 8-Track Recorder Deck, $95.00; Player Deck, $29.00; RC Tester, $22.95; Transistor Tester, $25.00; BSR Turntable with Cueing, $60.00; Heathkit Stereo Cassette Recorder, $95.00 (plus $1.80 postage). Bill Sudderth, Rt. 1, Brasstown, North Carolina 28902.

CBER'S: Understand your antenna system. Optimize range, performance. $1. American Information, Dept. 47, Box 740, Katy, TX 77450.

PLANS AND KITS

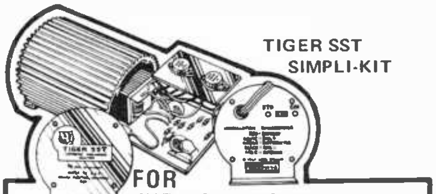
AMAZING ELECTRONIC PRODUCTS

LASERS SUPER POWERED, RIFLE, PISTOL, POCKET · SEE IN DARK · PYROTECHNICAL, DE-BUGGING · UNCRAMBLERS · GIANT TESLA · STUNWAND · TV DISRUPTER · ENERGY PRODUCING, SCIENTIFIC DETECTION, ELECTRIFYING, CHEMICAL, ULTRASONIC, CB, AERO, AUTO AND MECH DEVICES. HUNDREDS MORE · ALL NEW PLUS INFO UNLTD PARTS SERVICE.

CATALOG $1 — INFORMATION unlimited, Box 626 Lord Jeffery PZ. • Amherst, N.H. 03031

FREE KIT Catalog contains Test and Experimenter's Equipment. Dage Scientific Instruments, Box 1054P, Livermore, CA 94550.

TIGER SST SIMPLI-KIT



FOR THE DO-IT-YOURSELFER

NOW! a high quality CD Electronic Ignition System in kit form.

Contains all components and solder to build complete Solid-State Electronic CD Ignition System for your car. Assembly requires less than 3 hours.

- Increases MPG 15%
- Increases horsepower 15%
- Plugs and Points last 50,000 miles
- Eliminates 4 of 5 tune-ups
- Instant starting, any weather
- Dual system switch

Fits only 12 volt neg. ground . . . Only $21.95 postpaid

Tri-Star Corporation
P.O. Box 1727 Grand Junction, Colorado 81501

POCKET COLOR/BAR GENERATOR kit, 16 patterns, $49.95. Plans, $4.95. Workshop, Box 393PF, Bethpage, New York 11714.

MIXERS — Preamps — Speakers, Top Quality Kits — Plans — Parts. Send 25 cents for catalog. Audio Design & Engineering Co., P.O. Box 154, Lee, Mass. 01238. (413) 243-1333.

NEW! CONVERT TV TO 6 FT. WIDE SCREEN!

Easy Do-It-Yourself Kit

Project a giant 5'x6' picture onto wall or screen. B&W/Color. Kit contains detailed plans, Inst., and Precision Lens System. Only $15.95 ppd., or write for Free illustrated details.

Guaranteed to Work!

The Macrocoma Co., Dept. DB
Washington Crossing, PA 18977

THE "KING OF KITS". Artisan Organ Kits feature all new modular construction, with logic-controlled stops and RAM Preset Memory System. Write for brochure to: AOK Manufacturing, Inc., P.O. Box 445, Kenmore, WA 98028.

LASER WELDING PLANS—$9.00; Five Laser Plans—$8.00; catalog—$2.00. Solaser, PE1077, Box 1005, Claremont, Calif. 91711.

NEGATIVE ION Generator, (dual-stage). Detailed Construction Plans, $10.00. Golden Enterprises, Box 1282-PE, Glendale, Arizona 85311.

BURGLAR ALARMS

Burglar . Smoke Fire Alarm Catalog

• Billions of dollars lost annually due to lack of protective warning alarms.

FREE CATALOG Shows you how to protect your home, business and person. Wholesale prices. Do-it-yourself. Free engineering service.

Burdex Security Co.
Box 82802 PE 107 Lincoln, Ne. 68501

C.B.'s BECOME BURGLAR ALARMS with Modex Alarm Circuit. Plans $1.99. Modex, Box 887, Middletown, Conn. 06457.

DIALING UNIT automatically calls police. $29.95. Free security equipment catalog. S&S Systems, 5619-C St. John, Kansas City, MO 64123. (816) 483-4612.

WANTED

GOLD, Silver, Platinum, Mercury wanted. Highest prices paid by refinery. Ores assayed. Free circular. Mercury Terminal, Norwood, MA 02062.

TUBES

RADIO & T.V. Tubes—36 cents each. Send for free Catalog. Cornell, 4213 University, San Diego, Calif. 92105.

TUBES receiving, factory boxed, low prices, free price list. Transleteronic, Inc., 1365 39th Street, Brooklyn, N.Y. 11218A, Telephone: 212-633-2800.

TUBES: "Oldies", Latest. Supplies, components, schematics. Catalog Free (stamp appreciated). Steinmetz, 7519-PE Maplewood, Hammond, Ind. 46324.

TAPE AND RECORDERS

RENT 4-Track open reel tapes—free brochure. Stereo-Parti, P.O. Box 7, Fulton, CA 95401.

8-TRACK and CASSETTE BELTS — money back guarantee. Long wearing. Free Catalog — $3 minimum order. PRB Corp., Box 176, Whitewater, Wisconsin 53190.

VIDEO TAPE, Brand new. 1/2 inch, $10.50/hour. Free information. Oregon Magnetics, P.O. Box 13374P, Portland, OR 97213.

OLDTIME RADIO PROGRAMS make special Christmas gifts. Free Catalogue. Carl R. Froelich, Route One, New Freedom, Pennsylvania 17349.

RECORDS—TAPES! Discounts to 73%; all labels; no purchase obligations; newsletter; discount dividend certificates; 100% guarantees. Free details. Discount Music Club, 650 Main St., Dept 5-1077, New Rochelle, New York, N.Y. 10801.

GOVERNMENT SURPLUS

MANUALS for Govt Surplus radios, test sets, scopes. List 50 cents (coin). Books, 7218 Roanne Drive, Washington, D.C. 20021.

GOVERNMENT SURPLUS. Buy in your Area. How, where. Send $2.00. Surplus, 30177-PE Headquarters Building, Washington, D.C. 20014.

JEEPS, TRUCKS, Typically from $52.40 ... Automobiles, Boats, Motorcycles, Airplanes, Oscilloscopes, Tools, Clothing, Sports, Camping, Photographic, Electronics Equipment ... 200,000 Bid Bargains Nationwide Direct from Government ... Low as 2 cents on Dollar! Surplus Catalog and Sales Directory $1.00 (refundable). National Surplus Center, 240 Eastcass-PEL, Joliet, Illinois 60432.

PERSONALS

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free. Hermes-Verlag, Box 110660/Z, D-1000 Berlin 11, Germany.

INVENTIONS WANTED

INVENTORS: Manufacturers Need New Products. Free "Recommended Procedure," by a creative fee-based invention service company. Washington Inventors Service, 422-T Washington Building, Washington, D. C. 20005.

INVENTORS

RECOGNITION...FINANCIAL REWARD...OR CREDIT

FOR "INVENTING IT FIRST" MAY BE YOURS!

If you have an idea for a new product, or a way to make an old product better, contact us, "the idea people" We'll develop your idea, introduce it to industry, negotiate for cash sale or royalty licensing. Write now without cost or obligation for free information. Fees are charged only for contracted services. So send for your FREE "Inventor's Kit." It has important Marketing Information, a special "Invention Record Form" and a Directory of 1001 Corporations Seeking New Products.

the idea people

RAYMOND LEE ORGANIZATION
230 Park Avenue North, New York, NY 10017

At no cost or obligation, please rush my FREE "Inventor's Kit No. A-112"

Name ______

Address ______

City ______ State ______ Zip ______

Phone No ______ Area Code ______

FREE PAMPHLET: "Tips on Marketing Your Invention", from an experienced fee-based invention service company. Write: United States Inventors Service Company, Dept. T, 1435 G Street NW, Washington DC 20005.

INSTRUCTION

LEARN ELECTRONIC ORGAN SERVICING at home all makes including transistor. Experimental kit—troubleshooting. Accredited NHSC, Free Booklet. NILES BRYANT SCHOOL, 3631 Stockton, Dept. A, Sacramento, Calif. 95820.

SCORE high on F.C.C. Exams...Over 300 questions and answers. Covers 3rd, 2nd, 1st and even Radar. Third and Second Test, $14.50; First Class Test, $15.00. All tests, $26.50. R.E.I., Inc., Box 806, Sarasota, Fla. 33577.

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.D's. Free revealing details. Counseling, Box 317-PE10, Tustin, California 92680.

SELF-STUDY CB RADIO REPAIR COURSE. THERE'S MONEY TO BE MADE REPAIRING CB RADIOS. This easy-to-learn course can prepare you for a career in electronics enabling you to earn as much as $16.00 an hour in your spare time. For more information write: CB RADIO REPAIR COURSE, Dept. PE107, 531 N. Ann Arbor, Oklahoma City, Okla. 73127.

LEARN WHILE ASLEEP! HYPNOTIZE! Astonishing details, strange catalog free! Autosuggestion, Box 24-ZD, Olympia, Washington 98507.

GRANTHAM'S FCC LICENSE STUDY GUIDE — 377 pages, 1465 questions with answers/discussions — covering third, second, first radiotelephone examinations. $13.45 postpaid. GSE, P.O. Box 25992, Los Angeles, California 90025.

INTENSIVE 5 week course for Broadcast Engineers. FCC First Class license. Student rooms at the school. Radio Engineering Inc., 61 N. Pineapple Ave., Sarasota, FL 33577 and 2402 Tidewater Trail, Fredericksburg, VA 22401.

HIGHLY EFFECTIVE Degree Program in Electronics Engineering. Advance rapidly! Our 31st Year. Free literature. Cook's Institute, Box 20345, Jackson, Miss. 39209.

1977 TESTS-ANSWERS for FCC First Class License. Plus "Self-Study Ability Test." Proven! $9.95. Moneyback Guarantee. "FREE" BROCHURE. Command, Box 26348-P, San Francisco 94126.

GET your Commercial FCC License. New Exams by author of successful published workbooks of FCC Practice Tests. 500 Questions Second Class, $11.95; 200 First Class, $7.95; 100 Radar, $4.95; Postpaid. Save, all three $19.95. Complete mathematical solutions. Free counselling service. Victor Veley, P.O. Box 14, La Verne, Calif. 91750.

MICROCOMPUTERS—Learn microcomputer and microprocessing software and hardware fundamentals for hobby or career expansion. Send $5.95 per book to: Computer Concepts, P.O. Box 641, Dept. 23A, Hackensack, N.J. 07602.

COMPUTER PROGRAMMING (BASIC and FORTRAN), Mathematics, Electronics, FCC license. Free information: Intermountain Technical Institute, Box 258, Jerome, Idaho 83338.

MUSICAL INSTRUMENTS

UP TO 60% DISCOUNT. Name brand instruments catalog. Freeport Music, 114 G. Mahan St., W. Babylon, N.Y. 11704.

BUSINESS OPPORTUNITIES

I MADE $40,000.00 Year by Mailorder! Helped others make money! Free Proof. Torrey, Box 318-NN, Ypsilanti, Michigan 48197.

FREE CATALOGS, Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

MAILORDER MILLIONAIRE helps beginners make $500 weekly. Free report reveals secret plan! Executive (1K10), 333 North Michigan, Chicago 60601.

GET RICH with Secret Law that smashes debts and brings you $500 to $5 Million cash. Free report! Credit 4K10, 333 North Michigan, Chicago 60601.

HIGHLY PROFITABLE **ONE-MAN ELECTRONIC FACTORY**

Investment unnecessary, knowledge not required, sales handled by professionals. Postcard brings facts about this unusual opportunity. Write today! Barta-AL, Box 248, Walnut Creek, CA 94597.

NEW LUXURY Car Without Cost. Free Details! Codex-ZZ, Box 6073, Toledo, Ohio 43614.

MECHANICALLY INCLINED individuals desiring ownership of Small Electronics Manufacturing Business — without investment. Write: Marks, 92-K9 Brighton 11th, Brooklyn, New York 11235.

$500 PER DAY POSSIBLE. New C.B. related business. Send 25 cents. P.A. Schubert Company, P.O. Box 187, Howell, Mich. 48843.

$500.00 WEEKLY! IMMEDIATE Home income stuffing envelopes. FREE Supplies! Guaranteed! Send 25 cents, Stamp. ALCO, B19110-PE0, Las Vegas, NV 89119.

CONSULTING BUSINESS: How to start, operate, promote. $1,000 weekly. Get rich giving advice! Free Details ... write: Hamilton, Dept. PE-10, Box 88043, Indianapolis, IN 46208.

STUFF ENVELOPES, $250 per 1,000. Free Supplies, send stamped, self-addressed envelope: Midwest Data Systems, P.O. Box 3684, Peoria, IL 61614.

EARN $1,000 MONTHLY

Work one hour daily in the privacy of your home and in your spare time. "GUARANTEED," "FREE DETAILS" write: UNICORN, ZE 7350 NUGGET COURT, COLORADO SPRINGS, COLO. 80911.

HOME ENTERTAINMENT FILMS

SHOP EARLY FOR CHRISTMAS! Order Columbia, Universal & Sportlite Super 8 sound & silent action films. "Wheels Keep Rolling" 1976 Indy 500 film. Super 8 color 200' reel only $18.95 ea plus 75 cents shipping. Make selections from Columbia catalog 85 cents; Universal 8 catalog 75 cents; Sportlite forms 35 cents. SPORTLITE Elect-10, 20 N. Wacker Dr., Chicago, IL 60606.

REAL ESTATE

BIG...FREE...FALL CATALOG! Over 2,500 top values coast to coast! UNITED FARM AGENCY, 612-EP, West 47th, Kansas City, MO 64112.

EMPLOYMENT OPPORTUNITIES

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details FREE. Aviation Employment Information Service, Box 240E, Northport, New York 11768.

OVERSEAS JOBS! All Occupations! Complete Details. Where and How to Apply. Latest Company lists. Resume Tips. $2.00. Information Services, P.O. Box 3345P, Cocoa, Florida 32922.

DO-IT-YOURSELF

MODULAR TELEPHONES now available. Sets and components, compatible with Western Electric concept. Catalog 50 cents. Box 1147W, San Diego, California 92112.

TAPE-SLIDE SYNCHRONIZER, lap-dissolve, multiprojector audiovisual plans $8.50. Free Catalog. Millers, 1896 Maywood, South Euclid, OH 44121.

MAKE PROFESSIONAL QUALITY PC boards with silk-screen techniques. Complete information, $4.95 postpaid. TerraTronic Research, Box 513SP, Quincy, Ill. 62301.

REPAIRS AND SERVICES

SERVICEMEN — Cleaners, Lubricants, Adhesives for all electronic repairs — Write for FREE catalog. Projector-Recorder Belt Corp., Box 176, Whitewater, WI 53190. (414) 473-2151.

HIGH FIDELITY

DIAMOND NEEDLES and Stereo Cartridges at Discount prices for Shure, Pickering, Stanton, Empire, Grado and ADC. Send for free catalog. LYLE CARTRIDGES, Dept. P, Box 69, Kensington Station, Brooklyn, New York 11218.

RUBBER STAMPS

RUBBER STAMPS, BUSINESS CARDS. Many new products. Catalog. Jackson's, Dept. K, Brownsville Rd., Mt. Vernon, Ill. 62864.

BOOKS AND MAGAZINES

FREE book prophet Elijah coming before Christ. Wonderful bible evidence. Megiddo Mission, Dept. 64, 481 Thurston Rd., Rochester, N.Y. 14619.

POPULAR ELECTRONICS INDEXES For 1976 now available. Prepared in cooperation with the Editors of "P/E," this index contains hundreds of references to product tests, construction projects, circuit tips and theory and is an essential companion to your magazine collection. 1976 Edition, $1.50 per copy. All editions from 1972 onward still available at the same price. Add $.25 per order for postage and handling, $.50 per copy, foreign orders. INDEX, Box 2228, Falls Church, Va. 22042.

TECHNICAL MANUALS — Ameco, Arrl, Cowan, Gilfer, Rider, RCA Radio Callbook, Sams, Tab, T.I. Postage 35 cents bk, ppd. Five. Madison Electronics, 1508 McKinney, Houston, Texas 77002.

HYPNOTISM

SLEEP learning. Hypnotic method. 92% effective. Details free. ASR Foundation, Box 23429EG, Fort Lauderdale, Florida 33307.

FREE Hypnotism. Self-Hypnosis. Sleep Learning Catalog! Drawer H400, Ruidoso, New Mexico 88345.

AMAZING self-hypnosis record releases fantastic mental power. Instant results! Free trial. Write: Forum (AA10), 333 North Michigan, Chicago 60601.

MISCELLANEOUS

CORVAIR PARTS—catalog of 3,000 Corvair parts — $2.25. Clark's Corvair Parts, Shelburne, Mass. 01370. (413) 625-9092.

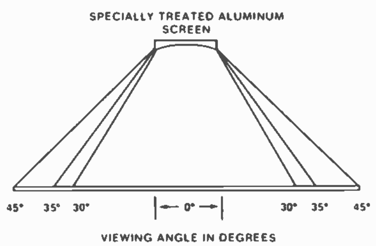
DELICIOUS! Chicken Vegetable Soup recipe $1.50 and SASE. RMSSR ZD, P.O. Box 34052, Phoenix, Arizona 85067.

HOW TO CHOOSE A PROJECTION TV SCREEN

(AND WHY TO CHOOSE OURS)

The screen you select for your projection TV shouldn't be just an afterthought. It can be one of the most critical components in your system.

Since most lenses gather less than 10% of the light from the picture tube, what your audience sees (or doesn't see) depends largely on the efficiency of the screen.



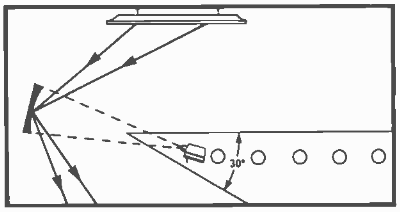
Reflection pattern of Kodak Ektalite screen shows a uniformly bright image across a typical viewing area.

The two most important criteria are: How bright is the reflected image in the actual viewing area? And how well is ambient light deflected?

The Kodak Ektalite screen. Brighter, better image for your audience.
The Ektalite screen combines a specially treated aluminum foil surface and a curved shape. These two features work together to "focus" a bright image into a viewing area roughly 60 degrees wide by 30 degrees high.

The level of reflectivity is 10 times that of a conventional matte screen. And because ambient light originating outside the viewing area is rejected, the Ektalite screen can be used in normal room light.

Blacker blacks mean brighter colors.
Images on an Ektalite screen appear richer, more exciting than on conventional screens. That's because the screen is dark except for the light projected onto it. This background "blackness" brings out color saturation and contrast.



The Ektalite screen deflects ambient light away from the line of vision of the audience, so screen image is bright and clear even with room lights on.

Images are crisp and bright—not washed out by stray light. You get more impact from your picture.

Send the coupon for full details on the Kodak Ektalite screen, plus a list of AV dealers.

Eastman Kodak Company
Dept. A0030
Rochester, N.Y. 14650

Please send complete technical details on the Kodak Ektalite screen, plus a list of AV dealers.

Name

Title

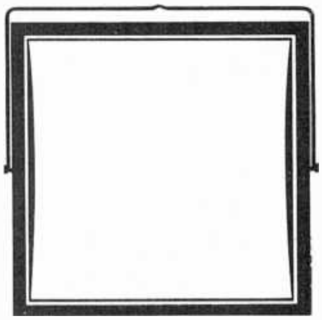
Organization

Address

City

State Zip

Kodak Ektalite projection screen



CIRCLE NO 66 ON FREE INFORMATION CARD

ATTENTION DEALERS:

Announcing

Jim-pak®

electronic components

One-Stop Component Center

- Over 200 quality items including integrated circuits, resistors, diodes, transistors, capacitors, connectors, switches, sockets, LEDs and Data Books covering all JIM-PAK® items.
- Immediate delivery on all orders
- Store display racks available
- Stock rotation and return policy
- Direct mail program available from list of active electronic buyers in dealers' area.
- National advertising campaign in leading electronics magazines to include list of qualifying dealers
- Nationally known manufacturers' products at prices every dealer can afford
- Guaranteed products
- Standard industry part numbers

A component line of proven sellers developed for the independent dealer. Ideal for computer shops, school stores, electronic dealers, hobby shops, or any location where there is a potential market for electronic sales.

A product line which supplies most of your needs from one distributor with a reputation for fast and efficient service. Attractive and compact display racks make initial installation of the JIM-PAK® line easy.

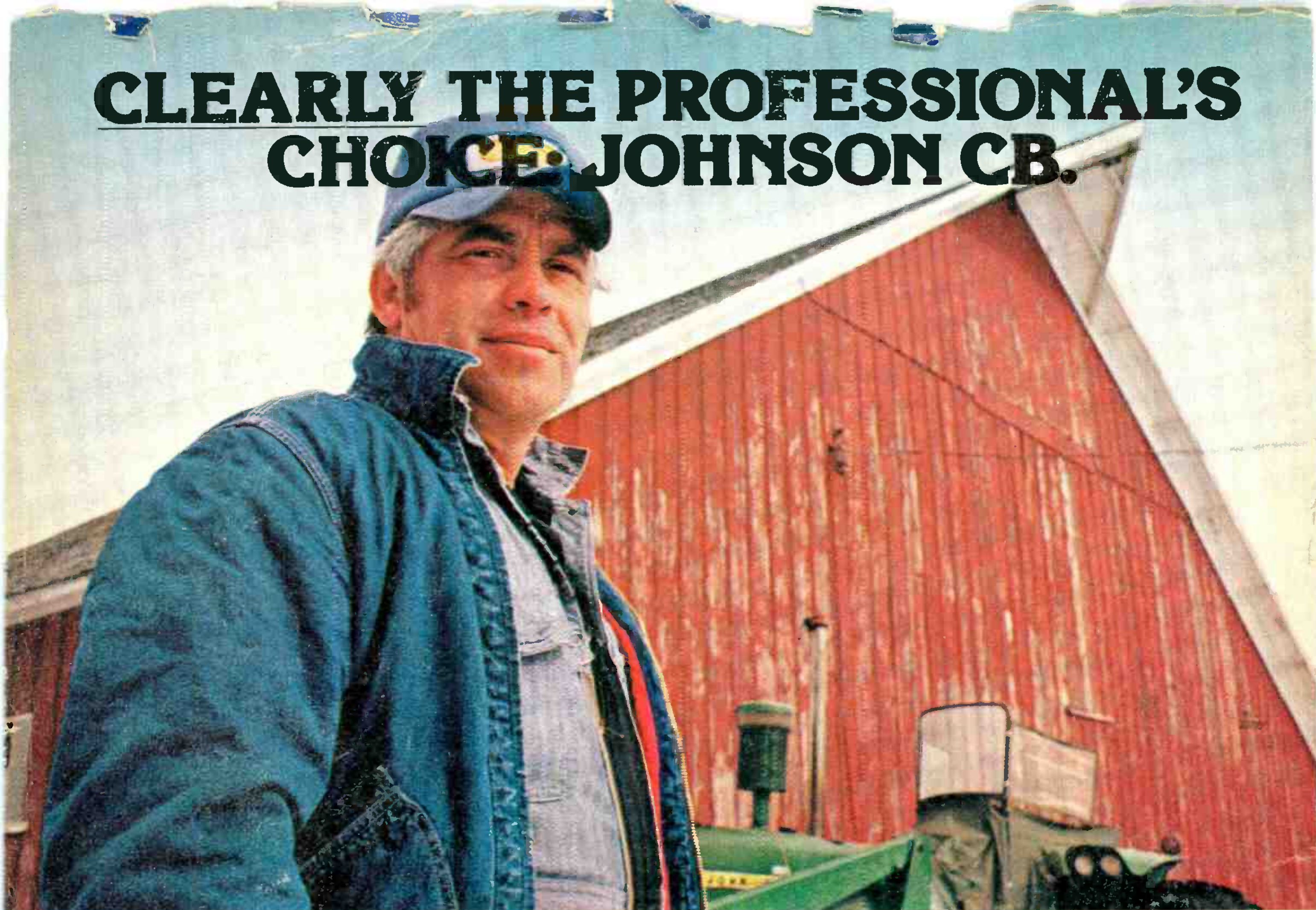
Your customers deserve the best. Now you can profitably retail name brand components at competitive prices. Be the first in your area to announce and sell the JIM-PAK® line. Write or call today.

FOR MORE INFORMATION AND PRICING SCHEDULE CONTACT:

Jim-pak® electronic components, a division of James Electronics, 1021 Howard Avenue, San Carlos, California 94070, (415) 592-8097

CIRCLE NO 28 ON FREE INFORMATION CARD

CLEARLY THE PROFESSIONAL'S CHOICE: JOHNSON CB.



Two to one over the next leading brand. That's how American farmers rate Johnson CB.

CB radio is becoming increasingly important on American farms to help save time, save fuel and to increase efficiency and productivity.

Performance and reliability mean a lot to these professionals.

The CB radio farmers use? Johnson . . . in a recent survey, Johnson was named more than twice as often as the next leading brand when farmers were asked what make of CB radio they owned.*

And for 1977, we've got a whole new line of 40-channel CBs for farmers, for you and for everybody who's serious about quality. CBs with more features and more value per dollar than ever before.

Exclusive features like our X300D single chip frequency synthesis circuitry for greater accuracy and reliability.

And our exclusive Tapered Automatic Noise Limiter that adjusts itself to changing noise conditions. Or the brightest idea in S/RF meters yet—Johnson's Power-Bar LED meter that can be read accurately at a glance from any angle. Johnson's electronic speech compression gives maximum transmit range and Johnson's voice-tailored audio circuitry delivers quieter, better reception.

Of course, you still get Johnson's solid, made-in-America quality and reliability. Plus the best warranty/service protection in CB—one-year on parts and labor with more than 1,000 Authorized Johnson CB Service Centers nationwide.

Made in U.S.A.

Johnson CB. Clearly the professional's choice.

*A copy of the Farmer Survey is available upon request.

JOHNSON®

PERSONAL COMMUNICATIONS DIVISION
E. F. JOHNSON COMPANY, CLEAR LAKE, IOWA 50428
In Canada: A. C. Simmonds & Sons, Ltd.

CIRCLE NO. 33 ON FREE INFORMATION CARD