

Radio- Electronics

**ELECTRONIC DEVICES
FOR SELF-IMPROVEMENT**

\$1.25 MAY 1980

**Put your cap meter to better use
What happened at WARC-79
Build a \$125 triggered scope**

**Dial-up network for home computers
Inside the Beta video recorder
Build a wide-range audio generator**



**BUILD THIS
PROFESSIONAL
DRUM SYNTHESIZER**



Take a good look at VACO.



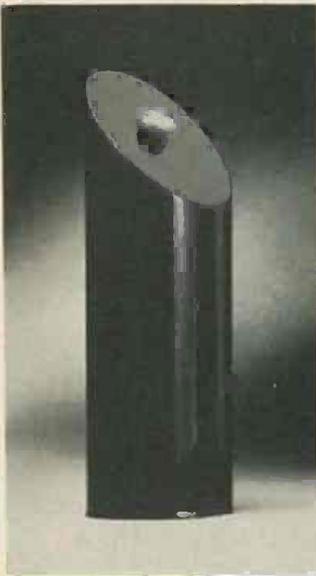
THE SUPER CASE
70260

The world famous Super Case. Complete with 48 of the most popular and professional problem-solving tools. From screwdrivers and nutdrivers to pliers, wrenches, crimping tools and more. A super variety and super value. All unconditionally warranted from Vaco, of course. The Super Case and all the other fine Vaco tools can be seen in our new 1979 catalog. It's free, just write. Say you want to take a good look at VACO.

Vaco Products Company, 1510 Skokie Blvd.,
Northbrook, IL 60062 U.S.A.

VACO[®]

CIRCLE 36 ON FREE INFORMATION CARD



The new Energaire ionized oxygen generator will make a handsome addition to any desk.

Miracle Fuzz

A new space-age invention and the same effect as lightning combine to create the world's first home oxygen regeneration system.

You need oxygen to live. You can live without food for 60 days, without water for seven days, but without oxygen, you won't make it past two minutes.

That small piece of fuzz located on top of the cylinder shown above emits negatively-charged electrons which attach themselves to molecules of oxygen, thus creating ionized oxygen.

You are already familiar with ionized oxygen if you've smelled the air after a thunderstorm. You feel great, revitalized, and alert. The lightning from the storm adds a small negatively-charged electron to each oxygen molecule in a process called ionization.

SCIENTISTS DISCOVER

Scientists discovered that air quality can actually affect your moods, your feelings and your sense of well being. Air that is positively charged caused people to be depressed, moody and tired. Negatively-charged air made people feel good. We have all experienced air that is positively charged in air-conditioned buildings or in a polluted environment.

Scientists looking for a way to turn positively charged air into negatively charged air developed the negative ion generator—a product that produces negatively charged particles that attach themselves to air molecules and thus create the same fresh feeling you get after a thunderstorm.

The new space-age product shown above is an ionized oxygen generator called the Energaire air purifier. The copper mesh fuzz on top of the unit is one of the secrets of the system.

Although it has no moving parts, you can actually feel a wind of ionized oxygen produced from the fuzz which spreads to fill an average-sized room in one minute.

CIGARETTE SMOKE TEST

To show the dramatic effect of ionized oxygen, you can take the Energaire, blow cigarette smoke into a clear bowl, and hold the bowl inverted over the system. The smoke will vanish. The charged oxygen particles appear to dissolve the smoke particles, precipitating them from the air.

In a room, the Energaire air purifier surrounds you with these oxygen ions and cleans and purifies the air so that even in a smoke-filled room, you will be breathing cleaner, country-fresh air all day long.

WALL TEST

Take our unit and place it next to a wall. Also

put a large piece of paper on the wall. Within a few days notice how black the paper gets. That black film is fine carbon particulate matter—the same pollutants you would normally breathe and that would pass through most air filters. By placing the unit in the center of a room or away from a wall, that same matter falls to the ground as dust.

A trip into the mountains exposes you to nature's freshly ionized oxygen. The Energaire produces this same effect. It will clean your room of odor-causing bacteria and stale, musty, or smoky air.

Ionized oxygen should not be confused with ozone. Ozone has a molecular formula of O_3 , whereas the molecular formula for ionized oxygen is O_2 with a negatively-charged ion.

DON'T BE CONFUSED

After we announced the Energaire last year, many companies came out with their own ion generators. We purchased a unit from each company and tested them at an independent laboratory. The results are shown below:

Name	*Ions	Price
Energaire	438,000	\$79.95
Omega 70Q	63,000	245.00
AirCare	72,000	149.95
Modulion	75,000	79.95

*Measurements indicate total number of ions per cubic centimeter per second at one meter. These figures may vary by plus or minus 10%.

Note: One unit not mentioned above produced no ions and actually produced ozone or several times the maximum ozone concentration allowed by federal government standards.

USED IN HOSPITALS

Many hospitals are now using ionized oxygen systems in their operating rooms and burn centers. Their units not only purify the air, but they also eliminate pollen and other irritants.

Working in a clean air environment, you think clearer, are more alert, and you function better. The Energaire is actually a miniature lightning machine. The minute you plug it in, energy is converted into ionized oxygen. This efficient system uses one watt of power or less than a penny per day to operate, so you leave it plugged in continuously.

We are so impressed with the pleasant effect of Energaire that we urge you to personally test it yourself in your home or office. Order one at no obligation. Put it by your desk, or in any room where you spend a great deal of time. See if it doesn't rid your room of odor-causing bacteria and stale, musty or smoky air. Try the smoke and paper tests mentioned in this advertisement.

SLEEP FASTER

At home, use the Energaire by your bed and see how country-fresh air allows you to sleep easier, deeper, and more relaxed.

You should notice the difference within one day—especially in a work environment. But use the Energaire for a full month. Then, if you do not feel totally convinced of the positive effects of ionized oxygen, return your unit for a prompt and courteous refund.

The Energaire is manufactured by the Ion Foundation, a leading ion research and development company.

Service should never be required, but if it is, there's a prompt service-by-mail center as close as your mailbox. JS&A is America's largest single source of space-age products—further assurance that your modest investment is well protected. The Energaire measures 9" high by 3" in diameter and weighs 24 ounces.

To order your Energaire ionized oxygen generator, send \$79.95 plus \$3.00 for postage and handling (Illinois residents, please add 5% sales tax) to the address shown below or credit card buyers may call our toll-free number below. We will send your Energaire ion generator complete with 90-day limited warranty on the electronics, a five-year warranty on the fuzz, and complete instructions.

Let space-age technology revitalize your life with the world's first home ionized oxygen generator. Order one at no obligation today.

JS&A PRODUCTS
THAT
THINK®

Dept. RA One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-7000
Call TOLL-FREE 800 323-6400
In Illinois Call (312) 564-7000

© JS&A Group, Inc., 1980

Ion Fountain™

YOUR ULTIMATE AIR FRESHENING/
IONIZING SYSTEM. TOP QUALITY.
LOW PRICE. STATE OF THE ART.



Breakthrough. The new Ion Fountain™ is in a class by itself. This negative ion generator gives you power to saturate your home or office with billions of refreshing ions. Without fans or any moving parts it puts out a pleasant breeze. A pure flow of ions pours from the top like water from a fountain, filling your room. The result? Your air feels like fresh ocean air—pure, crisp, and wonderfully charged.

The price? Only \$79.95. That's a price breakthrough because no other company can offer you a unit with higher ion output or better quality than the Ion Fountain™, even at triple our price.

HOW CAN WE DO IT?

Six years of experience helps. Plus a lot of ingenuity, aggressive research and a personal commitment to give our customers the best we can.

UTP Ion Research Center is a branch of our educational publishing company. And our commitment in publishing to give birth to new ideas and methods that enrich humanity is part of the Ion Research Center too. We're in business to serve you and your environmental needs.

WHAT ARE IONS?

Ions are electrically charged atoms in the air with either a positive or negative charge. The sun and cosmic rays as well as lightning and fast-moving water (like waterfalls, surf) generate trillions of negative ions every day. The more negatively ionized the air, the fresher and more alive it is. Air pollution, artificially controlled climates (with air conditioning and heating) and electronic equipment all produce excess positive ions, depriving the air of these small negative air ions and creating dead "stuffy" air.

WHAT'S THE SOLUTION?

Our rapid-growth technology, which sometimes takes its toll on the quality of our air, has also come up with the solution. Following Nature's model of the thunderstorm which uses a high electrical charge to purify, revitalize and stimulate the air, the UTP Air Energizer has been developed imitating this process. Both the thunderstorm and the Air Energizer fill the air with negative ions, restoring the natural electrical balance to the polluted, energy-depleted air. But the Ion Fountain can be used indoors in the home, office, workshop, laboratory, etc., keeping a fresh supply of ionized oxygen available night and day. This new breakthrough in fresh air control is not a cover-up

which masks or deodorizes. The unit actually removes the dust, smoke, bacteria and pollen particles from the air by attaching ions to them and causing them to sink to the earth where they can be vacuumed up rather than inhaled. At the same time ions electrically stimulate the energy-stripped air.

YOUR CHOICE OF TWO TOP-QUALITY UNITS!

There's only one unit that's better than the Ion Fountain. That's our own Executive System Four™. It sells for \$159. It has an even higher ion output. Plus! Our special Dial-An-Ion feature allows you to adjust the ion output anywhere from low to high. Not everyone knows that the need for ions varies. A large smoky room will require higher output than a small room. And some people want fewer ions while sleeping than while working. The new Executive System Four is our answer to this need for output flexibility.

FACTS YOU NEED TO KNOW The Ion Fountain™—System Five

<i>Ion density:</i>	430,000 ions per cm ³ /sec. at 1 meter. 1.55 million ions per cm ³ at 50 cms.
<i>Use:</i>	Large room or office—9000 cu. ft.
<i>Warranty:</i>	1 year
<i>Output voltage:</i>	15KV
<i>Ozone:</i>	Less than 2 parts per billion
<i>Dimensions:</i>	5 3/4" x 4 1/4" x 2 3/4"

Executive System Four™

<i>Ion density:</i>	Low to maximum of 540,000 ions per cm ³ at 1 meter. 1.6 x 10 ⁶ ions per cm ³ at 50 cms.
<i>Output voltage:</i>	15KV
<i>Ozone:</i>	Less than 2 parts per billion
<i>Dimensions:</i>	11" x 5" x 4"
<i>Use:</i>	Large room or office 10,000 cu. ft.
<i>Warranty:</i>	1 year

If the Executive System Four is better, why did we bring out the Ion Fountain? Not everybody is willing to pay \$159 for an air ionizing unit, no matter how good it is. Just like not everyone drives Rolls Royces. Most drive less expensive cars. The Executive System Four is for the person who wants the

absolute best quality and doesn't mind paying a little extra to get it. If you want highest ion output, flexibility, and a beautiful oak paneled case, buy the Executive System Four.

If you want something at half the price of the Executive System Four, but still better than any other units costing up to \$250, buy the Ion Fountain.

HOW TO GET ONE

To place your order now just send a check for \$79.95 plus \$3 shipping for the Ion Fountain. Or send \$159 plus \$4 shipping for the Executive System Four. Tell us your full street address as we cannot ship to Post Office boxes. (California residents add 6% sales tax.)

Our unit is dependable and trouble-free, but if by rare chance any problems occur our service-by-mail center sends off your unit within 24 hours of receipt or sends a replacement so you are not without fresh air and can enjoy your dust-free environment. And each Air Energizer is backed by a full one-year limited warranty.

HOW TO GET ONE FAST

Credit card holders can call our toll-free number below. Order a unit now and if you are not satisfied with its effects within 10 days simply return it for a full cash refund. Order your Air Energizer today.

UTP

Read "The Golden Egg"

University of the Trees Press
ION RESEARCH CENTER, DEPT. RE
Box 644 BOULDER CREEK, CA 95006
Call Toll-Free . . . 800-538-0750
In California call (408) 338-6663
Send check or use your Master Charge,
Visa or American Express card.

DETECT YOUR IONS

This simple but accurate detector instantly gives you a reading of ion intensity. The Econometer . . . (Pen Size) . . . \$7.95 (If ordering separately include \$2.00 for shipping.)

SURVIVAL! Spirulina is a new wonder food supplement higher in protein than any other natural source. Very high in other nutrients too. Find out how you can be a commissioned representative of the Light Force Family and distribute Spirulina in either bulk or as special vitamin supplements. Generous commissions and opportunities available. Phone or write for your free information. (408) 338-9436. Please do not use the toll-free number for information.

SPECIAL FEATURE 45

ELECTRONIC DEVICES FOR SELF-IMPROVEMENT

A look at how state-of-the-art electronics have combined with recent medical discoveries to help you master your mind and body's "involuntary" reactions. David R. Wheeler

62

NEW USES FOR YOUR CAP METER

If your capacitance meter is collecting dust, then you're not using it to its fullest advantage. Here's a look at some of its many uses besides testing capacitors. Martin Bradley Weinstein

BUILD THIS 49

PROFESSIONAL DRUM SYNTHESIZER

Unique device provides many of the features only found in synthesizers costing several times more. Steve Wood

53

TRIGGERED OSCILLOSCOPE

Part 2—Final construction details for a scope with a 2-MHz bandwidth and a zero baseline display for under \$125. Daniel Metzger and Dennis Perry

57

VERSATILE ANALOG INTERFACE

When connected to your computer, this simple device along with the proper software can be used for a wide variety of interfacing applications, including joysticks. John R. Hanson

76

WIDE-RANGE AUDIO GENERATOR

Great addition for your test bench produces sine and square waves over the audio band from 10Hz to 50kHz. Richard Schroeder

TECHNOLOGY 4

LOOKING AHEAD

Tomorrow's news today. David Lachenbruch

16

SATELLITE TV NEWS

The latest happenings in an exciting new industry. Gary H. Arlen

82

NEW IDEAS

A winning circuit application from our readers.

COMMUNICATIONS 60

WARC-79

Here are the results of the long-awaited World Administrative Radio Conference with an analysis of its expected impact. Stanley Leinwoll

88

COMMUNICATIONS CORNER

What is frequency companding and how it can jam more channels into the RF spectrum. Herb Friedman

VIDEO 65

TROUBLESHOOTING BETA TRANSPORT MECHANISMS

How to troubleshoot the transport mechanism in Beta-type videocassette recorders and how to fix them. Forest Belt

68

SERVICING COMMUNICATIONS EQUIPMENT

Repair and installation of two-way radios can be an alternative field for service shops. Greg Grambor

AUDIO 72

MORE ON SUPER CLASS-A AMPLIFIERS

New amplifier design produces ultra-low distortion levels. Here's a look at the driver stages. Len Feldman

74

R.E.A.L. SOUND LAB TESTS DENON CASSETTE DECK

Denon model DR-750 cassette deck rates excellent.

COMPUTERS 70

DIAL-UP COMPUTER SOFTWARE

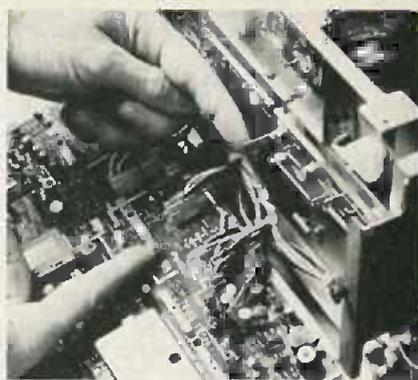
A look at the national software networks that your computer accesses via the telephone lines—what they offer and how to connect up. Jules H. Gilder

DEPARTMENTS 134

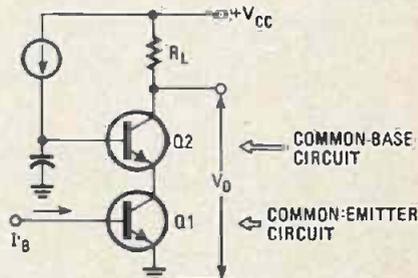
14	Advertising Index	22	Letters
104	Advertising Sales Offices	112	Market Center
101	Books	106	New Lit
14	Computer Products	96	New Products
26	Editorial	90	Radio Products
135	Equipment Reports	98	Stereo Products
84	Free-Information Card	92	Service Clinic
	Hobby Corner	93	Service Questions

ON THE COVER

This professional drum synthesizer consists of four individual modules that combine to provide features found only on synthesizers costing several times more. A unique pressure-sensitive transducer mounted inside the practice pad lets you literally pound out a tune. Get started building your own today, the story starts on page 49.



IT LOOKS COMPLICATED, and in fact, it is! It's the transport mechanism of a Beta-type videocassette recorder. But don't let looks scare you off. To find out how to troubleshoot and fix it, turn to page 65.



CASCODING CONFIGURATION of a common-emitter and common-base amplifier stages provide ultra-low distortion. To find out how this circuit works, turn to page 72.

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Phone: 212-777-6400. Controlled Circulation Postage Paid at Concord, NH. One-year subscription rate: U.S.A. and U.S. possessions, \$13.00, Canada, \$16.00. Other countries, \$18.00. Single copies \$1.25. © 1980 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

Subscription Service: Mail all subscription orders, changes, correspondence and Postmaster Notices of undelivered copies (Form 3579) to Radio-Electronics Subscription Service, Box 2520, Boulder, CO 80322.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

looking ahead

Fun and games: The latest electronics field to crack the billion-dollar sales mark probably will be the toy-and-game business. According to industry estimates, sales of those products at retail could total from \$800 million to \$1 billion in 1980—double the figure reached last year. There are an estimated 250 to 300 different electronic toys and games now on the market. One manufacturer, Coleco, says that factory sales last year totaled some \$425 million, with hand-held sports games leading the parade at about \$200 million. Football represented about half the sports game sales, followed by baseball, soccer, hockey, and basketball. Non-sports action games (shooting, space games, etc.) represented \$125 million; play and learning games at \$75 million, and miscellaneous toys at \$25 million.

Voice recognition and synthesis are promising new game-and-toy areas. A new game by Mattel has a microphone for each of two players and responds to vocal commands, distinguishing between their voices. Milton Bradley has introduced a new game which speaks half a phrase, challenging the participant to push the proper button to complete the phrase.

Microwave radiation: At what point can microwave radiation become hazardous to your health? That subject is preoccupying the Environmental Protection Administration, the Occupational Health and Safety Administration, the FCC, and many state and local bodies. It involves the telecommunications-electronics industry deeply, and will cut even deeper if it is determined that areas around powerful transmitters may be detrimental to wellbeing. The subject was brought into focus when it was found that the American Embassy in Moscow was being subjected to about 18 microwatts (μ W) of radiation per square centimeter, presumably from Soviet monitoring devices. (Interestingly enough, the Soviet Union has a set of standards which permits a maximum radiation level of only 1/20 of this value.) Although some Embassy employees complained of ill health, it's not known whether the radiation was responsible.

There are no official government standards for microwave radiation limits—the closest to a standard being the American National Standards Institute recommendation that levels be kept to 10,000 microwatts (10 milliwatts) or less. New York City has proposed a limit of fifty microwatts in populated areas—1/200 of ANSI's recommendation. Broadcasters say that this would result in a cutback so sharp that TV stations couldn't serve the metropolitan area.

Now, for the first time, the issue of microwave radiation is vitally affecting plans of broadcasters. The move of ten New York TV stations to the 110-story World Trade Center, scheduled for early 1980, has been postponed as the result of tests made with two UHF stations operating at full power from the 350-foot mast atop the Center's north tower. Radiation at the observation platform and on the top five floors of the south tower was measured at 200 microwatts and experts said it could rise as high as 360 μ W when all the stations are operating. Broadcasters and World Trade Center engineers are trying to devise shielding to prevent possible exposure of visitors and employees of the Center.

Among the proposals are a roof or some kind of screening atop the observation platform and metallized transparent Mylar wrapper on windows of the top five floors of the south tower.

JVC's videodisc: Japan Victor Corporation's VHD (Video High Density) videodisc system, now also endorsed by Matsushita Electric (see *Radio-Electronics*, April 1980), was demonstrated in production prototype form at a Tokyo press conference. The discs for the grooveless capacitance system measure 36 cm in diameter (about 10.2 inches), claimed to save about 25% in material cost as compared with a 12 inch disc. Each disc can play up to one hour per side, revolving at 900 rpm (twice the speed of the RCA disc and half the speed of the Philips/MCA disc.)

The disc, encased in a plastic cover, is fed into a slot in the player. The cover is then removed and play starts—a loading system similar to that employed by RCA. The stylus is a broad, diamond-tipped sled that rests on the disc and is positioned along the proper microscopic track by a pilot tone. The player can provide fast-forward and backward action, and accommodates dual audio tracks for stereo or two languages. An accessory provides random access, slow-motion and still frame. Another accessory converts the player into a PCM (Pulse Code Modulation) digital audio turntable.

JVC says the player could be ready for production next year and will be priced around \$500—timetable and price being similar to those established by RCA for its *SelectaVision* grooved capacitance system. RCA, meanwhile, invited some of its overseas licensees to a technical meeting on *SelectaVision* in Indianapolis. Two of the companies showing up hadn't been previously identified as licensees—Japan's Sony and Korea's Gold Star.

The presence of Sony in the group was seen as particularly significant. Sony is 50% owner of Japan's CBS/Sony Records. (The other owner is a recording licensee for *SelectaVision* videodiscs). Sony is also a licensee for the Philips/MCA optical disc system, which it plans to produce for the industrial-institutional-educational market. Other RCA videodisc licensees include such companies as Hitachi, General of Japan, Nippon Electric, Mitsubishi, Pioneer, Sharp, and Toshiba. Signing a license doesn't commit them to production. Pioneer plans to market a Philips/MCA-type player in the United States this year; it owns 50% of Universal Pioneer, which is manufacturing optical videodisc players. Sharp is also an optical disc system licensee.

TV industry returns: "Where was your TV made?" is no longer an answerable question, since television-set manufacture has become a truly international industry, with parts and subassemblies for all of them made all around the globe. But the answer to "Where was your 1980 TV assembled?" most likely is "In the U.S.A." Virtually every Japanese manufacturer selling sets here (except JVC, which is assembling in Canada) now has a plant in the United States—Sanyo in Arkansas; Forrest City, Arkansas; Sharp in Memphis, and Toshiba in Nashville, Tennessee; and Sony, Mitsubishi and Hitachi in Rancho San Bernardo (near San Diego), Irvine and Compton, California, respectively. Companies based in Taiwan and Korea are also starting assembly operations here, too. The major stimulus for those moves has been the quota on color TV imports from the Far East. But even when the quotas expire, the plants are expected to remain.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

The 90-minute miracle

Solderless saves time like you wouldn't believe. Our Proto-Board® solderless breadboards put everything you need to get your circuit up and running on an aluminum backplane that lets you work at frequencies from DC to half a Giga-Hertz. Three Proto-Board® models feature built-in regulated power supplies—and one of them's a build-it-yourself kit!

Our solderless breadboards save energy, too. Especially yours. Because circuit building becomes a simple plug-and-chug process, straight from an idea to a working circuit.

That's why we've become the easiest-to-find solderless breadboards in the world—available at more stores than anybody else in the business. Because people who know solderless best insist on ours.

Save time and energy. Get a head start with our Proto-Boards.

There are 9 Proto-Boards® in all, manufacturer's suggested U.S. resale prices from \$17.95 to \$155.00.*



GLOBAL SPECIALTIES CORPORATION

70 Fulton Terrace, New Haven, CT 06509 (203) 624-3103, TWX 710-465-1227

OTHER OFFICES: San Francisco: (415) 421-8872, TWX 910-372-7992

Europe: Phone Saffron-Walden 0799-21682, TLX 817477

Canada: Len Finkler Ltd., Downsview, Ontario

1-800-243-6077

Call toll-free for details

* Suggested U.S. resale. Available at selected local distributors. Prices, specifications subject to change without notice.

CIRCLE 31 ON FREE INFORMATION CARD

Sony is not committed to one disc system

Sony demonstrated its optical video-disc system at the International Tape Association Conference in New York last October. The system is completely compatible with the new Philips-MCA mini-disc format and provides both 30-minute and one-hour-per-side modes. Sony and Philips have a cross-licensing agreement that allows each to use each other's patent rights for a wide range of products.

But Sony is not solely committed to the optical video system. It is also developing a player and discs for a capacitance system, and is committed to marketing Betamax video cassette players and recorders to the consumer and industrial markets.

Sony has not determined marketing plans for any video-disc format at the present time, but is conducting an extensive video-disc market survey, in view of the growing demand for "random access" playback capability.

Entertainment by satellite for workers far from home

Personnel in oil, mining, shipping and other industries in remote and isolated areas of the world will now receive news, entertainment programs and late movies via satellite. Companies with personnel in isolated areas have long had the problem of maintaining morale, and have found "canned" entertainment by film or videotape an important boost. Now with satellite programming, employees will be able to watch live news and newer entertainment. A beneficial side effect to the companies will be the complete elimination of shipping and handling problems.

Transmission will be via Western Union's Westar III communications satellite, and the programming will be handled by Video Communications, Inc., of Tulsa, OK. At the time the project was announced, it was expected that transmissions would start January 1, 1980, with 12 hours of programming—to be increased to 24 hours daily before the end of the year.

Video Communications now supplies major international oil industry companies with entertainment in film and videotape form. This service will be replaced with satellite transmission. Subscribers to the service will, of course, have to install a receiving earth station.

Hi-fi stereo TV sound due within four years

Television receivers fitted with stereo TV sound will be available to American viewers two to four years from today, according to *New York Times* writer Les Brown. Its impact on the market, some believe, may be as great as that of color television, when it was introduced some years ago.

High-fidelity sound would have an important effect on TV programming. It would greatly enhance the quality of orchestral broadcasts and improve all programs that include instrumental or vocal music. Hence we might expect to see that type of material get a larger share of prime time than it does at present. A recent study indicates that the public is ready for improved sound, even if it increases the price of a television receiver by \$150 to \$300.

The technology has been available for some time, and stereo TV is in actual use in Japan, where it is also used for bi-lingual programming. (Instead of stereo, one channel is in Japanese and the other in a foreign—non-Japanese—language.)

An all-industry committee (led by Thomas B. Keller, WGBH-TV, Boston) working under the Electronic Industries Association is now at work setting up standards for American multi-channel television. It is considering four systems: the one now in use in Japan, one proposed by Quasar, the U.S. division of Matsushita, one developed by Zenith and a proposal from Telesonic, a Chicago company. The findings will be submitted to the FCC, which is expected to act as soon as it receives the recommendations.

NOW—A TAPE-OF-THE-MONTH CLUB



BOOKS ON TAPE, INC., a California organization is introducing what it calls the "driver's library," at present about 250 books on cassettes, for an average monthly rental of \$9.00. The titles range from those of current best sellers like *The Empty Copper Sea* and *The Thorn Birds*, to classic authors like Mark Twain, Charles Dickens and Sir Arthur Conan Doyle, plus such moderns as James Thurber and Erma Bombeck.

The books are not abridged and come on a series of cassettes mailed in sets to the listener. Containers are addressed for easy return, and round-trip postage is paid.

More than 150 authors have had some of their books recorded by Books on Tape. Copies of the latest catalog may be obtained from Books on Tape, Inc., P.O. Box 7900, Newport Beach, CA 92660.

Institute of High Fidelity Now merged with EIA

Officials of the Institute of High Fidelity and of the Audio Division of the Consumer Electronics Group, Electronic Industries Association, have announced the successful conclusion of negotiations to merge the IHF into the EIA/CEG. The governing bodies and full membership of both organizations have ratified the merger.

The IHF will become an operating subdivision of the EIA's Consumer Electronics Group, Audio Division. It will, besides maintaining existing IHF programs, maximize services to the constantly growing high-fidelity segment of the industry.

Video players in 30 to 50% of U.S. homes in ten years?

Video disc players will be in 30 to 50% of the country's television homes within the next 10 years, Herbert S. Schlosser, RCA executive vice president, told the Caucus for Producers, Writers and Directors at a meeting in Los Angeles last October. He told the audience that RCA expected to introduce its *SelectaVision* videodisc system with about 300 titles, of which half would be feature films.

The video player, he pointed out, will make programs available to smaller groups. Since prime-time commercial television seeks the largest possible audience, material that would interest "only" five to ten million people would not appear on prime time, which means that many millions would not get to see certain programs that interest them. The video player will permit "narrowcasting," or programs designed to appeal to smaller and specialized audiences. "And it will be possible to make a profit while reaching only a fraction of the audience required for commercial success in conventional television," he said.

AM broadcast channel spacing to be narrowed to 9 kHz?

The FCC has recommended that 9-kHz channel spacing be adopted for the AM broadcast band (See *Radio-Electronics*, December 1979, page 14.) Before being put into effect, approval of the U.S. State Department and the other nations of the Western Hemisphere will be required. Mexico and Canada are not expected to agree.

The National Radio Broadcasters Association has filed comments objecting to the new move, pointing out that tests already made have shown up difficulties not foreseen, and have demonstrated that "theoretical projections and practical results quite often differ." The Association is pressing for extensive study and testing before taking definite steps to implement the proposed change.

continued on page 12

Three good reasons to buy your handheld DMM from Fluke.

Ask yourself what you're really looking for in a handheld DMM, and then take a good long look at ours.

CHOICES? The Fluke line of handheld DMM's now offers three clear performance choices. There's the 8022A Troubleshooter, a solid value for basic voltage/current/resistance measurements that offers 0.25% basic dc accuracy. The 8020A Analyst is the world's best-selling DMM and first to offer conductance for high-resistance measurements to 10,000 Megohms — now with accuracy improved to 0.1%. And the new 8024A Investigator, a powerful instrument also with 0.1% accuracy that boasts three unique capabilities: *logic level/continuity detection* with an audible "beeper" for

instant continuity testing, and slow-speed logic checking, *peak hold* to lock onto elusive transient signals, and *direct temperature readings* to 1265°C via K-type thermocouples.

CONVENIENCE? Pick one up and you'll know what *true* one-hand operation means — tough, lightweight, palm-size packages designed with in-line push buttons for quick range and function changes.

RELIABILITY? Count on it. A substantial number of components are used exclusively to insure reliability and to guard against overloads.

Calibration is traceable directly to the National Bureau of Standards.

LOW COST? Compare these U.S. prices: \$139 for the 8022A, \$179 for the 8020A and \$219 for the powerful 8024A.

Fluke standards of quality and customer service, of course, are uncompromising — for our line of handheld DMM's and all our products. For more facts call toll free **800-426-0361**; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.



IN THE U.S. AND NON-EUROPEAN COUNTRIES:

John Fluke Mfg. Co., Inc.
P.O. Box 43210 MS #2B
Mountlake Terrace, WA 98043
(206) 774-2481
Telex: 152662

IN EUROPE:

Fluke (Holland) B.V.
P.O. Box 5053,
5004 EB Tilburg,
The Netherlands
(013) 673 973 Tlx: 52237

- Please send all the facts on Fluke low-cost DMM's.
- Please have a salesman call.

Name _____

Title _____ Mail Stop _____

Company _____

Address _____

City _____ State _____ Zip _____

Telephone () _____ Ext. _____

For technical data circle no. 24

RE 5/80

**NRI training in TV
and Audio Servicing
keeps up with the
state of the art.
Now you can learn to
service video cassette
and disc systems.**





You build color TV, hi-fi, professional instruments.

Now, in addition to learning color TV and audio systems servicing, you get state-of-the-art lessons in maintaining and repairing video cassette recorders, and the amazing new video disc players, both mechanical and laser-beam types.

Learn at Home in Your Spare Time

And you learn right at home, at your own convenience, without quitting your job or going to night school. NRI "bite-size" lessons make learning easier... NRI "hands-on" training gives you practical bench experience as you progress. You not only get theory, you actually build and test electronic circuits, a complete audio system, even a color TV.

Build Color TV with Computer Programming

As part of your training in NRI's Master Course in TV/Audio/Video Systems Servicing, you actually assemble and keep NRI's exclusive designed-for-learning 25"

(diagonal) color TV. It's the only one that comes complete with built-in computer tuning that lets you program an entire evening's entertainment. As you build it, you introduce and correct electronic faults, study circuit operation, get practical bench experience that gives you extra confidence.

You also construct a solid-state stereo tuner and amplifier complete with speakers. You even assemble professional-grade test instruments so you know what makes them tick, too. Then you use them in your course, keep them for actual TV and audio servicing work.

NRI Includes the Instruments You Need

You start by building a transistorized volt-ohm meter which you use for basic training in electronic theory. Then you assemble a digital CMOS frequency counter for use with lessons in analog and digital circuitry, FM principles. You also get an integrated circuit TV pattern generator, and an advanced design solid-state 5" triggered-sweep oscilloscope. Use them for learning, then use them for earning.

NRI Training Works... Choice of the Pros

More than 60 years and a million students later, NRI is still first choice in home study schools. A national survey of successful TV repairmen shows that more than half have had home study training, and among them, it's NRI 3 to 1 over any other school.

(Summary of survey on request.)

That's because you can't beat the training and you can't beat the value! For hundreds of dollars less than competing schools, NRI gives you *both* color TV and audio...



Other NRI training includes Computer Technology, Complete Communications Electronics.

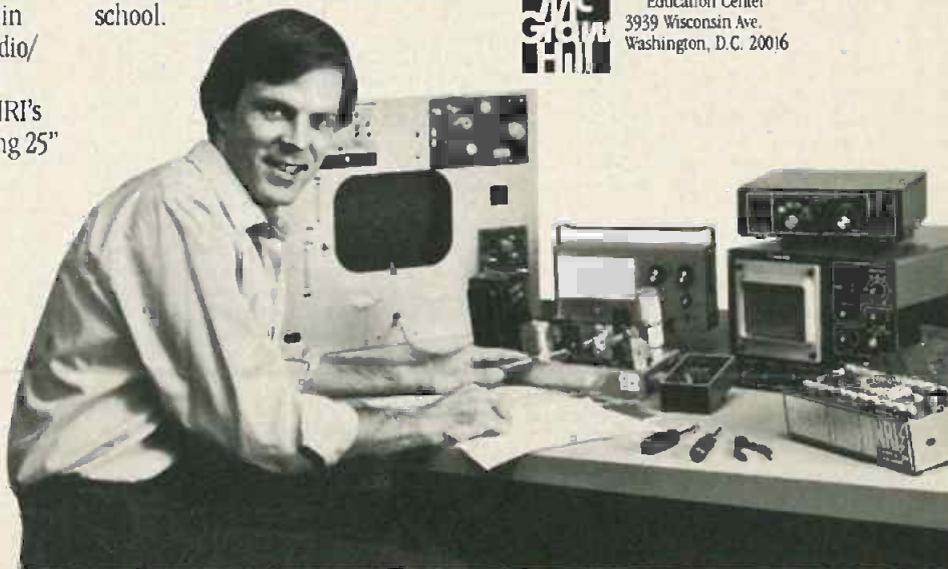
and now includes training in video cassette and disc systems. Send for our free catalog and see for yourself why NRI works for you.

Free Catalog... No Salesman Will Call

Send today for our free 100-page catalog which shows all the kits and equipment, complete lesson plans, and convenient time payment plans for courses to fit your needs and budget. Or explore the opportunities in other NRI home study courses like Microcomputers & Microprocessors, CB and Mobile Radio, Aircraft and Marine Radio or Complete Communications. Send the postage-paid card today and get a head start on the state of the art. If card has been removed, write to:



NRI Schools
McGraw-Hill Continuing
Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016



Learn at home at your convenience.

continued from page 6

Computer adjusts temperature for occupied or empty rooms

A new piece of equipment uses an intruder alarm and a door switch to reduce room temperature to a preset "empty room" value every time an occupant leaves. It then restores a higher temperature as soon as the room is again occupied.

The device was exhibited as a new product at the Second World Congress of Energy Engineers in Atlanta, GA. The manufacturer, Energy Management Systems of Austin, TX, states that production units will be available early in 1980. The device is intended for the hotel or motel market.

A sensitive, ultrasonic motion detector is combined with a remote door switch. Every time the door is opened the unit begins to monitor the room area for motion. If it discovers none, the room temperature control is set back to the "empty room" temperature until the door is again opened.

Since the temperature is set back only after detecting no motion, and since the equipment works only when the door is opened, the manufacturer believes the system is virtually fail-safe against accidentally setting back the temperature in an occupied room. (What happens if one occupant of a double-occupancy room leaves early in the morning, leaving the other asleep, is not entirely clear.)

Savings of 12 to 40% in heating costs are expected where the new device is used.

Superefficient generator to operate at -452°F

The rotor of a superconducting generator that will produce 18 megawatts of power has been put through its most severe qualifying test—spinning its 13-foot-long, 1.5-ton rotor 3,600 revolutions per minute, at 452 degrees below zero Fahrenheit (-269°C).

When completed, the new generator should produce as much electricity as a conventional machine twice its size and weight, say scientists of the General Electric Research and Development Center, Schenectady, NY, where the new generator is being developed.

At 452 degrees below zero, the windings of the stator magnets have practically no resistance; magnetic fields of fantastic strength can be produced.

The conductors used for the stator windings consist of thousands of filaments of a niobium-titanium alloy in a copper matrix. These are wound to form five racetrack windings, which are immersed in liquid helium at -452°F .

At that temperature, a critical problem was to prevent the windings from moving even a small part of a thousandth of an inch. A microscopic movement could gen-

erate enough heat through friction to reduce or destroy the superconductivity of the conductors. In the experimental generator, the windings are bonded into rock-solid modules with an epoxy-impregnation process. A unique aluminum support, designed by Dr. Trifon E. Laskaris, manager of the Center's Rotating Machinery unit, provides extra rigidity against the powerful magnetic and centrifugal forces to which the rotor is subjected.

The stator of the new superconducting generator is now under construction, and final tests of the completed generator are expected early in 1981.

SPACE PLATFORM FROM FIBERGLASS?



BEAMS OF HIGH-STRENGTH FIBERGLASS like the one above, being tested by chemist Pat Salisbury of Hughes Aircraft Co., may support platforms in the U.S. space programs. The material is fiberglass, impregnated with a polyester resin that starts out soft and sticky but becomes tough and rigid from the sun's radiation. The truss-like design is for greater rigidity. The weight is about half that of aluminum. Hughes is building a prototype seven-by-three-foot beam of this fishnet-like design for NASA's Marshall Space Flight Center at Huntsville, AL. If the idea proves practical, a series of beams could be joined to form a large platform in space, where the sun's ultraviolet rays begin hardening the material in a half hour and make it completely rigid within six hours.

CCD signal processor improves TV color

The first use of advanced charge-coupled device (CCD) technology in a mass-produced consumer product, a comb-filter signal processor that significantly improves the picture quality and sharpness of color TV sets, was described by RCA engineers

to the ninth annual Institute of Electrical and Electronics Engineers' (IEEE) Chicago Fall Conference on Consumer Electronics.

The CCD signal processor filters throughout the entire video-frequency range, thus making possible the enhancement of vertical detail in the picture. Furthermore, it is inherently stable because the CCD filter is not affected by the temperature and humidity conditions that are known to plague comb filters using more conventional technology.

The new RCA system incorporating the comb filter, through optimization of the horizontal and vertical aperture corrections, produces a clear and sharp picture free of the "dot crawl" and "cross color" that is associated with conventional color receivers.

Overall, the RCA engineers said, the new comb filter increases horizontal resolution to at least 330 TV lines compared with 260 lines in previous RCA sets.

Popular-priced metal tape announced by TDK

A new popular-priced metal audio cassette has been introduced by TDK Electronics Corp to meet the market demands created by the earlier MA-R.

TDK MA uses the same metal particle formulation as the top-of-the-line MA-R metal audio cassette. Like MA-R the coercivity and remanence of MA is 1050 oersteds and 3,000 gauss. Its magnetic energy is roughly four times that of the best high-bias tapes. The suggested list price for TDK MA is \$11.60.

Shopping mall takes lead in energy conservation

One of the largest enclosed shopping malls in North America, the Centre Mall of Oshawa, Ontario, Canada, has replaced the 80 lighting fixtures of its parking lot with 28 newly designed ones, with the double object of getting better light and saving 80 percent of the electricity formerly needed.

The older system used 320 mercury-vapor luminaires, mounted on 80 poles. With the new "double-reflector" system, each of the 28 poles carries a single thousand-watt metal halide lamp. The total consumption is 30.8 kW, as compared to 147.2 kW for the older system, making a saving of about \$9000 annually.

Besides saving energy, the new lights can be so equipped that they cut off on one or more sides, preventing "light pollution" in high-density residential areas. The smaller number of poles allows for additional parking space, and their more pleasing design improves the appearance of the parking lot.

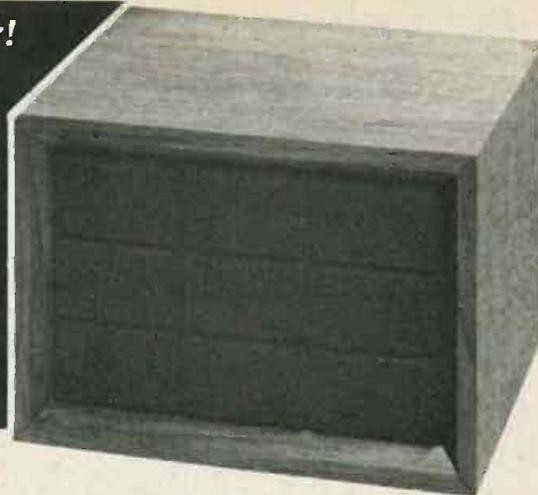
Not Just Another Limited Area Motion Detector!

guardex™

Protects Every Square Inch Of Your Building

Turns On Lights Automatically

Powerful Electronic Siren



The Guardex 8000 Alarm System is walnut grained and disguised to look like a small stereo speaker (6 3/4" x 9 3/4" x 8") and weighs less than 6 1/2 pounds.

Low Cost Computerized Burglar Alarm System Home - Office - Business

NO INSTALLATION

Just plug the Guardex 8000 alarm system in, make several simple control adjustments to suit your particular building and it works! There are no other wires to run. This totally self-contained burglar alarm can completely seal off every square inch of the surface of your building. It protects doors, windows, and what most alarms miss... your roof, walls and floors.

HOW CAN ONE SMALL COMPUTER PROTECT MY WHOLE BUILDING?

Guardex 8000 Alarm System works on the principle of audio discrimination. This, put simply, is the process of electronically separating normal everyday sounds, such as voices, telephones, etc. from break-in type noises such as breaking glass, prying metal, or forcing a door open. The Guardex 8000 protects one story homes and offices up to 2000 square feet and open commercial buildings up to 10,000 square feet. The Guardex 9300 with wireless remote sensor capability is available for multi-story homes and offices or single story with more than 2000 square feet. Call the factory for more detailed information.

TURNS ON LIGHTS AUTOMATICALLY

When the first break-in type sound is detected, the system will instantly turn on lights, radio, or other electronic equipment that you have plugged into the back of the alarm. These lights or other equipment will remain on for a period of five minutes, then automatically turn off.

POWERFUL ELECTRONIC SIREN

The Guardex 8000 alarm is equipped with a loud built-in siren. If during the five minute period the lights or other electronic equipment has been activated, a second break-in sound is detected, (it can be only a second or two after the first break-in sound) the built-in siren will start blasting for 90 seconds. At the end of approximately 90 seconds the siren will shut off and the alarm listens again. If another break-in sound is heard, the siren will come on for another 90 seconds. If no other break-in sound is detected, the siren will stay off and at the end of the five minute period the lights will shut off and the alarm instantly resets.



The rear control panel contains two standard AC plug receptacles for a table lamp, spot lights, radio, etc.; terminals for connecting optional outside siren and back-up battery (not included); entry delay time control and sensitivity control.

EXIT AND ENTRY DELAY

The Guardex 8000 alarm has a built-in exit delay allowing you approximately one minute to lock up and leave the building before the alarm is armed. When you enter your building you may find that just your normal entering sounds activate the siren. You may delay it from starting for up to 30 seconds by turning up the siren entry delay control.

BATTERY BACK-UP

Burglars rarely cut power. However, to give you total protection from a burglar and possible power failure, our alarm has provisions for a battery back-up. (Batteries not included). 12 volt lantern batteries are available at most hardware stores.

THE BURGLARY PROBLEM

The F.B.I. statistics show that at the present rate, one out of every four Americans are going to be burglarized. That is not a very pleasant fact, but it is true. You have a greater chance of being burglarized than being a victim of a fire or automobile accident. The time is now to help protect yourself and your valuables with a Guardex 8000 alarm system.

OUTSIDE SIREN

The Guardex 8000 alarm is equipped with a loud, built-in siren, but if you desire an additional siren to mount outside or in an area away from the main alarm, they are available with 50 feet of wire for \$24.95. (Connecting terminals are provided on the back of the alarm).

30 DAY NO RISK TRIAL

This is your opportunity to purchase an alarm system directly from the factory for only \$199.95. Try it in your home or business for thirty days without risking one cent. Put our Guardex 8000 alarm to your own test. See for yourself! It will protect every window and door from break-in. If you are not completely satisfied, return the alarm within 30 days for a complete refund. To order your Guardex 8000 alarm, CALL TOLL FREE to charge your credit card or send your check to Guardian Electronics, Inc. in the amount of \$199.95. If you want the optional outside siren, add \$24.94. (California residents add 6% sales tax.)

(If you require more information, call during California business hours, Monday - Friday)



Dealer Inquiries Invited

CALL TOLL FREE
(800) 423-5499

California residents:
(213) 889-1414 collect.

GE GUARDIAN
ELECTRONICS, INC.

31133 Via Colinas, Dept. B. Westlake Village, Calif. 91361

CIRCLE 68 ON FREE INFORMATION CARD

Teletext—To be or not to be

Once . . . each and every month, approximately two dozen people from the U.S. and foreign countries gather together for a meeting. It's official designation is Task Force A of the Teletext Subcommittee. This Subcommittee was organized by the Broadcast Television Systems Committee of the Electronic Industries Association. Its purpose is to gather and sift through the various proposals and make recommendations for instituting a teletext service within the United States. Eventually those recommendations will be forwarded to the FCC. I sit on that committee.

For those readers who may not already know, teletext is a system for transmitting information within the vertical retrace interval of a TV picture. Ultimately consumers will be able to attach decoders to their TV sets that will display the information. The exact nature of the information that will be transmitted is still undecided, but the possibilities are fascinating; they include everything from "electronic" mail and "electronic" newspapers and magazines to instant worldwide weather coverage. The service could even provide access to data bases and programs for "smart" (computer) terminals in the home.

If introduced, teletext will have a major impact on our lives as well as our economy. Never before have we had a means of transferring such huge amounts of raw data at lightning speed and providing that information to so many people. It can transform the TV set into much more than just a home entertainment device. It can become a vital adjunct to our everyday lives.

Teletext is more than simply a blackboard proposal. Task Force A is considering several systems that are already beyond the design stages and very much a reality. It is now up to Task Force A to gather the necessary information and make their recommendations. Certainly, each system must be carefully considered. But Task Force A must not drag its feet either—especially considering the snail's pace at which the FCC has instituted previous petitions dealing with the broadcast industry.

Nor should we as citizens let teletext slip by the wayside. If too much time is spent considering the proposals, and if too much politicking takes place, teletext will die. We mustn't let it! Let your opinions be known by writing to Charles D. Ferris, Chairman, Federal Communications Commission, 1919 M Street N.W., Washington, D.C. 20554.



ART KLEIMAN
MANAGING EDITOR

Hugo Gernsback (1884-1967) founder
M. Harvey Gernsback, editor-in-chief
Larry Steckler, CET, publisher
Arthur Kleiman, managing editor
Robert F. Scott, CET, W2PWG, technical editor
Jack Darr, CET service editor
Leonard Feldman, contributing high-fidelity editor
Karl Savon, semiconductor editor
Herb Freidman, communications editor
David Lachenbruch, contributing editor
Earl "Doc" Savage, K4SDS, hobby editor
Ruby Yee, production manager
Robert A. W. Lowndes, production associate
Marie J. Stolfi, production assistant
Gabriele Margules, circulation director
Arline R. Fishman, advertising coordinator

Cover design by Louis G. Rubsamen
Cover photo by Robert Lewis

Radio Electronics is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature*.

Gernsback Publications, Inc.
200 Park Ave. S., New York, NY 10003
(212) 777-6400
President: M. Harvey Gernsback
Vice President: Larry Steckler
Secretary/Treasurer: Carol A. Gernsback

ADVERTISING SALES

Larry Steckler
Publisher
Paul McGinnis
Director of Marketing

EAST

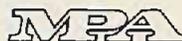
Stanley Levitan
Radio-Electronics
200 Park Ave. South
New York, NY 10003
(212) 777-6400

MIDWEST/Texas/Arkansas/Oklahoma

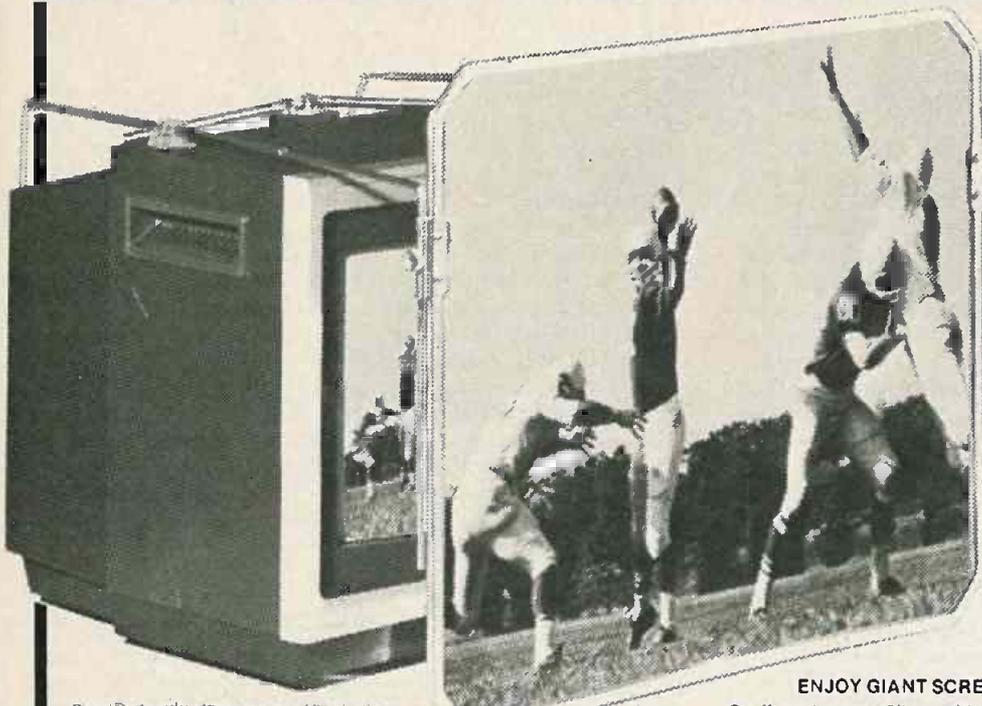
Ralph Bergen
The Ralph Bergen Co.
540 Frontage Road—Suite 361-A
Northfield, Illinois 60093
(312) 446-1444

PACIFIC COAST Mountain States

Jay Eisenberg
J.E. Publishers Representative Co.,
8732 Sunset Blvd.,
4th Floor,
Los Angeles, CA 90069
(213) 659-3810
Sales Mart Building
1485 Bayshore Blvd., Box 140
San Francisco, CA 94124
(415) 467-0125



The Incredible BEAMSCOPE ZOOM LENS



Simulated picture for purposes of illustration.

The Incredible Beamscope Zoom Lens represents a new application of technology to the field of T.V. Optics. One which we predict will tie the industry in knots, and force top management to re-examine their technical approach toward large-screen T.V. These are hard facts to face for an industry committed to charging more for what we believe is outmoded technology!

Today SONY, PANASONIC, G.E., ADVENT and SHARP, to mention only a few names, are marketing large-screen projection T.V. systems. These units are designed to offer dramatic theatre size screen presentation in your own living room. They are dramatic, and they are expensive! Expect to pay upwards of \$2,000 and more for a T.V. that must be viewed with separate movie-type screens, require precise placement of the lens with respect to the screen and can hardly be seen in daylight.

BEAMSCOPE SUPERIORITY

Beamscope provides a large-screen, theatre viewing system that can be used in any room, under any and all lighting conditions. Most important of all, it can be used with your present T.V. Depending on the size of the T.V. Beamscope will provide a superb picture, up to 475 sq. inch, with a diagonal measure of 30". The cost is not in the thousands, not even in the hundreds, but less than \$70! Football, basketball, hockey—bigger and better than you have ever seen them before. Every detail sharp and clear. The action easier to follow than it would be from the best seat in the house. Baseball, the races, your favorite program, Charlie's Angels, Chrissy and Janet of "Three's Company," come to life in your living room. And, what kind of quality can you expect for less than \$70, when SONY charges \$1,995 for its 40" video projection system. The answer is: Flawless! Beamscope not only gives you distortionless color and black and white but actually improves the color and sharpness of your present picture.

A PRODUCT OF COMPUTER SCIENCE

Due to the accuracy and precision required, Beamscope could not have been produced at a reasonable price without the aid of a computer. Simply stated, the Beamscope lens is constructed with thousands of spiral micro-grooves, so small they can't be seen. They are cut with computer accuracy into one side of a specially fabricated, exceptionally hard acrylic. When the Beamscope is placed in front of your T.V. these grooves literally explode the picture up to twice its normal size.

DISCOVERED BY ACCIDENT

Interestingly, we discovered the Beamscope Lens quite by accident, because it was intended for use by the visually impaired. It has been thoroughly tested and is today being used at the Optometric Center of the Southern California College of Optometry, and numerous other low vision clinics, Universities and Institutes throughout the U.S. Obviously then, the T.V. Zoom Lens is no gimmick, but a scientifically designed optometrically approved, University endorsed optical breakthrough, manufactured to the highest quality standards.

MORE THAN DOUBLES THE SIZE OF YOUR T.V. SCREEN...COLOR OR BLACK AND WHITE

- Turn a 13" screen from 96 sq. inches to 352 sq. inches.
- Turn a 19" screen from 192 sq. inches to 475 sq. inches.
- Fits any screen from 10" to 25"
- Installs in minutes without tools.

JUST \$69⁹⁵

ENJOY GIANT SCREEN TV AT ENORMOUS SAVINGS!

So, if you have a 19" portable, the T.V. Zoom Lens will turn it into a super-console with a 30" screen and 475 sq. inch picture. That's two and a half times the normal 160 sq. inch size. Your 15" set will go from a 125 sq. inch picture to a 328 sq. inch picture.

Of course, if you've been thinking about a new set—wait! Try the T.V. Zoom Lens on your old set. One look will convince you of the hundreds and hundreds of dollars you can save by using the T.V. Zoom Lens to get a bigger, better picture with a small set selling for \$200 or \$300 less!

DON'T TAKE OUR WORD. SEE BEAMSCOPE FOR YOURSELF!

Beamscope must be seen to be believed! That's why we are willing to let you see for yourself on your own T.V. Order today, if you don't agree that it is everything we claim and more, return it to us for a refund of purchase price.

Better yet—check out the large theatre-size systems at your local department store. Once you compare them to Beamscope, you will understand our enthusiasm.

For Credit Card Orders ONLY
24 Hour Toll Free Service 1-800-257-7850
In New Jersey 800-322-8650
For customer service write to:
BEACON SCIENTIFIC, 44 Ridge Drive, Plainview, N.Y. 11803



BEACON SCIENTIFIC

Dept. B118, 44 Ridge Drive • Plainview, N.Y. 11803

Please send _____ Beamscope T.V. Zoom Lens(es). I understand that under the terms and conditions of your refund guarantee that I can return my purchase within 15 days.

For 10" to 18" T.V. Screen

For 19" to 25" T.V. Screen

() Model TS-25 (22"x16")

() Model TS-30 (25"x19")

Buy one for \$69.95, plus \$4.00 shipping and handling

SAVE! Two for \$134.95, plus \$7.00 shipping and handling

SAVE! Three for \$199.95, plus \$10.00 shipping and handling

Prices slightly higher beyond Continental United States

Enclosed is \$ _____ Check or Money Order.

New York State Residents add Sales Tax.

Please Charge my Credit Card:

American Express

Visa

Master Charge

Carte Blanche

Charge # _____ Exp. Date _____

SIGNATURE _____

NAME (Print) _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

© Beacon Scientific MCMXXIII

Broadcasters agree on Westar

Look for much more television programming via satellite this Fall. Broadcast TV organizations, including independent programmers as well as the major networks, have made a commitment to use the Western Union Westar system. That means more news, sports, entertainment—and, yes—commercials will be available from the skies. But don't expect the full prime-time network line-up of programming to be beamed via satellite; for now, the networks only plan to use their newly acquired transponders as a back-up (in case of failures in the existing terrestrial web) and for special transmissions. In any case, barely three dozen of the nation's 800 TV stations have equipment to pick up a satellite signal yet.

Blairsat, a subsidiary of a leading broadcast advertising company, expects to start sending commercials to TV stations in about 31 cities this fall, and the company is presently analyzing how it can distribute syndicated game shows, reruns, and other TV programs to stations via the Westar transponder it will share with Hughes TV Network. Hughes, for its part, has completed an agreement with most professional baseball teams. Their viewers will see 500 "away" games this season beamed back to TV stations in the teams' home towns. Separately, Group W (Westinghouse Broadcasting) has a timetable for use of its transponder beginning in September when such syndicated shows as "John Davison" and "PM Magazine" go on the bird—with more likely to come.

The rest of the lineup aboard Westar birds will include programming from ABC, CBS, Bonneville Broadcasting, Spanish International Network, Video Communications Inc. and Satellite Communications Network. Cable News Network will use Westar to send news reports into its Atlanta headquarters (although CNN's 24-hour news service will travel via RCA Americom's Satcom 1 downstream to cable TV systems). Several other broadcasting groups will lease time aboard Westar transponders from Robert Wold Co., largely for use by their Washington or other news bureaus to feed stories back to the hometown stations. Meanwhile, ad agencies are expected to use the Blairsat service and others this fall for political commercials. The idea is that ad agencies can produce timely spots and, instead of using expensive air freight to deliver films or tapes (which can take a few days), the commercials can be beamed directly to TV stations for use that same day while a political issue is still in the news.

By corraling so many broadcasting clients (in addition to the Public Broadcasting Service), Western Union has set itself up in strong competition to RCA Americom's SMARTS for delivering programming via satellite directly to local TV stations. The first SMARTS tests (using Viacom programming and Post-Newsweek TV stations) finally got underway early this year. How impressed are local TV-station managers with satellite technology? Well, although such service is barely in its infancy, more than 80% of TV executives recently polled believe that satellites offer "great benefits" to commercial TV. That could mean we'll be seeing much more programming of all types transmitted via birds.

Much more programming from cable TV/satellite feeds

Every week seems to bring more program offerings intended for cable-TV customers via the cable/satellite hook-ups. Showtime Entertainment, one of the major pay-TV program providers, has announced it will earmark \$14 million this year to create

new shows—including concerts, musical performances, and comedy specials—in addition to the movies it buys from major studios. Home Box Office, the largest pay-TV company, similarly announced new programs and a commitment to use hundreds of new feature films during the coming year. Major League Baseball and UA-Columbia Satellite Services signed an agreement to continue their Thursday-night baseball Game of the Week next season under a multi-year contract which calls for about 40 regular season games to be transmitted annually, strictly for the cable/satellite viewers.

On the more esoteric side, "Pirate this Program," a free-form half-hour show which encourages viewers to videotape the telecast off the air, is now transmitted at 12:30 PM EST on Thursdays (right after Bob Cooper's "Coop's Satellite Magazine"). "Pirate this Program" is produced by the people who publish *Instant Replay* magazine, the periodical which is "printed" on videocassettes.

Crowded skies

A new version of "Space Wars" is about to be fought by lawyers representing companies who want the last remaining orbital-parking spaces available for domestic satellites over the United States. Hughes Communications, a new subsidiary of Hughes Aircraft, applied for the arc slots at 79° and 75° west longitude; then, a few weeks later, Southern Pacific Communications announced it wants those spots too, and told the FCC that it was unfair to hand out the last available C-Band slots without further examination. Hughes, a company which has long built satellites for Western Union and other companies, is expected to offer its satellite capacity for video as well as other services; each Hughes bird will have 24 transponders. The SP Communications satellites would largely supplement that company's terrestrial microwave network for voice and data communications. Details of the SPC satellite proposal will come out when the company submits its formal proposal to the FCC later this Spring.

Direct broadcast satellite activity

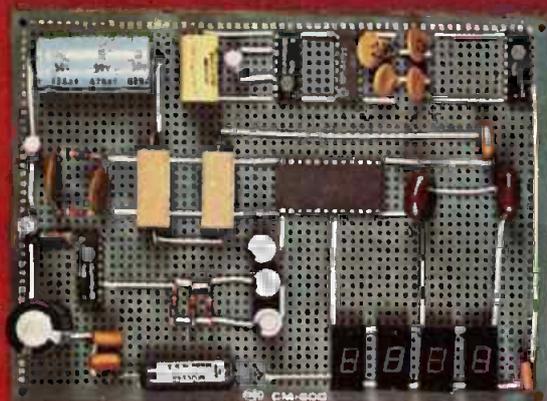
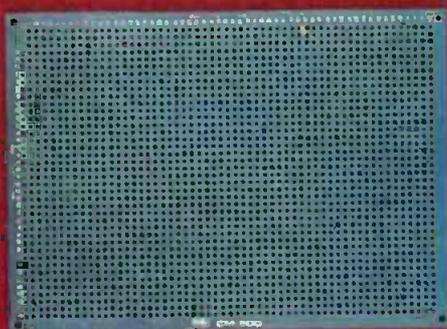
Comsat was due to submit its formal details for direct-to-home pay TV transmissions in the Ku-Band just as we went to press. But even before the complete proposal to the FCC turned up, there was considerable action about the plan to beam programs into one-meter, rooftop antennas. First, Comsat confirmed that it had negotiated a deal with Sears by which the giant retail chain would sell and install the home-reception equipment, expected to cost about \$300. That sort of nationwide distribution could speed the installation of the Comsat offering. Meanwhile, Comsat also hinted that it might make its package of programming (entertainment, sports, education, information, etc.) available to cable-TV systems so they could retransmit them to customers who didn't want to erect their own rooftop dishes.

Separately, the FCC has set up an internal task force to examine the feasibility of any direct-broadcasting in the 14/12 GHz range. Some observers believe that a heavy lobbying campaign (such as the one already begun by the TV broadcasting industry) could stymie the development of the Comsat plan. But others contend that Comsat's thorough preparatory work will help the project get into the sky close to the 1983 target date that Comsat has already announced.

continued on page 32



CM-600 Circuit Mount



CM-600 \$6.95*
RW-50 \$2.98*

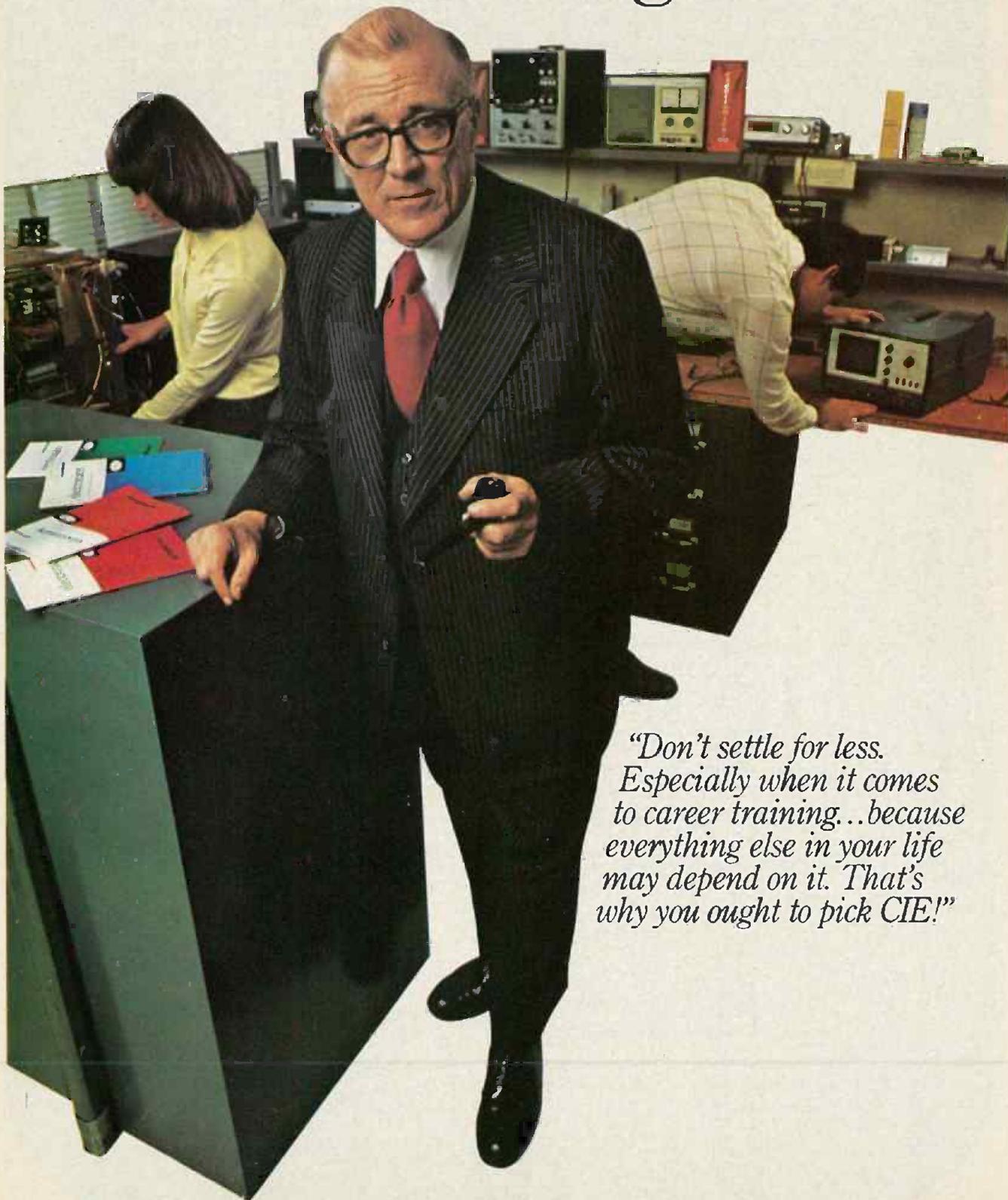
NEW CM-600 SOLDERLESS PROTOTYPE BOARD

CM-600 is a unique system for solderless construction of circuit prototypes, useful to both engineers and hobbyists. The CM-600 is a neoprene board 4½" (114mm) x 6" (152mm) with 2280 holes on .100" (2.54mm) centers. Standard components including DIP's are mounted by simply inserting leads into the holes in the long life neoprene material. Interconnections are easily made using 20 or 22 AWG (0.8 or 0.65mm) wire jumpers. Positive contact is assured by the elasticity of the hole, which compresses the leads together. To remove components or leads, simply pull out. This facilitates easy circuit changes making it ideal for breadboarding experimental circuits. CM-600 also features numbered rows and columns for easy reference. Accessory Kit RW-50 contains 50 pcs of AWG 20 (0.8mm) insulated jumper wires of assorted lengths from ½" (13mm) to 4" (100mm). Both ends are stripped and bent 90° for easy insertion. In stock directly from

OK Machine & Tool Corporation
3455 Conner St., Bronx, N.Y. 10475 U.S.A.
Tel. (212) 994-6600 Telex 125091

* Minimum billings \$25.00, add shipping charge \$2.00
New York State residents add applicable tax

“If you’re going to learn electronics, you might as well learn it right!”



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

You've probably seen advertisements from other electronics schools. Maybe you think they're all the same. They're not!

CIE is the largest independent home study school in the world that specializes exclusively in electronics.

Meet the Electronics Specialists.

When you pick an electronics school, you're getting ready to invest some time and money. And your whole future depends on the education you get in return.

That's why it makes so much sense to go with number one...with the specialists...with CIE!

There's no such thing as bargain education.

If you talked with some of our graduates, chances are you'd find a lot of them shopped around for their training. Not for the lowest priced but for the best. They pretty much knew what was available when they picked CIE as number one.

We don't promise you the moon. We do promise you a proven way to build valuable career skills. The CIE faculty and staff are dedicated to that. When you graduate, your diploma shows employers you know what you're about. Today, it's pretty hard to put a price on that.

Because we're specialists, we have to stay ahead.

At CIE, we've got a position of leadership to maintain. Here are some of the ways we hang onto it...

Our step-by-step learning includes "hands-on" training.

At CIE, we believe theory is important. And our famous Auto-Programmed* Lessons teach you the principles in logical steps.

But professionals need more than theory. That's why some of our courses train you to use tools of the trade like a 5 MHz triggered-sweep, solid-state oscilloscope you build yourself—and use to practice troubleshooting. Or a Digital Learning Laboratory to apply the digital theory essential to keep pace with electronics in the eighties.

Our specialists offer you personal attention.

Sometimes, you may even have a question about a specific lesson. Fine. Write it down and mail it in. Our experts will answer you promptly in writing. You may even get the specialized knowledge of all the CIE specialists. And the answer you get becomes a part of your permanent reference file. You may find this even better than having a classroom teacher.

Pick the pace that's right for you.

CIE understands people need to learn at their own pace. There's no pressure to keep up...no slow learners hold you back. If you're a beginner, you start with the basics. If you already know some electronics, you move ahead to your own level.

Enjoy the promptness of CIE's "same day" grading cycle.

When we receive your lesson before noon Monday through Saturday, we grade it and mail it back—the same day. You find out quickly how well you're doing!

CIE can prepare you for your FCC License.

For some electronics jobs, you must have your FCC License. For others, employers often consider it a mark in your favor. Either way, it's government-certified proof of your specific knowledge and skills!

More than half of CIE's courses prepare you to pass the government-administered exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their licenses!

For professionals only.

CIE training is not for the hobbyist. It's for people who are willing to roll up their sleeves and go to work...to build a career. The work can be hard, sure. But the benefits are worth it.

Send for more details and a FREE school catalog.

Mail the card today. If it's gone, cut out and mail the coupon. You'll get a FREE school catalog plus complete information on independent home study. For your convenience, we'll try to have a CIE representative contact you to answer any questions you may have.

Mail the card or the coupon or write CIE (mentioning name and date of this magazine) at: 1776 East 17th Street, Cleveland, Ohio 44114.



CIE Cleveland Institute of Electronics, Inc.

1776 East 17th Street, Cleveland, Ohio 44114

Accredited Member National Home Study Council

YES... I want the best of everything! Send me my FREE CIE school catalog—including details about troubleshooting courses—plus my FREE package of home study information. RE-87

Print Name _____

Address _____ Apt. _____

City _____

State _____ Zip _____

Age _____ Phone (area code) _____

Check box for G. I. Bill information: Veteran Active Duty

MAIL TODAY!

THE IONOPHONE SPEAKER

In "Lights That Failed," (October 1979), the author laments the passing of the *ionophone* speaker. It was made in DuKane in the early 60's, and was called the Ionovac (in Europe, the Ionophone). Most assuredly, it is *not* dead.

Dr. Allen Hill, a laser physicist, has developed the Hill Type 1 Plasma Speaker. Hornless, it is driven by an integral vacuum tube amplifier. It operates from 700 Hz to at least 100 kHz. Two "conventional" drivers of very high quality (Audax) serve to fill in below 700 Hz.

The sound? With good program material, it *sounds real*, in a way that no other speaker can touch. The theory is fully justified.

Nor is Thermo-Plastic Recording really a failed invention, since it is simply a "frozen" version of the Eldophor projection system. And GE has embodied those principles in its light valve projection TV.

Matsushita is about to produce a set using a tube like the Philco "Apple." They both work on the same principle. Another layer of phosphor behind one of the stripes generates UV (or X-rays in the Apple) that

is picked up by a sensor and used to switch the color signals applied to the gun. No second beam is needed. Why hasn't it been used in large tubes? Probably because there are so many stripes per line that the required switching frequency is too high, or causes RFI problems.

Ultimately, however, there are no failed lights. Any really good idea has a way of turning up again.

WILLIAM SOMMERWERCK
Rosemont, PA

ETCHANT DISPOSAL WARNING

I was alarmed to read the letter from L. Scott Hofer about the disposal of ferric chloride etchant (January 1980 issue). One of the very first rules of chemistry is: *Never pour a base (or water) into a strong acid.*

Sodium carbonate is a fairly strong base; and when it is added "slowly" (Hofer's words) to a strong acid there is a violent reaction (the "foaming" Hofer describes). That reaction generates a lot of heat, as a result of ionization.

A far safer way would be to mix a large quantity of sodium carbonate solution in

cold water. Then slowly pour the relatively smaller volume of ferric chloride into the carbonate solution. The larger volume of carbonate solution will more quickly neutralize the acid and dissipate the heat as well.

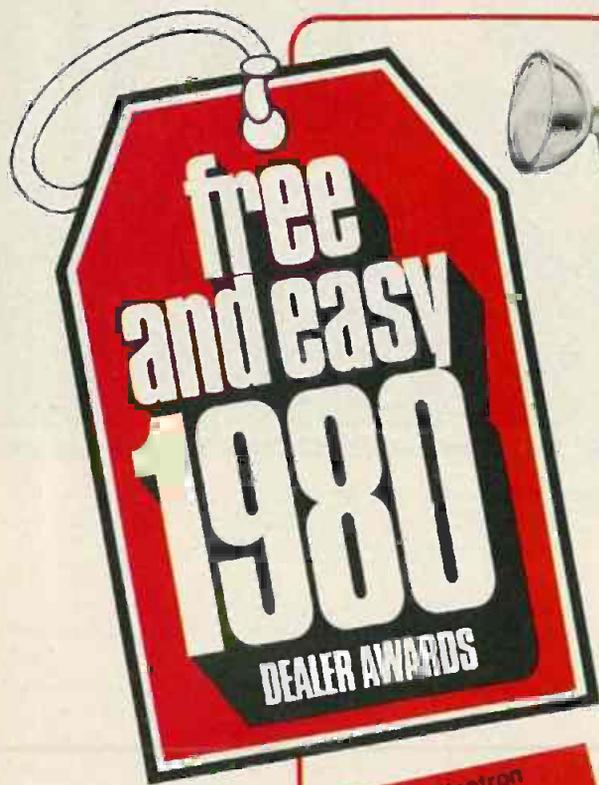
If he insists upon using his method, Mr. Hofer had better invest in a rubber apron, rubber gloves, and goggles! Sooner or later, he is going to have a small, but violent, "explosion" of chemicals spattering his clothes, face, and eyes.

ROBERT K. DEUNK
Cleveland, OH

AC OUTLET CHECKER

The "AC Outlet Checker" article (August, 1979) is interesting and provides a circuit that should give a lot of information. However, a much simpler checker for AC outlets can be made by connecting a neon lamp (through a resistor) between the hot terminal of a three-connector plug and the *grounding* terminal.

The neon lamp can be mounted in the base of the three-connector plug. If the lamp goes on, you know that (1) the hot



FE-6249
Ray-O-Vac
Sportsman No. 303
Sealed Beam
Lantern.
Value: \$25.95



FE-6245
Wilson Rubber
Soccer Ball.
Value: \$12.95

FE-6244
Hamilton Beach
5-Speed Mixer.
Value: \$33.95



FE-6259
Homelite® XL-12
Chain Saw.
Value: \$129.95



FE-6252
Trimarc Concealed
Rod® Getaway
Spinning and
Spincast Set.
Value: \$78.00



wire is connected correctly (2) the outlet box is grounded, and (3) the grounding wire is connected correctly. Those are the principle safety factors.

To check that the common wire is connected, all you have to do is to plug an ordinary lamp into the socket.

Incidentally, on page 53 of the article the labeling of the "O," "X," and "K" lamps is confusing. And should "K" be a red lamp?

CARL HARTMAN,
Newport Beach, CA

The labelling of the lamps is indeed confusing. They should be labeled as follows: DS1=O, DS2=X, DS3=K.—Editor.

TANK GAME

I am writing in regard to the Tank Game project published in the November and December 1978 issues.

As shown in the article, the game does not operate properly. The tanks move forward and reverse but will not turn. This is due to a wiring mistake made in the schematic and PC board pictorial. The circuit should be changed to match that of the schematic shown in Fig. 1.

This will now allow the tanks to turn. In addition, the control switches will now operate differently: i.e., when the switches are pushed away from the player, the tank will move forward. When pulled towards the player, the tank moves in reverse.

I hope this will help anyone who built the game and has had problems.

RICHARD R. FALLSTICH
Allentown, PA

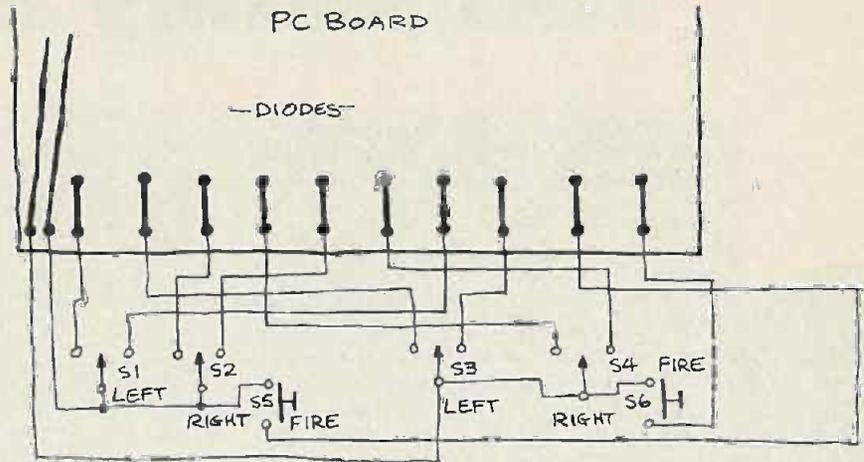
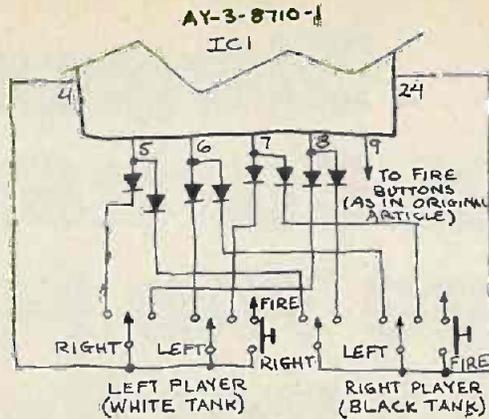


FIG. 1

continued on page 111

FE-6251
Instapure Water
Filter by Water Pik.
Value: \$29.95



FE-6247
Wilson Connors
Rally Tennis
Racket.
Value: \$27.50



FE-6253
Meco Swinger II
Smoker Grill.
Value: \$79.54



FE-6257
Hanson
Step Stool.
Value: \$22.00



Free gifts available with your purchase of RCA Receiving Tubes.

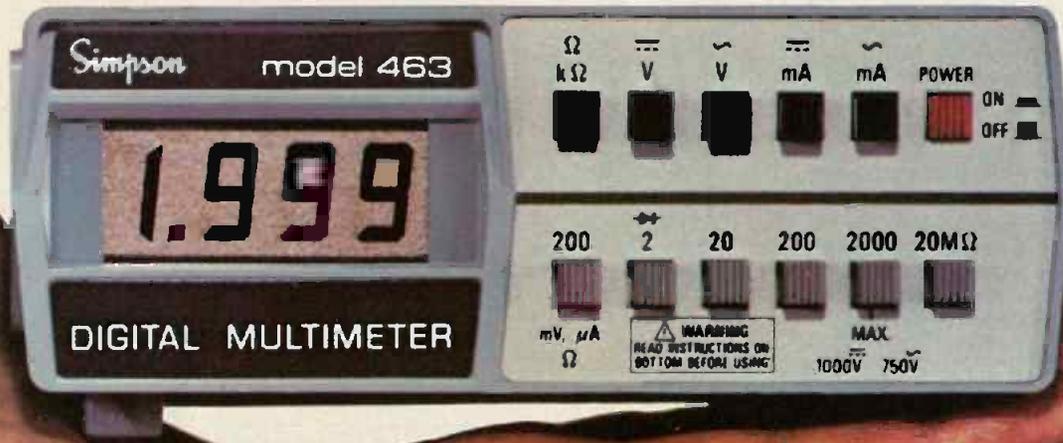
When you think of receiving tubes, think RCA! When you think of dealer awards, think RCA "Free and Easy 1980." Then get both from your local participating RCA tube distributor. Quality tubes and quality awards go hand in hand at RCA.

Shown here are just nine of the 20 awards available to you. Find out the details when you purchase quality RCA receiving tubes from your participating RCA tube distributor and earn the award of your choice.

RCA Distributor and Special Products Dept., N.J. 08096

RCA Receiving
Tubes

Simpson Hand Portable DMMS Have The Features You Really Need!



Model 463
Actual Size!
\$184



Model 461
\$173





On the Bench



On the Shelf



In the Field

The Best All-Around Design for hands-free measurements in all situations . . . in the production line, on the service bench, on the test-lab shelf, in the field.

Designed For Years Of Trouble-Free, Reliable Service by the maker of the world famous 260®.

These Simpson hand portable DMMs meet the new UL 1244 standard for safety of electrical and electronic measuring and testing equipment.

. . . and also meet ANSI C39.5.

Built To Last, Inside And Out — on the inside, with quality-selected active and passive components Plus a *high-energy, double fusing protection system*; on the outside, with a rugged high-impact ABS molded case.



Positive, Simple, One-Finger Push-button Selection of Functions and Ranges.

10 Megohm Input Impedance on both DC and AC voltage ranges . . . as most often referenced in factory service manuals.



Double Burn-In!

Every Simpson DMM gets double burn-in and final factory test of every range and function.

One-Year Warranty. Every Simpson DMM is backed by a *one-year factory warranty*. (Fully stated in operator's manual and warranty registration card. Copy available at factory or authorized Simpson distributors.)



UL Approved Safety-Engineered Test Leads are included with each instrument.

The Cordless Model 463 has easy-to-read .5" liquid crystal display, 26 most needed measurement ranges. Rated accuracy is 0.1% on DC V ranges. You can get up to a year of service on a 9-volt alkaline battery, included. . . . \$184

The Popular Model 461 has large, bright .3" LED display, 26 most needed ranges, 0.25% DC V accuracy. Gives 8 hours of continuous battery operation on a single charge. Price includes nickel-cadmium batteries and AC charger/adapter. . . . \$173

The Autoranging Model 462 automatically selects the range and the decimal point position on voltage and resistance measurements. Has bright .3" LED display, 0.25% DC V accuracy. Gives 8 hours of operation on a single charge. Price includes nickel-cadmium batteries and AC charger/adapter. . . . \$215



A Broad Line Of Accessories expands the measurement capabilities of the 461, 462, 463 and other popular Simpson DMMs. (A) universal temperature probe, (B) rf probe, (C) high-voltage probe, (D) AC Amp-Clamp adapter, (E) deluxe case.

Available from Simpson Distributors Worldwide. Ask or Write for Free Catalog.



SIMPSON ELECTRIC COMPANY
853 Dundee Avenue, Elgin, IL 60120
Telex 72-2416 • Cable SIMELCO
(312) 697-2260

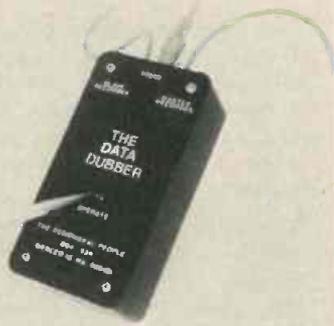


Model 462
\$215



CIRCLE 44 ON FREE INFORMATION CARD

Data Dubber For The TRS-80



CIRCLE 101 ON FREE INFORMATION CARD

ANYONE WHO OPERATES A RADIO SHACK TRS-80 microcomputer knows that loading in programs from cassette tapes is a touchy proposition—particularly with Level II BASIC. Tapes made directly from the microcomputer output are less touchy, but tapes from other

sources—borrowed or purchased—can be very difficult or impossible to load. Also, recorder-to-recorder copies, without special professional recording equipment or expensive duplicators, are usually a waste of time.

However, the *Data Dubber* (from The Peripheral People, Box 524, Marcer Island, Washington 98040. \$39.95 postage paid) solves those problems. You can duplicate and get perfect CLOAD's even from tapes with hum, distortion, or minor dropouts—and without any modification to the TRS-80. It can be used with both Level I and Level II BASIC.

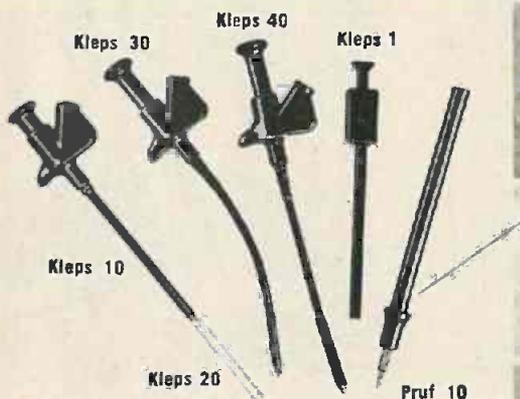
Ideally, the pulses from the TRS-80 to the cassette recorder during a CSAVE operation should be stored on the tape as perfect pulses—or at least as perfect sinewaves. That seldom happens because of the poor frequency response of standard audio recorders. Also, ideally, the TRS-80 would rather input pulses than sinewaves, and it especially dislikes the distorted sinewaves produced on playback of tapes made on other recorders. Head alignment, speed, and frequency response could be quite different from that of your recorder!

The *Data Dubber* is designed to take whatever data is on the tape, distorted or not, and

regenerate exact duplicates of the original pulses. Those idealized pulses are also available to feed a second cassette recorder for duplication. The *Data Dubber* does not care if the program is in BASIC or assembly language, since it simply idealizes the pulses. Unless there are data pulses actually missing from the recording—or pulses and pops that shouldn't be there at all!—the *Data Dubber* will usually load the tape the first time.

The first two stages of the *Data Dubber* essentially duplicate the high-pass filter and full-wave rectifier circuitry of the TRS-80 cassette input. The input pulses are then leveled in amplitude by a threshold detector, the output of which triggers a series of one-shot multivibrators. The time constant is set to duplicate the width of the pulses that the TRS-80 produces. Positive and negative pulses are summed together to make the bipolar pulses required by the tape recorder—a kind of sine-wave built out of squarewaves. There are two outputs, one preset to the optimum level for the TRS-80 input and the other preset just under the automatic volume-control threshold of the AUX input of the tape recorder.

continued on page 28



Clever Kleps

Test probes designed by your needs—Push to seize, push to release (all Kleps spring loaded).

- Kleps 10.** Boathook clamp grips wires, lugs, terminals. Accepts banana plug or bare wire lead. 4¾" long.
- Kleps 20.** Same, but 7" long.
- Kleps 30.** Completely flexible. Forked-tongue gripper. Accepts banana plug or bare lead. 6" long.
- Kleps 40.** Completely flexible. 3-segment automatic collet firmly grips wire ends, PC-board terminals, connector pins. Accepts banana plug or plain wire. 6¼" long.
- Kleps 1.** Economy Kleps for light line work (not lab quality). Meshing claws. 4½" long.
- Prof 10.** Versatile test prod. Solder connection. Molded phenolic. Doubles as scribing tool. "Bunch" pin fits banana jack. Phone tip. 5½" long.

Write for complete catalog of - test probes, plugs, sockets, connectors, earphones, headsets, miniature components.



Available through your local distributor, or write to:
RYE INDUSTRIES INC.
 126 Spencer Place, Mamaroneck, N.Y. 10543
 In Canada: Rye Industries (Canada) Ltd.

CIRCLE 19 ON FREE INFORMATION CARD



INTERNATIONAL FM-2400CH FREQUENCY METER FOR TESTING MOBILE TRANSMITTERS AND RECEIVERS

Portable • Solid State • Rechargeable Batteries

The FM-2400CH provides an accurate frequency standard for testing and adjustment of mobile transmitters and receivers at predetermined frequencies.

The FM-2400CH with its extended range covers 25 to 1000 MHz.

The frequencies can be those of the radio frequency channels of operation and/or the intermediate frequen-

cies of the receiver between 5 MHz and 40 MHz.

Frequency stability: ±.0005% from +50° to +104°F.

Frequency stability with built-in thermometer and temperature corrected charts: ±.00025% from +25° to +125° (.000125% special 450 MHz crystals available).

- Tests Predetermined Frequencies 25 to 1000 MHz
- Extended Range Covers 950 MHz Band
- Pin Diode Attenuator for Full Range Coverage as Signal Generator
- Measures FM Deviation

FM-2400CH (meter only) \$690.49
 RF crystals (with temperature correction) \$28.89 ea.
 RF crystals (less temperature correction) \$21.92 ea.
 IF crystals catalog price

Write for catalog



INTERNATIONAL CRYSTAL MFG. CO., INC.
 10 North Lee Oklahoma City, Okla. 73102

CIRCLE 77 ON FREE INFORMATION CARD

THE **ROADRUNNER** ADMM
Audio Digital Multimeter
FROM **WESTON**

ONLY
\$139



ARE YOU CONFUSED BY ALL THOSE HAND-HELD DIGITAL MULTI-METERS ON THE MARKET? COMPARE PRICE AGAINST FUNCTIONAL FLEXIBILITY AND YOU WILL BE CONVINCED THAT THE WESTON MODEL 6100 ROADRUNNER IS YOUR BEST BUY!

CHECK THESE FEATURES

- 29 Ranges
- .1mV to 1000VDC
- .1mV to 750VAC
- .001 to 2000mADC
- .001 to 2000mAAC
- 1ohm to 20Mohms
- 300VAC protection in ohms and audio
- Automatic polarity
- 200 hours battery life
- 10% "lo-batt" indication
- 3 1/2 digit LCD 5" display
- 1, 10, 100mV and 1, 2V threshold pulse detect*
- 1, 10, 100 Ohm threshold continuity testing*
- Diode tests*
- Transistor tests*
- Capacitor tests*
- Stuffed PCB tests*
- RFI shielded
- X5 analog VOM accuracy
- Self Calibration
- Overrange indication
- Rugged case. Built-in stand.

*DENOTES AUDIO RESPONSE™ FUNCTION

FULL LINE OF ACCESSORIES

AC Clamp-on Probe.....\$57.75	Carrying case.....\$15.00
Battery Eliminator.....15.00	RF Probe.....29.00
Light Meter attachment...262.00	VHF RF Probe.....63.00
Temperature Probe. (avail. soon)	HV Probe.....38.75

MODEL	FLUKE 8020A			DATA PRECISION 935			SABTRONICS 2037		
	FLUKE 8024A			BECKMAN 3010			B & K 2815		
	WESTON 6100			FLUKE 8022A					
DC VOLTS	D	D	D	D	D	D	D	D	D
AC VOLTS	D	D	D	D	D	D	D	D	D
DC CURRENT	D	D	D	D	D	D	D	D	D
AC CURRENT	D	D	D	D	D	D	D	D	D
RESISTANCE	D	D	D	D	D	D	D	D	D
CONDUCTANCE		D	D		D	D		D	D
DIODE TEST	A	A		D	D		D	D	
LOGIC LEVEL	A	A							
CAPACITANCE	A								
CONTINUITY	A	A			D				
TOTAL FUNCTIONS	9	9	7	6	7	6	6	6	6
PRICE (\$)	139	199	169	129	139	150	150	150	120

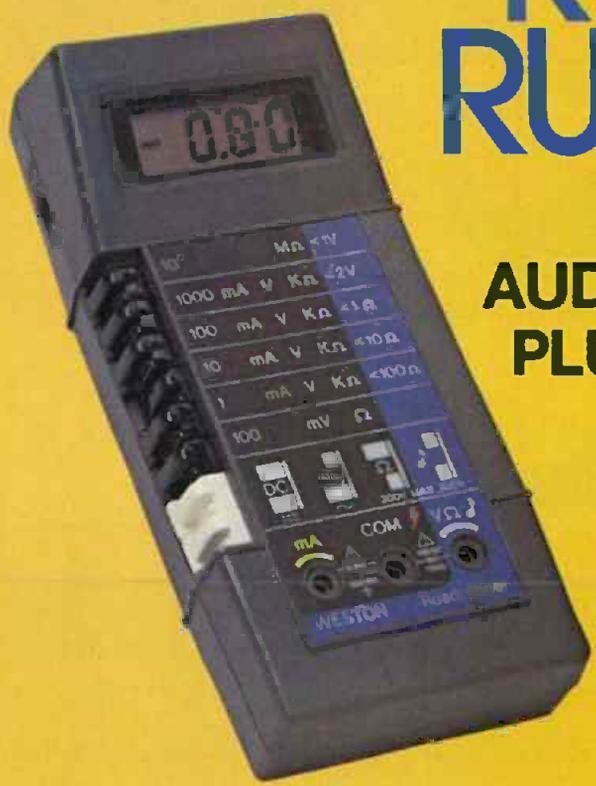
(A) Denotes AUDIBLE function (D) Denotes DISPLAY function

INSTRUMENTATION, INC.
1554 ELMIRA, AURORA, COLORADO 80010
(303) 340-8728 364-8325
CALL COLLECT BUY NOW
SPECIALIZING IN DIGITAL & ANALOG METERS AND MULTIMETERS

CIRCLE 79 ON FREE INFORMATION CARD

INTRODUCING... THE

ROAD RUNNER ADMM™
FROM WESTON



AUDIO RESPONSE™ PLUS DIGITAL DISPLAY

- 5 RANGE AUDIBLE SIGNALING FUNCTION
- RUGGED FIELD SERVICE DESIGN
- 0.5" LCD DISPLAY
- 6 FUNCTIONS
- 29 RANGES

\$139.00

WESTON INSTRUMENTS
THE MEASUREMENT PEOPLE®
614 Freilighuysen Ave.,
Newark, NJ 07114

SANGAMO WESTON
Schlumberger

CIRCLE 75 ON FREE INFORMATION CARD

The *Data Dubber* measures 5 × 2 × 1½ inches and has no controls. The only external connections are two cords ending in miniature phono plugs and a miniature phono jack. The cord labelled **MASTER RECORDER** connects to the earphone jack of the recorder that has the program. The cord from the *TRS-80* that normally goes to this earphone jack is instead plugged into the jack on the *Data Dubber* marked **TRS-80**. The cord labelled **SLAVE** is only used with a second recorder if you wish to make a copy of a tape; that cord plugs into the auxiliary input of the second recorder.

A red LED on the front panel of the *Data Dubber* is used as a level indicator. Simply set the master-recorder volume control so the LED lights brightly and steadily during the program lead-in pulses, and faintly flickers in brightness as the program is playing.

A clever battery-saver feature is incorporated into the *Data Dubber*. As long as there is no signal input, the *Dubber* draws only a fraction of a microampere of current from the 9-volt battery. However, as soon as a signal is input, an electronic switch turns the circuit on, and the battery supplies 7-10 milliamperes. When the input ceases, the circuit goes back into a virtually-off standby condition. That eliminates the need for an on-off switch.

In actual use tests, I found that the *Data Dubber* would load tapes that would not load elsewhere. I had one tape that only one recorder out of four different models would load, but it loaded fine with the *Data Dubber* and the standard *TRS-80* recorder. I made copies of that tape using the *Data Dubber* and the copies also loaded without any trouble. Some experimentation with level settings was necessary, as described in the instructions that come with the unit, since the LED apparently lights both above and below the ideal range.

While the *Data Dubber* will solve many tape problems for *TRS-80* owner, it cannot resurrect the dead. A program tape that has all the pulses recorded (even though they may be distorted) is loadable with the *Data Dubber*. However, if even one sync pulse is missing there is no way you will ever get the tape to load properly. If you have a tape that has never been "loadable" under any circumstances, don't think the *Data Dubber* will create any missing data. It won't. On the other hand, if one of your tapes loads after much fiddling with the volume control, the *Data Dubber* should clean it up sufficiently to permit a good load on the first try. R-E

Triplett Model 30 Grabber AC Clamp-on Meter

NAMING A PIECE OF TEST EQUIPMENT THE "Grabber" seems inappropriate to say the least. However, in this case the name is very appropriate: The *model 30 Grabber*, recently announced by the Triplett Corporation, actually does grab onto the reading and holds it indefinitely.

As you may have already surmised, the *Grabber* is a clamp-on type of device. However, the name can be more fully understood when you discover that, having once connected the *model 30* into the circuit to be tested, a slight push of a button on the right-hand side of the case will lock the pointer in that position as long as you desire. Triplett has called this feature *Memo-lock*, but it is easy to see why the meter is called the *Grabber*.

hy-gain. Super Stix.

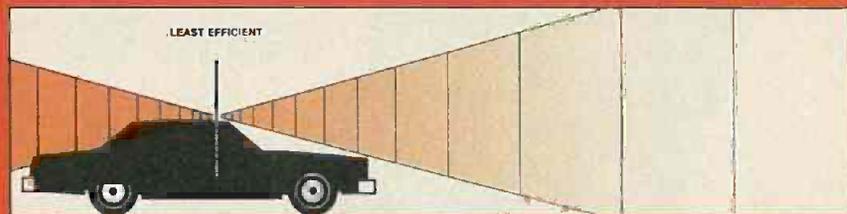
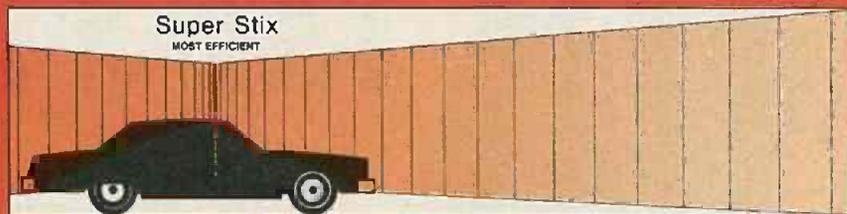
The best darn top-loaded CB antenna your money can buy!

- ☀ Just like the serious CBers, amateurs demand Hy-Gain, and 1,000,000 hams can't be wrong!
- ☀ Hand-crafted antennas, built with pride and precision by skilled craftsmen with 25 years experience.
- ☀ Every Super Stix antenna is inspected for 100% quality control, including SWR check.
- ☀ Because we use the finest materials available, we guarantee these Stix against failure. Any failure. That's how confident we are! We don't recommend it, but even bent a full 360°, it will not break.



Why Super Stix Perform Better

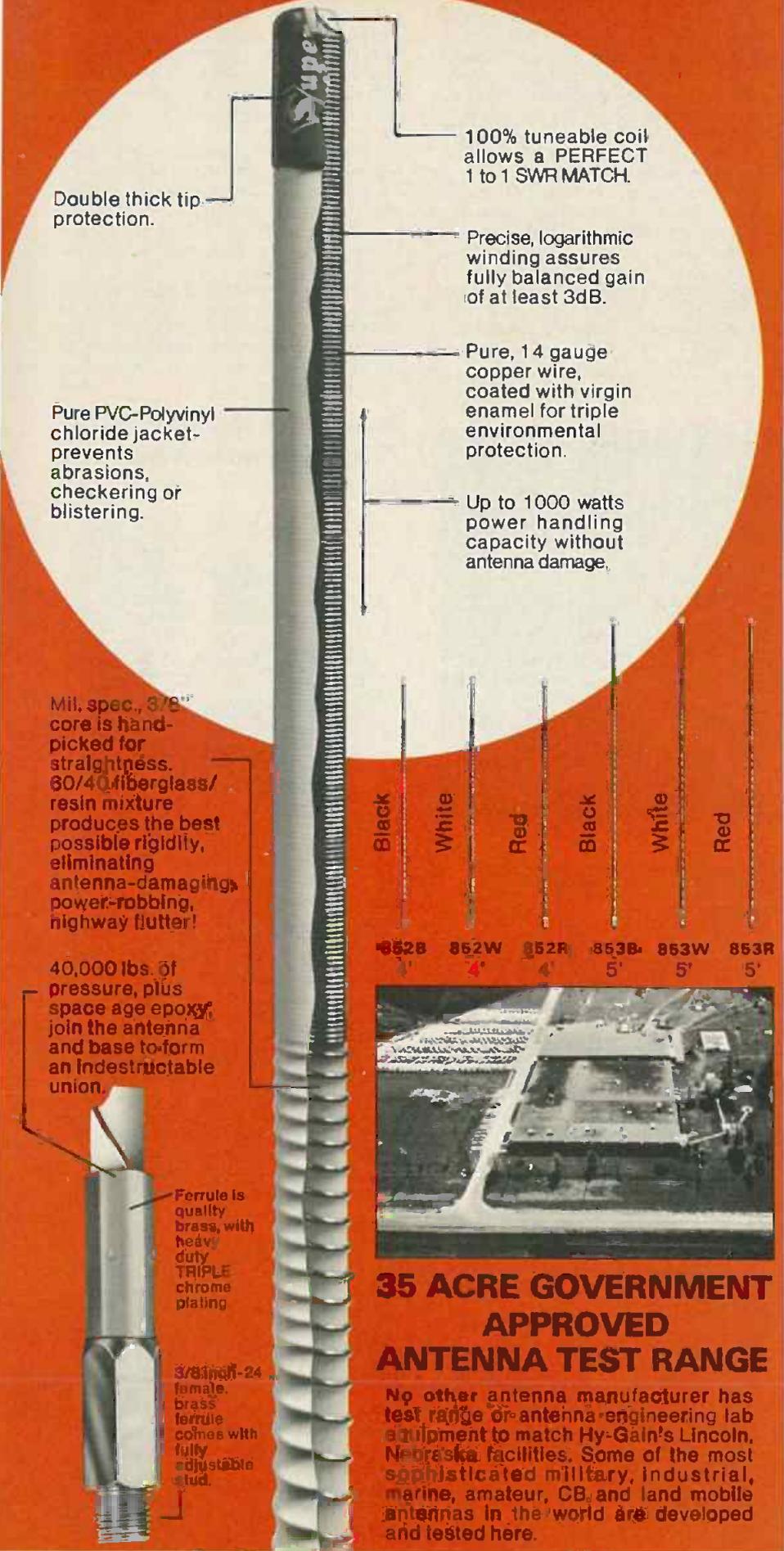
Super Stix are more than 5/8 wave electrically. This allows more than 80% of the signal to radiate from the most efficient portion of the antenna—the top.



TELEX *hy-gain*

TELEX COMMUNICATIONS, INC.

8601 Northeast Highway Six, Lincoln, NE 68505 U.S.A.
Europe 22, rue de la Légion-d'Honneur, 93200 St. Denis, France.



Double thick tip protection.

100% tuneable coil allows a PERFECT 1 to 1 SWR MATCH.

Precise, logarithmic winding assures fully balanced gain of at least 3dB.

Pure, 14 gauge copper wire, coated with virgin enamel for triple environmental protection.

Up to 1000 watts power handling capacity without antenna damage.

Pure PVC-Polyvinyl chloride jacket prevents abrasions, checkering or blistering.

Mil. spec., 3/8" core is hand-picked for straightness. 60/40 fiberglass/resin mixture produces the best possible rigidity, eliminating antenna-damaging, power-robbing, highway flutter!

40,000 lbs. of pressure, plus space age epoxy, join the antenna and base to form an indestructible union.

Ferrule is quality brass, with heavy duty TRIPLE chrome plating

3/8 inch-24 female brass ferrule comes with fully adjustable stud.

Black

White

Red

Black

White

Red

852B 852W 852R 853B 853W 853R



35 ACRE GOVERNMENT APPROVED ANTENNA TEST RANGE

No other antenna manufacturer has test range or antenna engineering lab equipment to match Hy-Gain's Lincoln, Nebraska facilities. Some of the most sophisticated military, industrial, marine, amateur, CB, and land mobile antennas in the world are developed and tested here.



CIRCLE 102 ON FREE INFORMATION CARD

If there is a need to measure the current in a conductor carrying AC to a large motor, for instance, all that has to be done is to find a convenient spot where the supply wires are available, open the *Grabber's* jaws (up to 1-inch) and slip them over the wire. Allow the jaws to close and, with the *model 30's* range switch set to the highest current position, reduce the range until a useful reading is obtained. If the *Grabber* happens to be in a position where it is difficult to see the reading, then press the button on the side, open the jaws, move the unit to where it can be seen; you'll find the last reading recorded while it was still on the conductor.

The clamp-on ammeter is a device with wide applications in industrial electronics. In the consumer electronics field, however, it is relatively unknown. Yet, it could serve even there if the technicians had access to such units. For instance, in a solid-state stereo amplifier, many facts can be determined if one learns to rely upon one measurement *not* normally made.

TABLE 1

- AC current: 0-6, 12, 30, 60, & 300 AC amperes
- Accuracy: $\pm 3\%$ of full scale (calibrated at 77°F (25°C))
- AC Voltage: 0-150, 300, & 600 AC volts
- Accuracy: (same as AC amps)
- Sensitivity: 5,000 ohms/volt
- Frequency Response: $\pm 1\%$ of full scale from 20 to 5,000 Hz.
- Rectifier: Average responding circuit calibrated to read RMS value of a pure sinewave.
- Max. Input Voltage: 600V RMS.
- Meter Movement: Core magnet pivot-and-jewel type.
- Overload Protection: Diode type.
- Weight: Approx. 1 pound (0.45 kilograms) with test leads.
- Size: 7 1/4 L x 2 1/4 W x 1 1/2 inches D (19 x 6.9 x 2.9 cm)
- Accessories: *model 32* ohmmeter adapter.
- Max. Wire Size: 1-inch diameter.

That is the current that is being drawn from the AC line. A quick reading of that current, converted into power, will tell a great deal when compared to the published input power of the amplifier.

In addition to the current ranges (see Table 1), the *model 30* also has an accurate AC voltmeter scale. A set of test leads (supplied with the tester) is plugged into the end of the *Grabber* and you are ready to measure AC voltage in three ranges (150V, 300V, and 600V full-scale). Also supplied are two screw-on alligator clips, insulated for your protection and color-coded red and black. An optional adaptor (*model 32*) is available that allows the *Grabber* to measure resistances of up to 1,000 ohms.

The reading of the AC line voltage was found to be as accurate as one could require. When compared to the usual VOM used for such readings, the *Grabber* was easier to read if set to the 150V range, since that allows the line voltage to be read in the upper portion of the scale. (I have just checked the line voltage to my workbench and found it to be exactly 120 volts. That is the norm for this location. Very few standard VOM's will read that close.)

Another accessory available is the *model 101 Line Separator*. That unit allows the user to clamp the *Grabber* onto one leg of the line without slitting or separating the wires to do so. In addition, the *Line Splitter* increases the sensitivity of the *Grabber* by factors of 10 or 20. Thus, when using the *Line Splitter*, current measurements as low as 300 mA full-scale are possible.

The instruction manual is quite complete and, as with other Triplett instruments, the emphasis is upon safety; that element cannot be stressed too often or too much. There is a good applications section and a troubleshooting section that contains a schematic diagram and parts list for both the *model 30* and *model 32*.

The instrument is covered by a one-year limited warranty on defects and workmanship. There is a rather complete list of warranty service stations provided with the instrument and a bright-red tag which outlines the dangers associated with the measurement of electrical currents and voltages.

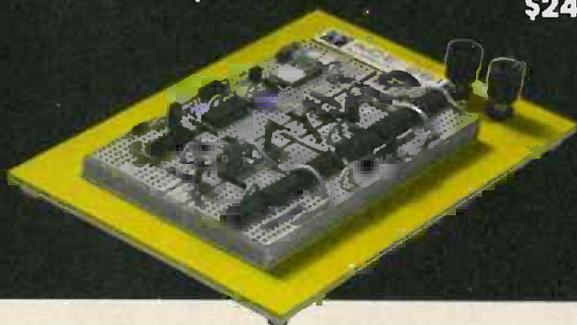
Any measurement that we tried with the *model 30 Grabber* verified that it met or exceeded the published claims made for the unit. It can be an important addition to your service bench or lab, whether you are a professional or a hobbyist. **R-E**

ACE 200-K with 728 solderless plug-in tie points, two 5-way binding posts. Capacity, up to eight 16-pin DIPs.

\$18.95

ACE 201-K (shown here) with 1032 solderless plug-in tie points, two 5-way binding posts. Capacity, up to twelve 14-pin DIPs.

\$24.95



A P All-Circuit Evaluator kits give you the best...for less.

Assemble your A P "ACE" yourself (easy with our instructions) and you save money.

Then you save time—time after time—because there's no faster or easier way to prototype.

You figure out your circuit, plug it in for testing. You decide to improve your layout, and you make your moves as quickly as you think them up. It's super-fast breadboarding—with the electronic integrity you expect from A P Products. Our solderless plug-in tie points are a special noncorroding alloy. Use them over and over again. They continue to grip hard, make excellent contact.

Where to buy? Phone (toll-free) 800-321-9668 for the name of your local A P Distributor. And ask for our complete A P catalog, The Faster and Easier Book.



"Faster and Easier is what we're all about."



A P PRODUCTS INCORPORATED
1359 W. Jackson St.
Painesville, Ohio 44077
Tel. 216/354-2101
TWX: 810-425-2250

Muraphone Remote Telephone Answering System



CIRCLE 103 ON FREE INFORMATION CARD

THE PRIMARY CONVENIENCE OF HAVING A REMOTE cordless telephone is in the answering. It makes sense to market a low-cost answer-only model that excludes a dialing option.

That is the philosophy behind the economical little *Muraphone*, a walkie-talkie size two-way telephone answering portable from the Mura Corporation (177 Cantiague Rock Road, Westbury, NY 11590.)

The *Muraphone* system consists of two main subsystems: the remote answering device (model *MP-100*) and the telephone interface base unit (model *MP-101*). An adaptor plugs into the AC line to operate the base unit. A small plug-in cord is provided with the system to recharge the nickel-cadmium batteries in the remote unit when the system is not in use.

Installation

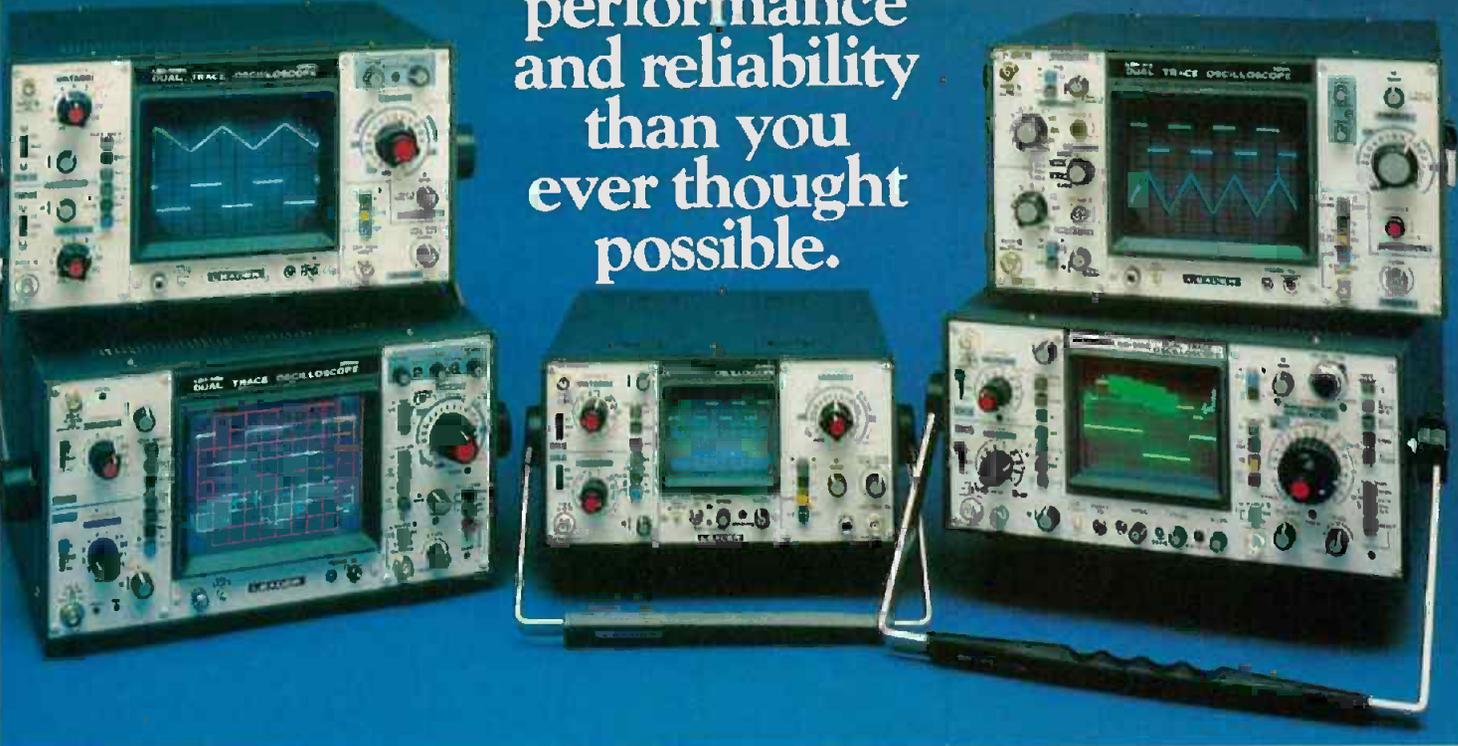
To hook up the remote answering system, all that is required is a telephone jack that uses a modular connector. If your telephone is equipped with the older style four-pin plug, an adaptor will have to be acquired to install the system. The need for a modular connector is nothing exclusive with Mura; all new telephone options come equipped with the modern plug. Fortunately, many electronic hobby and specialty stores offer several types of modular receptacles to extend the flexibility of your telephone.

Once the base unit has been connected to the telephone line, the first necessity will be to charge the hand-held's batteries. That is readi-

continued on page 40

CIRCLE 47 ON FREE INFORMATION CARD

10 to 30 MHz oscilloscopes with more performance and reliability than you ever thought possible.



It's easy to see why LEADER oscilloscopes are now specified more than ever. More performance and quality for less cost... with immediate deliveries from over 100 stocking distributors. They also come with the best two-year warranty in the industry... backed by efficient factory service depots on the East and West Coasts.

A full-range of reliable, medium bandwidth oscilloscopes.

LEADER's oscilloscope line includes 11 models, single and dual trace versions, for bench or field use. All models offer comprehensive triggering controls, TTL compatible Z-axis modulation, front panel trace alignment control and convenient, color-keyed front panel layout. Probes are furnished with every oscilloscope and options include probe pouches, carrying cases, front panel covers and rack mounting adapters.

30 MHz delayed sweep - \$1,530.

LBO-515B is a compact, precision oscilloscope at a moderate price. Using a PDA 4-inch CRT with parallax-free internal graticule, it features 5 mV sensitivity and delayed sweep for viewing and measuring complex waveforms. Also has 120 ns signal delay, trigger hold-off and x-y operation at full sensitivity.

30 MHz with signal delay - \$1,100.

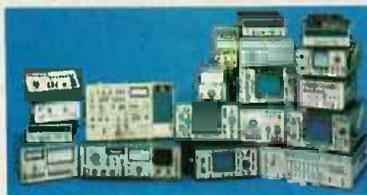
LBO-520 combines a 11.7 ns rise time with 5 mV sensitivity and 120 ns signal

The surprising leader.

delay lines. Has single shot triggering, X10 sweep magnifier and bright, sharp PDA CRT. Triggers to 50 MHz.

20 MHz dual and single trace - \$835., \$610.

LBO-508A and LBO-507A give you versatility at low cost. Rise time is 17.5 ns with 1 MΩ (35 pFd) input impedance. Automatic or external triggering, X5 sweep magnifier, 10 mV/cm sensitivity and add/subtract modes.



Oscilloscopes, frequency counters, function generators, video and audio instruments... a LEADER instrument for almost every need.

10 MHz with 1 mV sensitivity - \$645.

LBO-514 has both vertical and horizontal X5 magnifiers. Sensitivity is from 1 mV/cm to 10 V/cm. Sweep speeds from 0.2 s/cm to 0.1 μs/cm. Auto or normal triggering. Z-axis modulation. (Single trace version, LBO-513, \$495.)

20 MHz battery/ac portable - \$950.

LBO-308S provides lab performance and high reliability in field service applications. Sensitivity is 2 mV with a complete set of triggering controls and 18 sweep ranges to 0.1 μs/div. with X5 magnifier. Compact, lightweight with 3-inch rectangular, internal graticule CRT. (Optional 2 hour internal battery pack is recharged during ac operation, \$75.00.)

Two-year warranty. Evaluation units.

A history of high reliability permits LEADER to provide a generous 2-year warranty... backed by factory service depots on the East and West Coasts. A free, trial use of LEADER instruments

is available to all qualified companies.

Call toll-free (800) 645-5140 to request:

- an evaluation unit
- our 40-page catalog
- the name of your nearest "Select" distributor
- additional information

When Quality Counts

LEADER
Instruments Corporation

380 Oser Avenue
Hauppauge, N.Y. 11787 (516) 231-6900

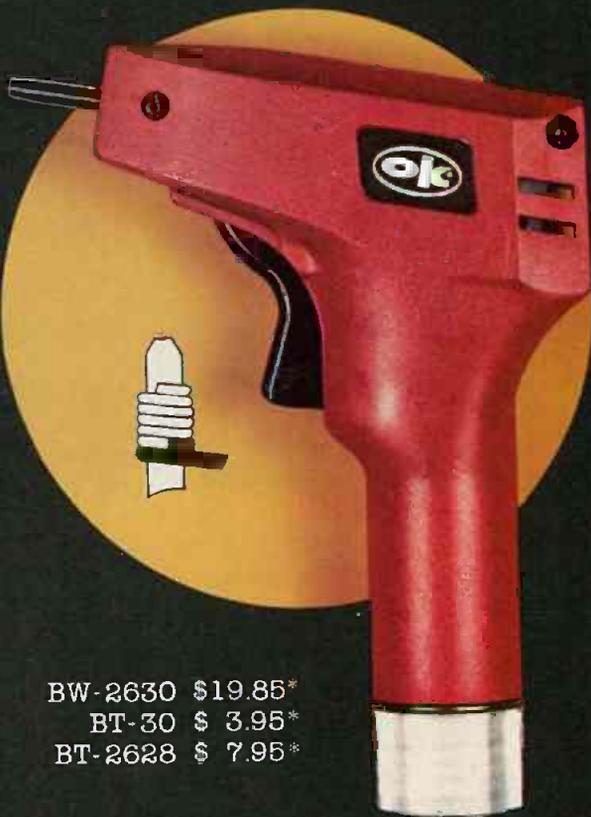
Regional Offices:
Chicago, Los Angeles, Dallas.

CIRCLE 78 TO BE CONTACTED BY LOCAL DISTRIBUTOR

FOR CATALOG, CIRCLE 80 ON FREE INFORMATION CARD



BW-2630 Battery Tool



BW-2630 \$19.85*
 BT-30 \$ 3.95*
 BT-2628 \$ 7.95*

BW-2630 BATTERY TOOL

The new BW-2630 is a revolutionary battery powered wire-wrapping tool. The tool operates on 2 standard "C" size NiCad batteries (not included) and accepts either of two specially designed bits. Bit model BT-30 is for wrapping 30 AWG wire onto .025" square pins; BT-2628 wraps 26-28 AWG wire. Both produce the preferred "modified" wrap.

Designed for the serious amateur, BW-2630 even includes both positive indexing and anti-overwrapping mechanisms — features usually found only in industrial tools costing five times as much. Pistol grip design and rugged ABS construction assure performance and durability. In stock at local electronic retailers or directly from

OK Machine & Tool Corporation
 3455 Conner St., Bronx, N.Y. 10475 U.S.A.
 Tel. (212) 994-6600 Telex 125091

*Minimum billings \$25.00, add shipping charge \$2.00
 New York State residents add applicable tax

SATELLITE TV NEWS continued from page 16

Canada gets the jump

Even as American policymakers and corporations make plans for direct-broadcast satellites, foreign efforts on similar ventures are moving along. In Canada, programs from the Canadian Broadcasting Corp.'s Pacific TV Network and Vancouver TV station CHAN are beamed, via Anik B, to cable TV systems and private homes in remote parts of the country. Homes authorized to get the service are being loaned a 1.8-meter earth terminal, free of charge. Meanwhile, a joint venture by several European electronics and aerospace companies may lead into a direct-broadcasting-satellite system for Western Europe—possibly as early as 1983. French and German organizations are spearheading the effort; but members of the British parliament are concerned about a Continental system that would also reach the United Kingdom, raising nationalistic viewing problems.

Audio going aloft too

National Public Radio, which began limited satellite feeds to its affiliates last Fall, expects to begin 24-hour service via its Westar I transponder this Spring. Plans call for the eventual use of 12 audio circuits for simultaneous feeds (with different programs going to different time zones). The high quality stereo transmission would include all formats of music in addition to NPR's first-rate public affairs programs. About 17 public radio stations presently have uplinks to feed entertainment and news programs into the network.

Mutual Broadcasting has begun to beam its radio programming to affiliates via Westar. Mutual's news, sportscasts, and special programming will travel via satellite. ABC, CBS, and the new RKO "Lifestyle" radio networks are committed to satellite transmission. Some of it is likely to begin this year and United Press International, the wire service that also provides hourly newscasts to radio stations, has moved ahead with its plans for satellite delivery too; it's likely to start within a matter of months. All those developments are in addition to the already existing half-dozen audio circuits that are aimed at cable TV systems using RCA Americom's Satcom birds.

Non-wave of the future

Digital transmission is almost certain to become the predominant format during the 1980's. That message has been repeated constantly in recent months at meetings as diverse as a conference of the Society of Motion Picture and TV Engineers and a computer/telecommunications seminar. Leaders from the satellite industry and other business groups see a rapid change-over to digital technology, not only for data and business communications, but also for video and other services. Most experts agree that satellites will spearhead the change. Indeed, Intelsat has already approved policies which will lead to complete international use of digital transmission by 1986.

"Flying saucers" ready for broadcasting uplinks

Small transportable satellite uplinks to help broadcasters cover sports and news events are being used for the first time this Spring. The equipment is supplied by Microwave Associates and is operated by Satelink of America, the new subsidiary of Robert Wold Co. Satelink leases use of the facilities to the TV networks and to other program producers.

The three packages can be deployed to different events and have been nicknamed "flying saucers" because the components can be collapsed and packed into 11 crates and shipped quickly by air-freight. One of the trade-offs in using the small 4.5-meter uplink dishes is that signals from them can be picked up only with downlink antennas of a diameter of at least 10 meters. Network headquarters and most TV broadcast stations are expected to install dishes that size—but, of course, that precludes many cable systems, and other users who are opting for antennas of 5 meters and smaller, from using the system.

GARY H. ARLEN

HICKOK LX SERIES MULTIMETERS OBSOLETE YOUR TRUSTY OLD VOM!

Here are the truly inexpensive, no nonsense, high performance DVOM's you've been looking for! Compact. Lightweight. Easy to read, indoors or out. Accurate. Precise. Reliable. Rugged. Safe. Self-contained. Easy to hold and operate with the same hand.

A complete line of inexpensive accessories is available to extend other capabilities far beyond those of a comparably priced VOM.

All the super-durable, high quality professional meter you need for service and maintenance work at an analog price. So why pay as *much* for analog inaccuracy...or *more* for digital frills?

Write today for complete details or contact your local Hickok distributor. Better yet, call us toll free, outside Ohio, at 800-321-4664.

LX303 — \$74.⁹⁵

LX304 — \$89.⁹⁵

- Automatic polarity, zero and overrange indication
- Easy-to-read 1/2" high LCD display
- 1/2 year battery life in typical use
- 12 oz. including 9V battery
- Withstands 4 ft. drop without loss of accuracy
- Automatic decimal point, built in low battery indicator, diode and transistor testing capability (LX304 only)

Carry it in your pocket, brief case or tool box and enjoy on-the-spot accuracy whenever and wherever you need it.

No need to worry about damage. It's built to take it...so you can take it with you wherever you go.



HICKOK
the value innovator 

THE HICKOK ELECTRICAL INSTRUMENT CO.
10514 Dupont Avenue • Cleveland, Ohio 44108
(216) 541-8060 • TWX: 810-421-8286



New Portable Digital Capacitance Meter



Call For Our Price

MODEL 820

- Measures capacitance from 0.1 pF to 1 Farad
- Resolves to 0.1 pF
- 10 ranges for accuracy and resolution
- 4 digit easy-to-read LED display
- 0.5% accuracy
- Special lead insertion jacks or banana jacks
- Fuse protected
- Uses either rechargeable or disposable batteries
- Overrange indication

DATA PRECISION Model 938
0.1%, 3 1/2-Digit, LCD DIGITAL CAPACITANCE METER



\$149

- **WIDE RANGING** — from 199.9 pF full scale (0.1 pF resolution) up to 1999 µF full scale, in eight ranges, virtually every capacitance you'll ever need to measure.
- **FAST AND EASY TO USE** — Direct reading, pushbutton ranges. Just plug in and read.
- **EXCEPTIONALLY ACCURATE** — provides ±0.1% basic accuracy.
- **TOUGH AND COMPACT** — Built to take rough usage without loss of calibration accuracy. Fits and goes anywhere, takes very little bench space, always handy for quick capacitance checkout, matching, calibration, and tracking.
- **PORTABLE** — Palm-sized, light-weight, operates up to approximately 200 hours on a single 9V alkaline battery.
- **EASY READING** — big, clear, high-contrast 3 1/2-digit LCD display, a full 0.5" high, readable anywhere.
- **VALUE PACKED** — Outstanding measurement capability and dependability. Outperforms DC time-constant meters, and even bridges costing 2 to 5 times as much.
- **RELIABLE** — warranted for 2 full years.

FLUKE DIGITAL MULTIMETERS

Model 8022A: The Troubleshooter

\$139

Model 8020A: The Analyst

\$179

Model 8024A: The Investigator

\$219



NEW

- **Seven functions:** dc voltage, ac voltage, dc current, ac current, resistance, diode test, conductance (1/R)
- 3 1/2-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection
- **Free case**
- Two year parts and labor warranty

- **Nine functions:** dc voltage, ac voltage, dc current, ac current, resistance, diode test, conductance (1/R), logic level and continuity detect, temperature (K-type thermocouple)
- Peak hold on voltage and current functions
- Selectable audible indicator for continuity or level detection
- 3 1/2-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection

HICKOK

LX304 DIGITAL MULTIMETER

FAST, EASY, ONE HAND OPERATION

NEW



AVAILABLE NOW \$89⁹⁵

New Low Distortion Function Generator



Call For Our Price

MODEL 3010

- Generates sine, square and triangle waveforms
- Variable amplitude and fixed TTL square-wave outputs
- 0.1 Hz to 1MHz in six ranges
- Push button range and function selection
- Typical sine wave distortion under 0.5% from 0.1Hz to 100kHz
- Variable DC offset for engineering applications
- VCO external input for sweep-frequency tests

New Sweep/Function Generator



Call For Our Price

MODEL 3020

- Four instruments in one package—sweep generator, function generator, pulse generator, tone-burst generator.
- Covers 0.02Hz-2MHz
- 1000:1 tuning range
- Low-distortion high-accuracy outputs
- Three-step attenuator plus vernier control
- Internal linear and log sweeps
- Tone-burst output is front-panel externally programmable

Simpson

B&K PRECISION

LEADER

DORIC



Non-Linear Systems



DATA PRECISION

PORTABLE OSCILLOSCOPES

BATTERY OPERATED

NLS Non-Linear Systems

MS-15



Single Trace 15MHz
Reg. price \$349.

\$299⁹⁵

MS-215



Dual Trace 15 MHz

Reg. price \$465.

\$399⁹⁵

MS-230



Dual Trace 30MHz

Regular price \$598.

\$499⁹⁵

SUPER SPECIAL

**HICKOK 385X
500MHz COUNTER**

Reg 499⁹⁵

NOW 229⁹⁵

LIMITED QUANTITIES



Model LBO-520

**30 MHz Dual Trace
Scope with Delay Line**

List Price \$1100

\$879⁹⁵

High Sensitivity:
Wide Bandwidth.

Single Shot Trigger. P-D-A CRT.

- 5mV sensitivity facilities accurate signal viewing from low level sources.
- Built-in delay line makes it easy to view the leading edge of a pulse.
- Single shot trigger (CH-1, CH-2) captures transient phenomena — no guesswork, no "double-takes".



**THESE 1980 B&K OSCILLOSCOPES
ARE IN STOCK AND AVAILABLE
FOR IMMEDIATE DELIVERY**



BK PRECISION

- 1479 Dual-Trace 30 MHz
- 1477 Dual-Trace 15 MHz
- 1432 Dual-Trace 15 MHz Portable
- 1476 Dual-Trace 10 MHz
- 1466 Single-Trace 10 MHz
- 1405 Single-Trace 5 MHz

**CALL FOR OUR
EARLY BIRD SPECIAL LOW PRICE**

**KEITHLEY MODEL 130
DIGITAL MULTIMETER**



NEW

\$99

	RANGE	ACCURACY
DC VOLTAGE	200mV, 2V, 20V, 200V, 1000V	.5%
AC VOLTAGE	200mV, 2V, 20V, 200V, 750V	1%
DC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	2%
AC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	3%
RESISTANCE	200Ω, 2kΩ, 20kΩ, 200kΩ, 20MΩ	.5%



THE TEST EQUIPMENT SPECIALISTS

TOLL FREE HOT LINE

800-223-0474

5-4 WEST 45th STREET, NEW YORK, N.Y. 10036 212-687-2224



**ADVANCE
ELECTRONICS**

MAY 1980

35

EQUIPMENT AND TRAINING NO OTHER SCHOOL CAN MATCH.

**NTS HOME TRAINING INVITES YOU TO EXPLORE MICROCOMPUTERS,
DIGITAL SYSTEMS AND MORE, WITH STATE-OF-THE-ART EQUIPMENT
YOU ASSEMBLE AND KEEP**

Without question, microcomputers are the state of the art in electronics. And NTS is the only home study school that enables you to train for this booming field by working with your own production-model microcomputer.

We'll explain the principles of troubleshooting and testing your microcomputer and, best of all, we'll show you how to program it to do what you want.

You'll use a digital multimeter, a digital logic probe and other sophisticated testing gear to learn how to localize problems and solve them.

Send for the full color catalog in the electronics area of your choice—discover *all* the advantages of home study with NTS!

NTS also offers courses in Auto Mechanics, Air Conditioning and Home Appliances. Check card for more information.



1.

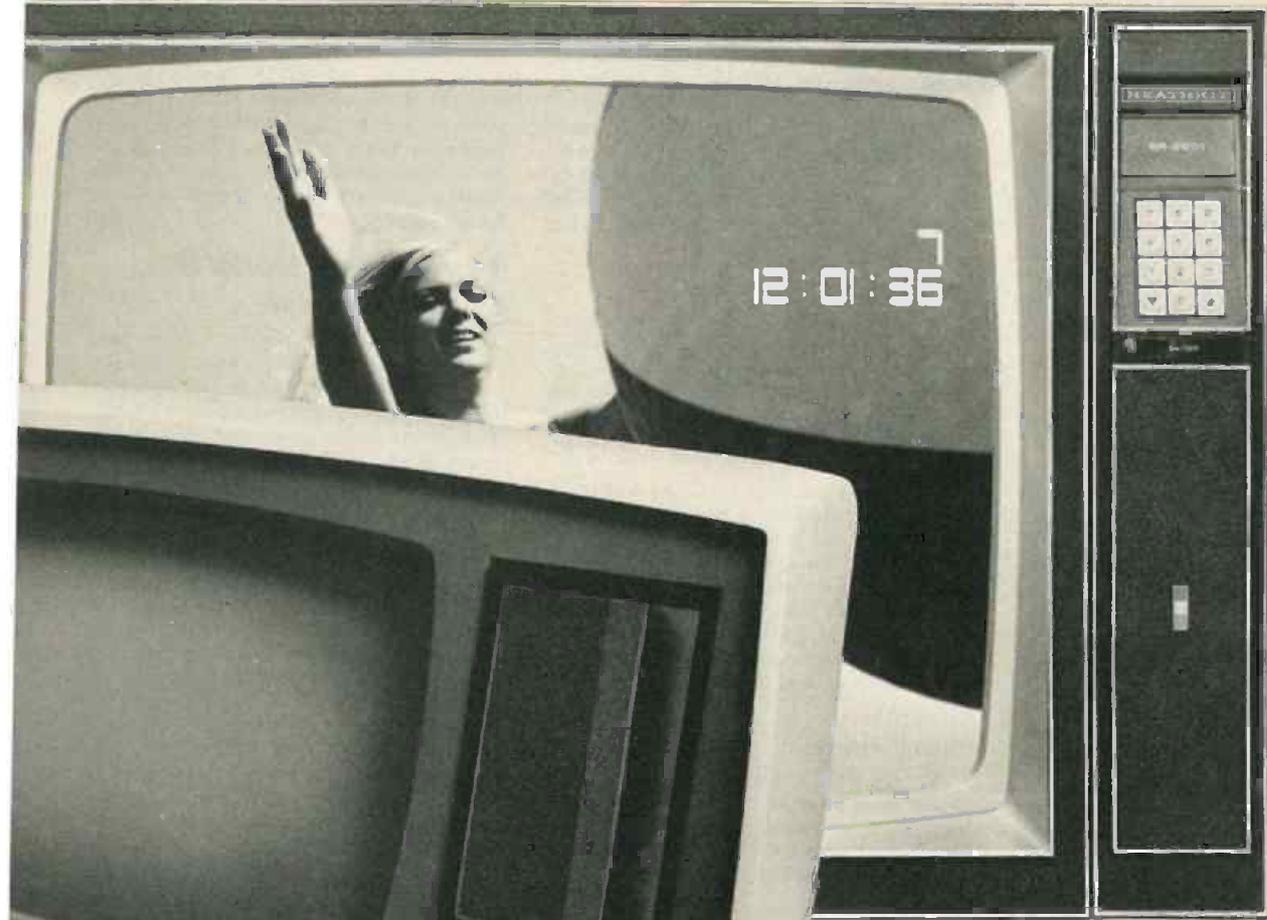
2.

We believe that training on production-model equipment, rather than home-made learning devices, makes home study more exciting and relevant. That's why you'll find such gear in all 14 of NTS's electronics programs.

For instance, to learn Color TV Servicing, you'll build and keep the 25-inch (diagonal) NTS/HEATH digital color TV.

In Audio Electronics, you'll be able to assemble your own NTS/HEATH digital stereo receiver with 70 watts per channel.

But no matter which program you choose, NTS's Project Method of instruction helps you quickly acquire practical know-how.



Simulated TV Reception

1. The NTS/Rockwell AIM 65 Microcomputer A single board unit with on-board 20 column alphanumeric printer and 20 character display. A 6502-based unit 4K RAM, expandable.
2. The NTS/KIM-1 Microcomputer A single board unit with 6 digit LED display and on-board 24 key hexadecimal calculator-type keyboard. A 6502 based microcomputer with 1K RAM, expandable.
3. The NTS/HEATH H-89 Microcomputer features floppy disk storage, "smart" video terminal, two Z80 micro-processors, 16K RAM memory, expandable to 48K.
4. The NTS/HEATH GR-2001 Digital Color TV (25" diagonal) features specialized AGC-SYNC muting, filtered color and new solid-state high voltage tripler rectifier.

NATIONAL TECHNICAL SCHOOLS

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

**NO OBLIGATION. NO SALESMAN WILL CALL.
 APPROVED FOR VETERAN TRAINING.**



NATIONAL TECHNICAL SCHOOLS
 4000 South Figueroa Street, Dept. 206-050
 Los Angeles, California 90037

Please rush FREE color catalog on course checked below

<input type="checkbox"/> MicroComputers/MicroProcessors	<input type="checkbox"/> Audio Electronics
<input type="checkbox"/> Communications Electronics	<input type="checkbox"/> Auto Mechanics
<input type="checkbox"/> Digital Electronics	<input type="checkbox"/> Air Conditioning
<input type="checkbox"/> Color TV Servicing	<input type="checkbox"/> Home Appliances

Name _____ Age _____
 Address _____
 Apt. _____ City _____
 State _____ Zip _____

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

ly accomplished by interconnecting the base unit and the portable with the patch cord provided.

An initial charging time of 16 hours is recommended by the manufacturer. We advise prospective buyers to heed the manufacturer's advice. New nickel-cadmium batteries require an initial forming time to assure proper function after the initial charge.

While the manual plug-in battery charging scheme may not be as convenient as the built-in charge mechanism activated by setting competitive units in their base units, it is substantially less expensive.

In use

Once the batteries of the remote unit have been charged and the system is ready to use, operation is extremely simple. Merely switch on the hand-held remote and await an incoming call. You may wish to have the operator call you to test the system.

When your regular telephone rings, a piercing, pulsing call signal will wail from the remote speaker of the *Muraphone*. Its volume level is settable by the volume control.

To answer the *Muraphone*, merely press the talk button on the side of the remote—just as you would on a walkie-talkie.

There is no need to shout into the remote unit; level is factory-set for comfortable audio gain with normal telephone-voice level.

While you are using the *Muraphone* remote answering system, you will hear a consistent pulsing noise in the background. It is barely perceptible to the caller, but becomes very prom-

inent in the remote unit. The pulsing should not significantly degrade the intelligibility, but it is very noticeable.

To deactivate the *Muraphone*, or to hang up after the call has been completed, the user merely presses the LINE RELEASE button on either the remote or base unit.

A POWER indicator light shows the ready state of the base. During the recharge operation of the remote's nickel-cadmium batteries, the light is automatically switched off to show that the remote system cannot be used during that cycle.

It's a paging system, too

With the remote unit switched on and in the possession of someone whom you may wish to summon, the system becomes an effective paging system. The pager merely depresses the intercom button, and the alarm tone will then be heard from the speaker of the awaiting remote unit.

The person paged responds by pressing his talk switch and converses with the operator of the base unit in a normal manner.

While the *Muraphone* does not have the polish of more costly remote cordless telephones, it does work dependably. We found the maximum separation between the base and remote units that would still support reliable conversation to be in the neighborhood of 200 feet or so.

Specifications

The operating frequency of the *Muraphone* is the familiar 49.86 MHz, popular among license-free low power systems. Output is purposely kept below 100 milliwatts, and receiver sensitivity is nominally 3 microvolts.

An automatic disconnect circuit prevents the system from keeping a telephone "off the hook" accidentally. The circuit activates after 2 minutes have passed without any signal received from the remote.

The *MP-100* and *MP-101* provide the convenience of remote response to incoming calls while the user is away from the telephone. A prospective buyer would do well to look into the dollars-and-sense combination of the *Muraphone*. The *Muraphone* remote answering system sells for \$89.95. R-E

Transtronics Model 65 Continuity Tester

WITH ADVANCING TECHNOLOGY, NEW BASIC testers appear from time-to-time on the electronic scene. The \$19.95 model 65 *Electronic Workmate* from Transtronics is such a device. This unique penlight-size leadless continuity tester comes complete with 2 AAA 1.5 volt batteries and pocket clip. Unlike most continuity testers, the *Electronic Workmate* needs no additional wires or clip-leads, and has a 220K internal DC resistance.

It is useful in testing many different types of electronic components, or in checking wiring and repairing appliances. You simply hold one lead of the component under test with one hand, and the *Electronic Workmate* in the other hand. When the probe of the *Workmate* is touched to the other component lead, your body and fingers complete the circuit! If the component under test has continuity—even beyond 10 megohms—a red LED in the tip of the *Workmate* glows bright enough to be recognized. The brighter the glow, the lower the

continued on page 42

Price Without Sacrifice.



HITACHI V-302 & V-152

Put a proven Hitachi dual-trace oscilloscope on your bench for as little as \$695. Our V-152 15MHz model includes unprecedented sensitivity (1 mV/div)...10X sweep magnification...front panel XY operation...trace rotation...Z-axis input...and more. Need greater bandwidth? Our V-302 model is the only 30MHz dual-trace scope with signal delay line priced under \$1000, with all the above features, to make your testing operations fast, easy, and accurate. Reliability is exceptional, too. (As you'd expect from a manufacturer with over 20 years of experience "outscoping" the competition.) So exceptional, in fact, that Hitachi quality is backed by a 2-year warranty...the longest in the industry. Whether you use it for teaching or repairs, for video, audio, or computer testing, you can't find more scope for your dollar than at Hitachi. Write for more details.

Hitachi...The measure of quality.

- V-152 15 MHz Dual Trace . . . \$695*
 - V-302 30 MHz Dual Trace . . . \$945*
- *Probes included.



HITACHI
Hitachi Denshi America, Ltd.
175 Crossways Park West
Woodbury, NY 11797
(516) 921-7200

The only thing that beats their performance is their price.

Accurate performance you can rely on, time after time. That's what you expect from a quality DMM. But don't expect to pay as much for it any more. Because now Sabtronics brings you top quality DMMs with more features and better accuracy than other comparable units on the market today. And they cost surprisingly less!

We cut the price. Not the quality.

What you get is a precision crafted unit that features single-chip LSI logic, laser trimmed resistor network and a stable band-gap reference element for better long term accuracy. Basic DCV accuracy is 0.1%. The Model 2035A gives you 32 measurement ranges over 6 functions and the Model 2037A an additional two temperature ranges.

First in features. First in price.

Both models feature a "touch-and-hold" capability with the optional probe - a reading is retained for as long as you wish. Now you can make measurements in hard-to-reach places without taking your eyes off the probe tip or stopping to record data.

The two-terminal input for all measurement functions eliminates switching test leads when measuring voltage, resistance or current. The Model 2037A even has a built-in temperature measuring circuit with a -50°C to +150°C range and is supplied complete with the sensor probe. It is ideal for checking IC, resistor, transistor, heat sink and enclosure temperatures or for

monitoring environmental test temperatures.

Plus more features.

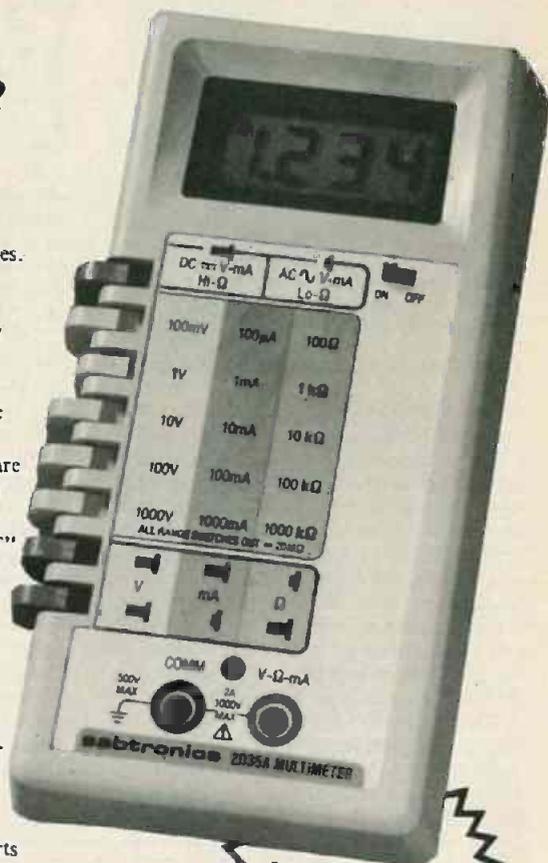
The Hi-and-Low power ohms capability allows you to make in-circuit resistance measurements and to check semiconductor PN junctions. In addition automatic polarity, automatic zero, automatic decimal point and overload protection are standard features. And you get up to 200 hours operation from a single 9V transistor battery. The automatic "LO BAT" indicator warns you of the last 20% of battery life. The large, crisp LCD readouts allow easy viewing indoors or outdoors in bright sunlight.

One-evening kit assembly.

Assembling either kit is simple with our easy-to-follow, step-by-step instructions. The built-in calibration references allow you to calibrate the unit any time, any place. We've even eliminated difficult point-to-point interconnect wiring. All parts mount on the PC board. The only wires you solder are the two battery clip leads.

Order yours now.

With all of these features and performance characteristics no other handheld DMM comes even close to matching the price/performance ratios of the Models 2035A and 2037A. Providing the best value for money in test equipment, Sabtronics has become one of the world's largest producers of DMMs. You can order with confidence. Use the convenient order form or call us with your Master Charge or Visa number for prompt delivery.



Model 2035A
\$74.95
 F.O.B. Factory

Making Performance Affordable



5709 North 50th Street, Tampa, Florida 33610
 Telephone 813/623-2631

BRIEF SPECIFICATIONS:
 DC VOLTS: 100 μ V - 1000V, 5 ranges
 AC VOLTS: 100 μ V - 1000V, 5 ranges
 DC CURRENT: 0.1 μ A - 2A, 5 ranges
 AC CURRENT: 0.1 μ A - 2A, 5 ranges
 HI-OHMS: 0.1 Ω - 20M Ω , 6 ranges
 LO-OHMS: 0.1 Ω - 20M Ω , 6 ranges
 TEMPERATURE: -50°C - +150°C
 (-58°F - +302°F), 2 ranges
 (Model 2037A only)

Size: 3 1/2" W x 6 3/4" L x 1 5/8" H

WEIGHT: 11 oz. (excl. battery)
 OVERLOAD PROTECTION: 1000V DC or AC peak all voltage ranges, 250V DC or AC peak all Ohms ranges; 2A/250V fuse all current ranges.

SABTRONICS SERVICE AVAILABLE
 IN MOST COUNTRIES OF THE
 WORLD

To: Sabtronics International, Inc., 5709 North 50th Street, Tampa, FL 33610

Please send me

- _____ Model 2035A Handheld Multimeter kit(s) @ \$74.95 ea. \$
- _____ Model 2037A Handheld Multimeter kit(s) @ \$99.95 ea. \$
- _____ Shipping and handling @ \$5.00 per kit (see below)† \$
- _____ Model THP-20 Touch-and-hold Probe(s) @ \$19.95 ea. \$
- _____ Model AC-110 Battery Eliminator(s) @ \$7.95 ea. \$
- _____ Model HVP-30 30 kV DC High-voltage Probe(s) @ \$29.95 ea. \$
- _____ Florida residents add 4% State Sales Tax \$
- TOTAL** \$

I enclose check* money order. Bill my Master Charge Visa

Card Account # _____

*Allow 2-3 weeks clearance time for personal checks. No C.O.D.

Name _____

Street _____

Apt _____

City _____

State _____

Zip _____

†Continental U.S. only. AK, HI & PR: \$6.00; Canada: \$7.50; Foreign: \$19.00 Airmail.

Expiry date _____



CIRCLE 104 ON FREE INFORMATION CARD

resistance of the item under test.

Because the tip is at a small negative polarity (.5 volt) compared to the case, you can test diodes, transistors and SCR's. Fuses, switches, relay coils and contacts, solenoid coils, transformers, motor windings, tube filaments, incandescent lights, meter movements, photocells, cables and cable harnesses, line cords, selenium rectifiers, resistors (up to 12 meg-ohms) and even capacitors (down to 50 picofarads!) can be checked for continuity, opens, or shorts. Traces on printed circuit boards can be checked for opens or solder bridges.

The *Electronic Workmate* is five inches long and 1/2 inch in diameter, with a 1/2-inch pin-point probe that can penetrate PC board masks or thin wire insulation. The silver metal flourescent finish, black tip, and slip-on plastic

protective probe cover, combine to give the *Workmate* a sleek modern appearance. The top of a mini-LED protrudes slightly from the black tip and it glows with sufficient brightness to be used in well-lighted surroundings.

The circuitry is permanently potted in the probe-end, making the unit virtually indestructible. It is guaranteed for two years! No circuit information is provided—or needed—but a detailed instruction sheet tells you specifically how to check fuses, low-leakage silicon diodes, silicon transistors (identifies NPN or PNP), non-electrolytic capacitors and long cables (including twisted-pairs), and lists 18 other types of continuity and direct current checks. The instructions also cover using the *Workmate* as a logic probe, but I found it almost useless for that purpose.

The maximum tip current when testing a component is only about 25 microamperes, so the *Workmate* can even be used to test sensitive meter movements or other very low-current devices. When testing meter movement, don't expect to see the meter needle move unless it's a 50 microampere, or more-sensitive, meter movement. The *Workmate* tests coil continuity, not deflection. In addition, AC voltages as low as 3 volts peak-to-peak are detectable.

When testing capacitors, the length of time the *Workmate* LED is lighted gives you a rough idea of the capacitance. With a .25 µf capacitor, the LED will take about 3 seconds to dim and go out. A small capacitor gives a quick flash. That feature allows you to check for the location of opens in long coaxial or paired cables, since there is sufficient capacitance between the wires (or the center conductor and shield) to flash the LED. The duration of the

flash is a rough indication of how far down the cable one conductor is open.

In actual use, I found the *Electronic Workmate* to be extremely handy and easy to use. My first real test for the *Workmate* was in tracing a wiring harness above and below the chassis of a stereo tape player. The wires ran all over the place, but end-to-end checking was easy with the *Workmate* using just a fingertip instead of a cliplead. (Of course, the power was off!) The trouble, incidentally, was traced to an open rectifier in the power supply—the *Workmate* indicated that there was no continuity in either direction.

About the only limitation of the *Workmate* for semiconductor testing is a result of its great sensitivity. High-leakage semiconductor devices (such as selenium rectifiers, or germanium transistors and diodes) light the LED dimly when reverse-biased. However, in the forward direction the LED glows brightly, as you would expect.

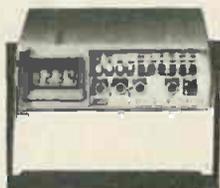
The *Electronic Workmate*, Model 65, complete with batteries and two-year warranty, sells for \$19.95, plus 60¢ postage and handling, from Transtronics, Dept. RE, 13101 NE Hwy 99, Suite C-3, Vancouver, WA, 98665. R-E



NEW 1980 DIGITAL MULTIMETERS FROM FLUKE®

8010A
\$249

\$289
w/rechargeable
batteries
(OPTION - 01)



8010A and 8012A

- Large 3 1/2-Digit LCD's - view in any light
- Conductance function - resistance to 10,000 MO
- AC measurements to 50 kHz and higher
- True RMS for ac accuracy
- Touch-Hold probe for tricky places (Y8008)
- Diode test and low power ohms
- AC or dc current to 10 amps with 8010A
- Resistance resolution to 0.001Ω with 8012A
- Built-in batteries and charger (Option -01)

8012A
\$299

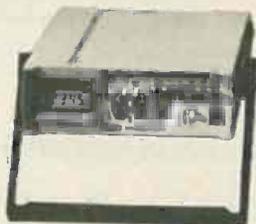
\$339
w/rechargeable
batteries
(OPTION - 01)



NEW

8050A
\$329

\$379
w/rechargeable
batteries
(OPTION - 01)



8050A
4 1/2-digit multimeter
microprocessor technology

- dB: That's right, direct readings in dBm, referenced to any of 16 impedances that you select from the 8050A's scrolling reference memory.
- REL: This stands for relative reference in the dB mode or offset measurements in other functions.

- Conductance function - resistance to 10,000 MO
- AC measurements to 50 kHz and higher
- True RMS for ac accuracy
- Touch-Hold probe for tricky places (Y8008)
- Diode test and low power ohms
- Built-in batteries and charger (Option -01)

NEW

8024A
\$219

Model 8024A:
The Investigator

- Nine functions: dc voltage, ac voltage, dc current, ac current, resistance, diode test, conductance (1/R), logic level and continuity detect, temperature (K-type thermocouple)

- Peak hold on voltage and current functions
- Selectable audible indicator for continuity or level detection
- 3 1/2-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection



Model 8022A:
The Troubleshooter

- Six functions: dc voltage, ac voltage, dc current, ac current, resistance, diode test
- 3 1/2-digit resolution
- 0.25% basic dc accuracy
- LCD display
- Overload protection



8022A
\$139

Model 8020A:
The Analyst

- Seven functions: dc voltage, ac voltage, dc current, ac current, resistance, diode test, conductance (1/R)
- 0.1% basic dc accuracy
- LCD display
- Overload protection
- Free Case
- Two year parts and labor warranty

8020A
\$179



TOLL FREE HOTLINE 800-223-0474

54 WEST 45TH STREET, NEW YORK, N.Y. 10036 212-687-2224

ADVANCE ELECTRONICS

Yesterday you could admire all-band digital tuning in a short wave receiver.*

Today you can afford it.



RF-4900

Tune in the Panasonic Command Series™ top-of-the-line RF-4900. Everything you want in short wave at a surprisingly affordable price. Like fluorescent all-band readout with a five-digit frequency display. It's so accurate (within 1 kHz, to be exact), you can tune in a station even before it's broadcasting. And with the RF-4900's eight short wave bands, you can choose any broadcast between 1.6 and 31 MHz. That's all short wave bands. That's Panasonic.

And what you see on the outside is just a small part of what Panasonic gives you inside. There's a double superheterodyne system for sharp reception stability and selectivity as well as image rejection. An input-tuned RF amplifier with a 3-ganged variable tuning capacitor for excellent sensitivity and frequency linearity. Ladder-type ceramic filters to reduce frequency interference. And even an antenna trimmer that changes the front-end capacitance for reception of weak broadcast signals.

To help you control all that sophisticated circuitry, Panasonic's RF-4900 gives you all these sophisticated controls. Like an all-gear-drive

tuning control to prevent "backlash." Separate wide/narrow bandwidth selectors for crisp reception even in crowded conditions. Adjustable calibration for easy tuning to exact frequencies. A BFO pitch control. RF-gain control for improved reception in strong signal areas. An ANL switch. Even separate bass and treble controls.

And if all that short wave isn't enough. There's more. Like SSB (single sideband) amateur radio. All 40 CB channels. Ship to shore. Even Morse communications. AC/DC operation. And with

Panasonic's 4" full-range speaker, the big sound of AM and FM will really sound big. There's also the Panasonic RF-2900. It has most of the features of the RF-4900, but it costs a lot less.

The Command Series from Panasonic. If you had short wave receivers as good. You wouldn't still be reading. You'd be listening.

*Short wave reception will vary with antenna, weather conditions, operator's geographic location and other factors. An outside antenna may be required for maximum short wave reception.



RF-2900

Panasonic
just slightly ahead of our time.

AMERICA'S NEWEST, MOST SOPHISTICATED SCANNER IS ALSO THE EASIEST TO PROGRAM SCANNER.

Presenting the new Bearcat® 300 Scanner with Service Search.

It's like having a frequency directory already pre-programmed in your set—to let you tune in all the action at the touch of a button.

The incredible, new, 50 channel Bearcat 300 Scanner with Service Search is another first in scanner innovation. Another triumph in synthesized spaceage technology. Another first from the leader in real excitement.

Over 2100 active frequencies are pre-programmed into the Bearcat 300 Scanner memory bank. These frequencies are arranged in eleven service categories, as allocated by the F.C.C.

Simply push the police service button, for example. You'll search and find only the frequencies allocated to police—and be able to monitor every local, active frequency. Then they are programmed into the normal scan operation via keyboard entry.

It's that easy. That automatic for every service category—fire, marine, HAM, emergency, air, etc. It's truly like having a frequency directory already pre-programmed in your set.

The new 50-channel Bearcat 300 Scanner brings you every feature you've ever wanted, and then some. 7-band coverage, AM/aircraft and FM. Patented Track Tuning. Automatic squelch. Priority. Automatic lockout. Activity count. Selective scan delay. Direct channel access. Digital display, and a lot, lot more—even a digital clock, and mountings for mobile operation.

The new Bearcat 300 Scanner. Possibly the ultimate Scanner. Certainly the most automatic, easiest to use Scanner ever.

Now that's real excitement.



BEARCAT® 300 SCANNER.

Follow the leader to real excitement.



Copyright 1979 Electra Company, Division of Masco Corp. of Indiana, 300 E. County Line Road South, Cumberland, Indiana 46229

ELECTRONIC DEVICES FOR SELF-IMPROVEMENT

State-of-the-art electronics combined with recent medical discoveries can help you master your mind and body's "involuntary" actions.

DAVID R. WHEELER

"EVERY DAY, IN EVERY WAY, I AM GETTING better and better."

Emile Coué had the idea that telling yourself you were improving was enough. That was in the 1920's and before the miracle of electronics made it possible to have total control over one's body and mind.

To change your behavior, your habits, and/or to improve yourself, two conditions—call them principles of behavioral technology—must be present and used.

They are something which can be observed and measured, and feedback of the observed "something" has to occur. To improve at bowling, golfing, pool, or handball, you have to know where the ball went after being hit. Improvement comes about as adjustments are made from feedback. Knowledge of the results is of critical importance if you are to learn.

Electric devices have been used since the beginning of this century as crude, and sometimes dangerous, apparatus for curing diseases. Electrical current

was sent through the human body to purge the system of "malevolent and evil spirits." Many of the mail-order catalogs at the time contained advertisements for the miracle "cure in electricity." Today, medical researchers are experimenting with low-voltage currents as a means of stimulating bone repair in patients with broken bones. That is not self-improvement, but medical treatment.

Behavior modification—the technology of altering and controlling thought and action—rests soundly on the prin-



galvanic skin response and the numbers on the dial. Twenty-five percent of police have alcohol problems, 60 percent are divorced, and there are high suicide rates. Three-fourths of the heart attacks suffered by police officers are directly related to stress on the job. Learning to reduce stress by learning to relax seems to be one way of counteracting the serious problem. Biofeedback is effective in reducing stress.

Noise can sicken you. It reduces the ability to concentrate. Students nearer distracting noises (freeway traffic) did less well in their grades than students farther from the noise. Noise leads to stress, tension, nervousness, heart disease, high blood pressure, chronic headache, and stomach ulcers. It affects one's mental health. Sudden noise stops food digestion.

Pink noise generators

Psychologists have found that electronic sound conditioners can change the impact of noises on the human system. Those devices can mask or reduce the noise's impact. One of the most inexpensive devices for generating a white-noise masking effect is the electric fan. Most of the devices for sale today are pink-noise generators. White noise has equal distribution of sounds throughout the frequencies; on the other hand, pink noise is a distribution weighted toward the audio spectrum.

Some years ago dentists experimented with the use of pink noise instead of anesthetics. It worked for some patients, but not all.

sound. A six-and-one-half inch diameter cylinder is \$98. Those devices allow privacy in meeting rooms.

Marpac Corporation manufactures sound-conditioning devices. James Buckwalter, president of Marpac has said: "Users of the electromechanical devices got 50 percent more delta—deep sleep—than those who did not use it."

Those electronic devices seem to reduce stress and anxiety by helping people produce more alpha rhythms. Dr. Lou Gerstman, psychologist in City University of New York, has suggested why the electronic sound devices help us to concentrate. The left side of the brain deals with structured thought—reading, problem solving—while the right side deals with abstract thought, imagination, and subjective feelings. Dr. Gerstman believes that the noise generators interfere with the functioning of the left side, freeing the right to function in artistic and creative areas.

Ions, health, & the unknown

The mixture of negative to positive ions in the air around us influence the way we think, our emotional attitudes, and subjective feelings. Restlessness and anxiety are modified by the electrostatic field in which we are exposed.

In Israel, civil order is disrupted by the dry, positive ion-rich winds that blow across the country. Scientists have developed the Ionotron (at the Hebrew University) to enrich the air with negative ions. Throughout the world, the winds alter the composition of ions in living space. When that happens people begin suffering from thyroid conditions and breathing problems—particularly asthma; auto accidents increase, and crime can jump by 20 percent.

In the Middle East, the winds are called the khamsin which blow in from across the deserts of the Sahara. Italians suffer physiological and psychological disruptions from the winds calls the sirocco. France has the mistral. The Alpine regions have the foehn. The Rocky Mountain area in the United States has winds called chinook. California has the Santa Ana winds. Regardless of their names, the results are the same. People absorb the positive ions; they develop migraine headaches, nausea, and have an inability to relax and concentrate.

Electronic air cleaners do remove particles and clean the air, but they also produce ozone, which is much more toxic than carbon monoxide. (One-tenth of a part per million causes eye trouble and throat irritation.)

Breathing positive ions reduces reaction time. With negative ion environments, old rats learned mazes faster than control groups in normal air. A researcher at the University of Pennsylvania found that negative ions in the air promote feelings of exhilaration and

well-being. The growth of house plants was better in negative ions than in positive ions. Many firms now have started to market devices which generate negative ions. They use modern microelectronics to produce ionized ions.*

Athletes, joggers & electronics

The development of products using electronics to use in self-development programs for athletic and exercise activities has mushroomed in the last couple of years. There is a device that gives the user a LED display of jogging performance while the person jogs in place in the home. (Beacon Scientific). Dynavit digitally displays heart rate, oxygen pulse, watts workload, and caloric expenditure. The Amerex Exercise Rate Monitor electronically watches human physiology and warns the user if he is about to reach his limit. Tredex has developed the experience in fitness. It gives a LED display of exercise performance. Then there are the smaller, less expensive electronic units—pacesetters to help a jogger adjust his pace, electronic stopwatches (Texas Instruments has a light-weight one that retails for less than \$20), and light-weight transistor radios that strap to a jogger's chest. Also, a relatively new addition appears to combine the best of then electronics element (precise observation of an event) with the principles of behavior modification (feedback)—the unit is a puttermeter.

For those wanting to improve themselves in terms of weight, there are now electronic scales. What makes those units better than regular household scales is the read-out mechanisms—they are LED digitals. To improve oneself, a objective measure of changes is needed. See the precise number "187" is better feedback than having to guess at what the hand is pointing at with conventional scales.

Electronics has given those desiring ways of improving themselves precise and objective methods. The marriage of electronics with behavioral technology allows people to design their own self-improvement programs that work better than any other method. The subject designs the program, administers the rewards for sequential completion, and he or she is the person in charge, not someone else.

Every day, in every way, electronics and behavior modification are helping people master themselves. R-E

*One potential problem with those negative ion devices is a lack of a meter, dial, or some other indicator of ion concentration. Since we can neither see nor feel directly the influence of negative ions, there may be a tendency to doubt the output. Several years ago a manufacturer developed a super-quiet vacuum cleaner. It did not sell because no one believed that a quiet cleaner was working.

PSYCHOACOUSTICS

This new sounder provides the generation of sounds and therefore to help you study sleep, concentration, or meditation. You don't listen "noise" in these sounds, you electronically performed and treated with them. The sounds of pink noise, providing stress, "white noise", etc. provide a natural environment for the individual, helping your conscious mind to proceed with the work at hand.

Rest Your Mind And Your Body With Sound Conditioners

(A) Edmund Professional Sound Conditioner
Setting a specific psychoacoustic atmosphere is much to think, to read, or to study. The Edmund Professional Sound Conditioner helps you concentrate by providing a background of sound. Used by light sleepers, apartment dwellers, office workers, travelers and others, it electronically simulates the natural sounds of nature. The Edmund Professional Sound Conditioner is a sound conditioner for the mind. It provides a natural environment for the individual, helping your conscious mind to proceed with the work at hand.

See 7428

(B) Low-Cost White Sound Conditioner
An ideal "background" sound model, "white-noise" only provides a pleasant, steady "white-noise" sound which helps you concentrate, study, sleep & concentrate. Line 1159 AC. Only 7428.

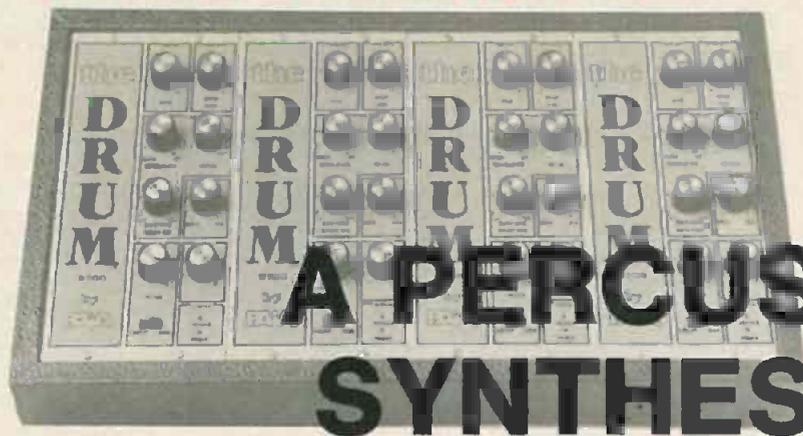
NOISE GENERATORS mask external distractions and reduce their effects.

There are several sources of pink-noise generators: some are in kit form, others ready-to-use. One electronic masking device is made by Control Electronics Company (139 Florida Street, Farmingdale, New York 11735). The device is suspended over a noise source and tuned to mask a specific sound with another, almost subliminal

J.F.T. Corcoran (chief and staff psychologist Department of Mental Health, Lackland AFB), M.D. Lewis, and R.B. Garver, "Biofeedback-Conditioned Galvanic Skin Response and Hypnotic Suppression of Arousal," *Journal of Forensic Sciences*, Vol. 23, No. 1, pages 155 to 161.

BUILD THIS

the DRUM . . .



A PERCUSSION SYNTHESIZER

For the musician and musician to be.

This unique 4-channel synthesizer adds more than just a beat to your music.

STEVE WOOD

PERCUSSION SYNTHESIS SEEMS TO BE growing more popular daily. The trouble is, it's expensive! Or it was. Building The Drum is a good way to get yourself fixed up with a great little percussion synthesizer that can do all the fascinating things that you're hearing on the radio and TV (and much more), without going into the red. The Drum is a four-channel synthesizer consisting of four type-5700 percussion modules.

The Drum has some goodies that don't seem to be available on most percussion synthesizers now on the market. Let's examine the functions of some of the control and interface features on The Drum, and I think you'll see what I mean.

One of the most unique features of The Drum is its sensor device. It's a small audio transducer that can be mounted just about anywhere you want to put it. That means that you don't have to add more "things to hit" to your existing drums. You can simply mount the sensor on one of the drums you are already using and have that drum serve a dual purpose. The Drum synthesizer has provisions for a "cancel" control, such as an ordinary on/off type foot-switch (like the kind used with special-effects for guitar). That way, you don't have to dislocate your arm trying to hit a new piece that's behind you because there was no more room in front or to the sides.

For those who would like something that looks and feels like an actual drum surface, we have found that mounting the sensor in a practice-pad gives good results. However, it has also been noted that the dynamic range (evidenced by differences in synthesizer output pitch and volume level, with respect to the degree of force exerted on the practice-pad or drumhead) is somewhat less when using a practice-pad than that afforded by, say, a tom-tom. The reason is that the tom-tom (and just about any other drum) has a much longer decay time than a practice-pad, and a natural amplification that far exceeds that of the practice-pad. This gives the "envelope follower" circuit in the synthesizer a stronger and longer lasting signal to work with. We'll get into that a little later.

Since there are as many different ways to mount the sensor as one can think of, there must be a control on the synthesizer to allow the drummer to make adjustments for the differences in source-signal amplitude that will be encountered when using various drums and/or practice-pads as the "trigger" source. That control is simply a 500K pot, across which the input signal is dropped. The wiper picks off the desired signal level and feeds it to the input amplifier. We call that control **SENSOR GAIN**, and it is labeled R1 on the schematic in Fig. 1. The power supply for The Drum is shown in Fig. 2.

turn page for diagrams

Other front-panel controls include: **ENVELOPE DECAY TIME**, **INITIAL PITCH**, **PITCH MODULATION UP/DOWN** (this one is unique; we'll see why shortly), **WAVEFORM SELECT/MIX**, **NOISE/OSCILLATOR MIX**, **NOISE FILTER** (auto sweep or manual), and **OUTPUT LEVEL**. There are two status-indicator LED's on the front panel, one of them to show when the power is on, and the other to show when a trigger has been sensed.

We will explain the function of all those, as well as the half dozen interface jacks that are associated with The Drum module, in the design analysis.

How it works

The Drum transducer, which converts the mechanical action of striking the drumhead to the electrical input required by the synthesizer board, consists of a piezoelectric element encapsulated in a silicon compound. The silicon encapsulant supports and protects the element as well as serving as a coupling medium for the mechanical excitations. The voltage produced by the transducer is proportional to the magnitude of the mechanical force applied. (how heavily the drumhead is struck.)

The signal that is derived from the transducer is fed to input jack J1 (Fig. 1) and dropped across R1. The wiper of that pot picks off the signal at the desired level and feeds it to the non-inverting amplifier built around IC1-a; in turn, the amplifier

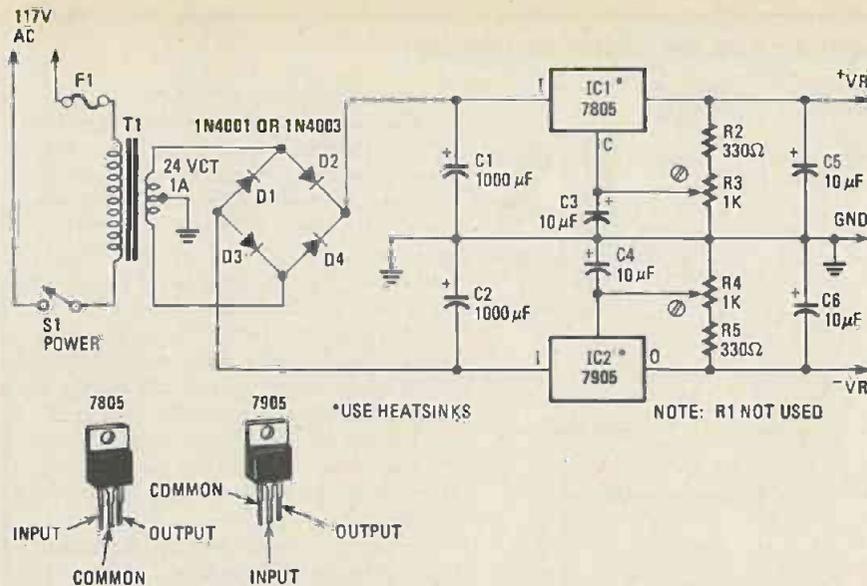


FIG. 2—THE POWER SUPPLY is hefty enough to supply the four modules that are used in the four-channel percussion synthesizer.

POWER SUPPLY PARTS LIST

- R1—not used
 R2, R5—330 ohms, ½ watt
 R3, R4—1000 ohms, trimmer pot
 C1, C2—1000 µF, 20 volts, electrolytic
 C3—C6—10 µF, 10 volts, electrolytic
 D1—D4—1N4001 or 1N4003
 IC1—LM340T-5 or 7805 positive voltage regulator, 5 volts
 IC2—LM320T-5 or 7905 negative voltage regulator, 5 volts
 T1—transformer, 24 volts, CT, 1 amp

Transistor Q3 serves as a second emitter-follower which tracks the voltage on C3 and provides the relatively heavy currents required to charge C4 quickly enough to produce a percussive attack waveform. Capacitor C4's discharge path is through resistor R10 and DECAY control R11. The attack and release (A/R) waveform that appears across C4 is buffered by the voltage-follower IC1-c. IC1-c's output provides the voltage that will control dynamics by means of the voltage-controlled amplifier and sweep the voltage-controlled oscillator and voltage-controlled filter.

Amplifier-stage IC1-d is configured as a sign-changer which allows the A/R control voltage to produce either upscale or downscale pitch shifts from the VCO. After it has been processed by the sign-changer, that control voltage is coupled by R25 and the INITIAL PITCH control R26 to the frequency-control input of the VCO, IC2.

The outputs of the 566 VCO are found at pins 3 (squarewave) and 4 (triangle). Because of the differences in the energy content of a squarewave and a triangle, the squarewave will sound louder. That accounts for the rather large difference between the values of the mixing resistors R28 and R29. The 500K pot R32 serves as a mix control by attenuating the unwanted waveform to the desired degree. Isolation-resistors R30 and R31 sum the mixed signal which is then coupled to the input of the next mixing stage by C9.

Resistor R43 couples the selected or mixed VCO signal to the VCO noise mixer circuit. The other input to this mixer circuit, R44, is fed from IC3-b. IC3-b's output is filtered white noise, generated by Q4—a transistor selected for its noise characteristics when operating in an avalanche condition.

The noise generated by Q4 is picked off at its base and capacitively coupled to the filter/amplifier IC3-b. Diodes D5, D6, D7, D8, and associated components, form the circuitry which sets the corner frequency of that filter. If S3 is switched to make connection with R33, then R34 (INITIAL FREQUENCY) serves as a manual filter frequency control. With S3 switched to sweep (the envelope follower output) the filter will be swept by the envelope-follower output and R34 serves as a sweep-range control.

PARTS LIST

Resistors ¼ watt, 10% unless otherwise specified

- R1, R24—500,000 ohms, potentiometer, linear taper
 R2, R3, R19, R20, R29, R39, R60, R_{SP} (only one needed)—100,000 ohms
 R4—680,000 ohms
 R5, R30, R31, R41, R44, R46, R47—470,000 ohms
 R6, R17—1500 ohms
 R7, R27—3.9 megohms
 R8, R9, R28, R61—1 megohm
 R10, R15, R33, R38, R50, R51—1000 ohms
 R11—250,000 ohms, potentiometer, audio taper
 R12, R18, R22, R23, R37, R40, R48, R56, R57, R58, R_S (only four needed) 10,000 ohms
 R13, R14, R53—150,000 ohms
 R16—2.2 megohms
 R21—50,000 ohms, trimmer potentiometer
 R25—3900 ohms
 R26, R34—100,000 ohms, potentiometer, reverse audio taper
 R32, R45—500,000 ohms, potentiometer, linear taper with SPST switch
 R35—3300 ohms
 R36—470 ohms
 R49, R59—220,000 ohms
 R52—15,000 ohms
 R54—5000 ohms, potentiometer, linear taper
 R55—33,000 ohms
 R62—100,000 ohms, potentiometer, audio taper (only one needed)

Capacitors

- C1, C7—15 pF, ceramic disc
 C2, C3, C9—0.1 µF, Mylar
 C4, C14—33 µF, 16 volts or higher, electrolytic
 C5, C6, C8, C13—.05 µF ceramic disc
 C10—1 µF, 10 volts, electrolytic
 C11, C12—.01 µF, polyester

Semiconductors

- D1, D2, D5—D8—1N914 or 1N4148
 D3, D9—TIL-209-B light-emitting diode
 Q1, Q6—2N5139 or PN5129
 Q2, Q3—2N3391 (GE)
 Q5—2N5129 or PN5129

Q4—2N2712 (GE, Sprague or other, selected for noise output. As supplied in the kit, the center lead has been clipped off.)

IC1, IC3—4136 quad op-amp (Exar, Raytheon, TI)

IC2—566 voltage-controlled oscillator (National, Signetics)

IC4—CA3080 (RCA or equal) operational transconductance amplifier

IC5—CD4001 CMOS quad NOR gate

S1, S2—SPST switch, on R32 and R45, respectively

S3—SPST slide switch

J1, J6, J7—open-circuit phone jack, ¼ inch
 J2, J3, J5—closed-circuit phone jack, ¼ inch

J4—stereo phone jack, ¼ inch

Miscellaneous: wire, knobs, hardware, circuit board, front and rear panels, drum transducer, etc.

The following are available from Paia Electronics, Inc., PO Box 14359, Oklahoma City, OK 73114:

- No. 5700 —Complete kit of all parts necessary for a single drum module, including drum transducer, circuit board, front panel, etc. \$59.95 plus \$3.00 postage and handling.
 No. 5700PC—Etched, drilled and labeled circuit board for single module. \$15.95 postage paid.
 No. 5700P—Complete kit for four-module drum set, including case, power supply, and four drum modules. \$269.75 plus \$10.00 postage and handling.
 No. 5700S—Piezoelectric transducer \$25.00
 No. 4771—Complete kit of parts for power supply \$29.95
 No. 4771PC—Etched and drilled circuit board for power supply, \$6.95
 Assembled units available. Write for prices.

JOHN S. SIMONTON, JR.

ELECTRONIC CIRCUITS FOR SIMULATING drum sounds have been around for a long time. In the past they have primarily been simple bridged or parallel T oscillators as shown in Fig. 1. In use, the gain of the amplifier is adjusted so that the circuit is held just below the point of oscillation. When a narrow pulse is applied to one of those oscillators, its normal stability is disturbed and it generates a damped sinusoidal waveform.

That type of circuit is frequently used in automatic percussion units because in that kind of application we are most concerned with the timing of the beats.

The reason that every drummer in the world is not rushing out to replace his bulky and cumbersome instruments with those small, inexpensive electronic equivalents is that devices of that type aren't capable of the dynamic control that a musician needs for personal expression in performance. Damped oscillators are good for simulating the sound of a fixed-pitch drum struck with more or less constant force, but little else.

But recently, many percussionists have begun to use electronics to supplement their traditional instruments, using devices that can capture the dynamics and style of their playing. And because the circuitry used in these electronic drums is close kin to that used in modern electronic music synthesizers, drum synthesizers can produce an unbelievably wide range of voices from natural to unearthly.

Figure 2 shows a block diagram of a typical drum synthesizer (The Drum, as it happens). Undoubtedly the most striking difference between that and a more conventional type of music synthesizer is that The Drum has no keyboard, this element's function of real time control being taken over by the drum transducer, a device that translates the force of the stick hitting the drumhead into an electrical signal that the rest of the synthesizer can use.

After being amplified, the output of the transducer is applied to a circuit that is called an envelope follower, but is in fact more a peak detector with a controllable release time. The envelope produced by this circuitry is used in a number of ways. In conjunction with the voltage-controlled amplifier it is used to change the constant amplitude output of an oscil-

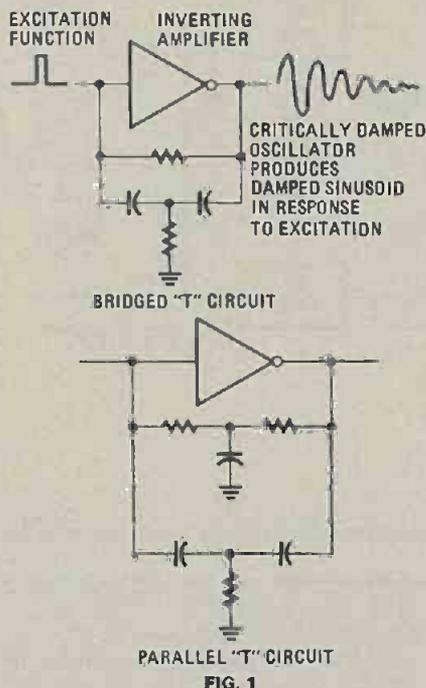


FIG. 1

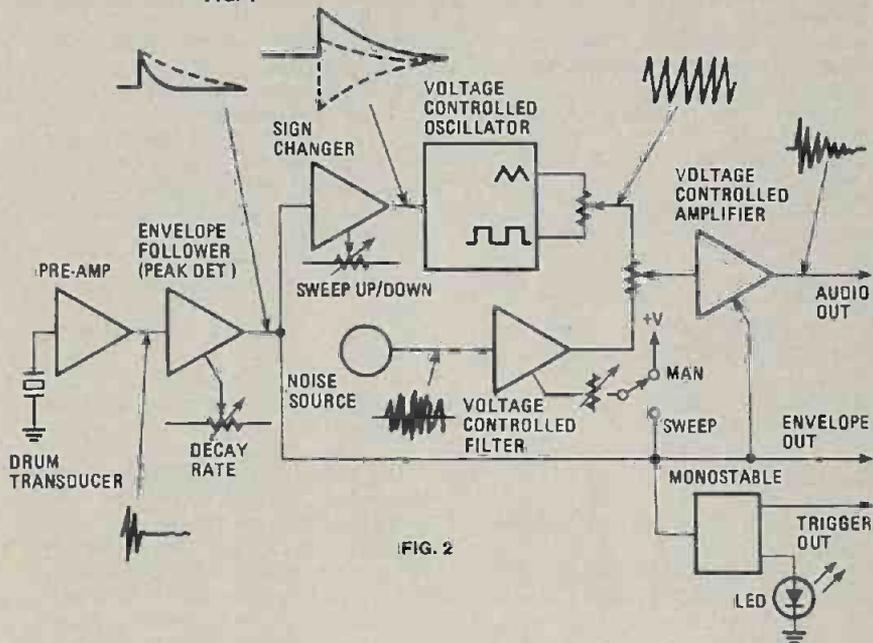


FIG. 2

lator into the classic percussive sound envelope. That approach is capable of producing longer decay times than are possible with either mechanical drums or damped oscillators. And since the peak output of the envelope follower is related to the output of the drum transducer, which is in turn a function of the striking

force, dynamics are preserved.

The control envelope is also applied to a sign changer where it can be either attenuated or inverted depending on the setting of a knob and the resulting new control voltage is used to change the frequency of the primary pitch source, a voltage-controlled oscillator. Because of that the pitch can be modulated either up or down to follow the envelope (like a pedal timpani only with much greater than natural range); or, at mid settings of the control, produce no pitch shift at all.

The use of a VCO as the pitch source also allows us a somewhat broader selection of the tone colors than is allowed by alternative expedients.

In addition to a pitched component, many drums—most notably snares—also have un-pitched components. In the synthesizer, un-pitched sounds are produced by the noise source. Since noise comes in different colors (white, pink, etc.), a voltage-controlled filter is provided to alter the noise spectrum as desired. The filter

is voltage controlled so that it too can track the envelope, another effect that can not be duplicated by mechanical drums.

The remaining circuitry (envelope and trigger out, etc.) is useful in combining more than one synthesizer card to produce a single voice.

Resistor R45 works in a manner similar to R32 in the waveform-mix circuit, attenuating either signal to the desired degree. Resistors R46 and R47 sum the mixed signal and feed it to the input of the buffer amplifier IC3-a and from that point the signal is applied to the signal input of the VCA, IC4.

Except when sinewave output is select-

ed, S2 will be closed, putting R51 in parallel with R52. That provides an attenuator at the input of IC4 which will keep the input signal level to the CA3080 transconductance amplifier within its linear operating region (input of 100 mv or less). Opening S2 removes the major portion of the attenuator and allows the VCO triangle output to overdrive the VCA's

input slightly, producing a sinewave.

The gain of IC4 is determined by the current that is flowing into pin 5 of the device. That current flow is manipulated by Q5 and Q6 which in turn are controlled by the envelope-follower's A/R output voltage.

We'll discuss construction and use next month.

R-E



TRIGGERED OSCILLOSCOPE

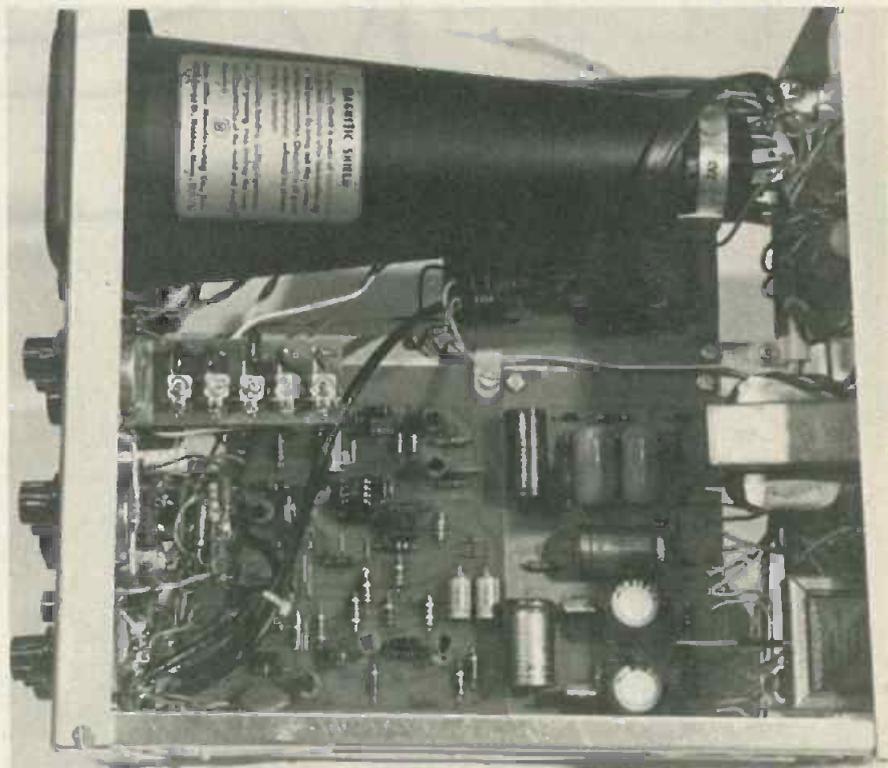
Part II—Construction details and calibration instructions for the low-cost scope that features a continuously displayed zero baseline.

DANIEL METZGER and DENNIS PERRY

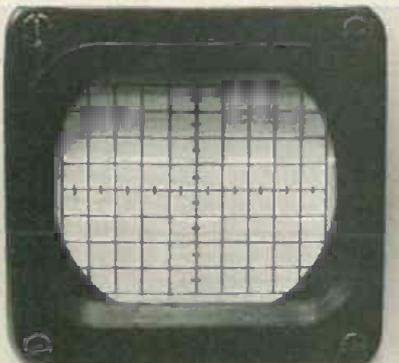
LAST MONTH WE DESCRIBED THE FEATURES of this inexpensive DC scope and went into detail on the operation of its various circuits. We continue this month by resuming our broken-off discussion with suggestions on selecting the CRT to meet your requirements.

Construction

Many types of CRT's have been used in this design, including 3BP1, 3EP1, 3ACP11, 3FP7, 3RP1, and 2AP1. Five-inch types can be used, but whatever is gained in screen size will be lost in sharpness of focus. The 3RP1A and 3WP1 are especially nice because they are flat-faced. The 3WP1 has about twice the deflection sensitivity of the others, and can be used to produce a scope with 5-mV sensitivity. The CRT must be shielded with MuMetal (nothing else will work) unless the power transformers can be located two feet from the CRT. Surplus houses that sell CRT's usually have fully formed shields.



TOP VIEW of the scope. The amplifier board is beneath the CRT. The power-supply board is at the rear near the transformers mounted on the back panel. The sweep board is up front near the controls. The attenuator board, with its five trimmers, is on a bracket held by the vertical-sensitivity control. Astigmatism control is on rear panel near base of the CRT.



DISPLAY of a 500-kHz squarewave at 0.4 μ V/div shows a fast risetime and clean squarewave response.

The vertical and horizontal output wires must run straight to the CRT and be kept away from each other and from other wiring and the chassis. The vertical and horizontal inputs should be kept short and separate from other wire bundles. The wires to and from the TRIGGER LEVEL switch carry fast squarewaves

and must be shielded to prevent coupling to other wires. The wires to the VERTICAL VARIABLE GAIN control should be kept reasonably short. Other wiring should be bundled and laced in the interests of neatness.

The input attenuator and sweep-timing resistors must be held to 1% if good

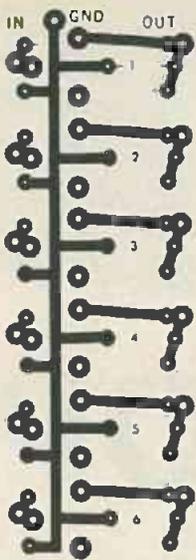


FIG. 6—FOIL PATTERN for the attenuator used in the vertical-sweep circuit.

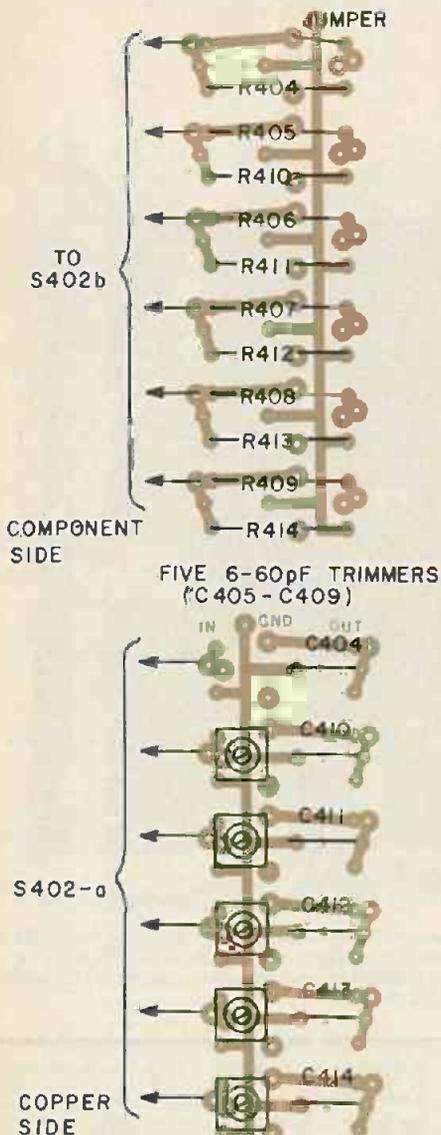


FIG. 7—COMPONENT PLACEMENT GUIDE for the vertical-input attenuator. The precision resistors are on one side and the frequency-compensating capacitors are on the other.

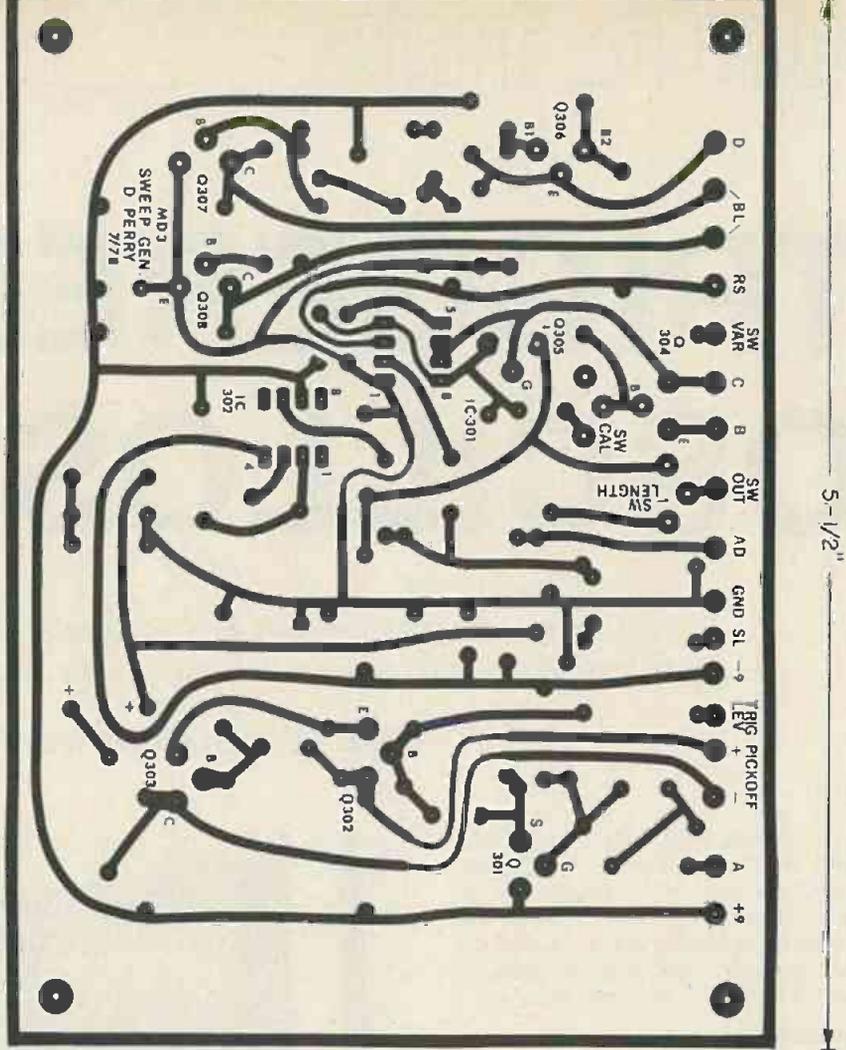


FIG. 8—THE SWEEP-GENERATOR PC-board foil pattern. The pads along the top edge are for connections to off-the-board components and leads to other circuit boards.

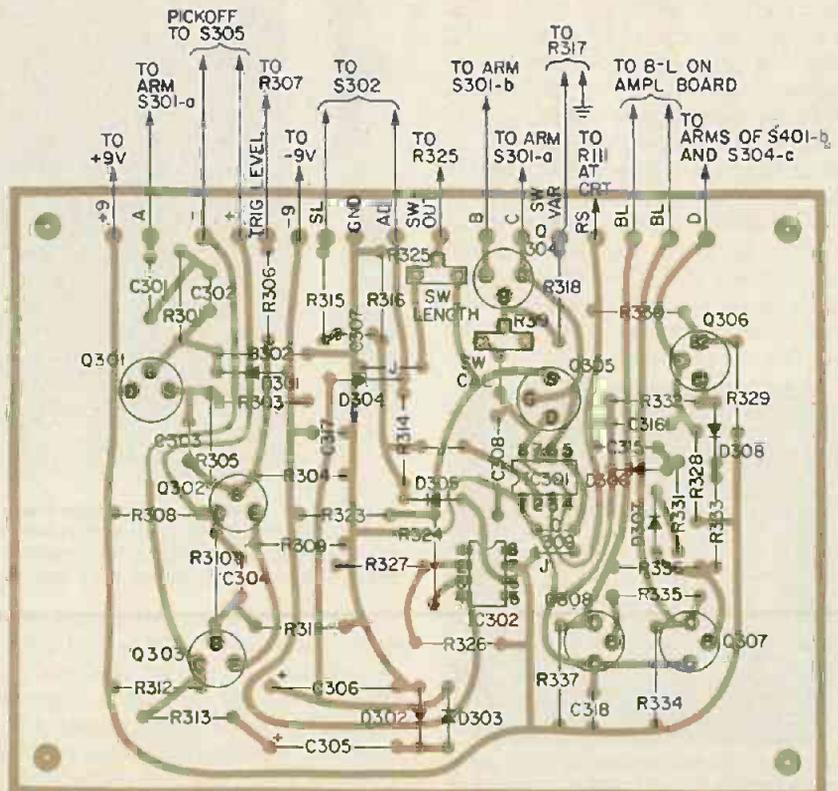


FIG. 9—HOW THE COMPONENTS ARE PLACED on the sweep-generator PC board. Note the positions of the three jumpers.

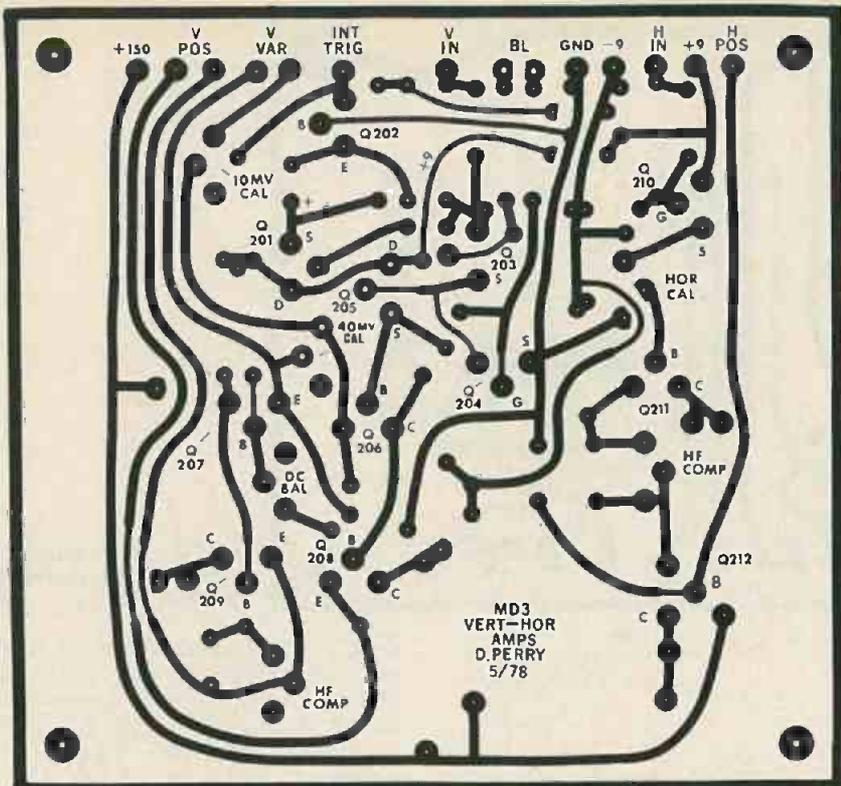
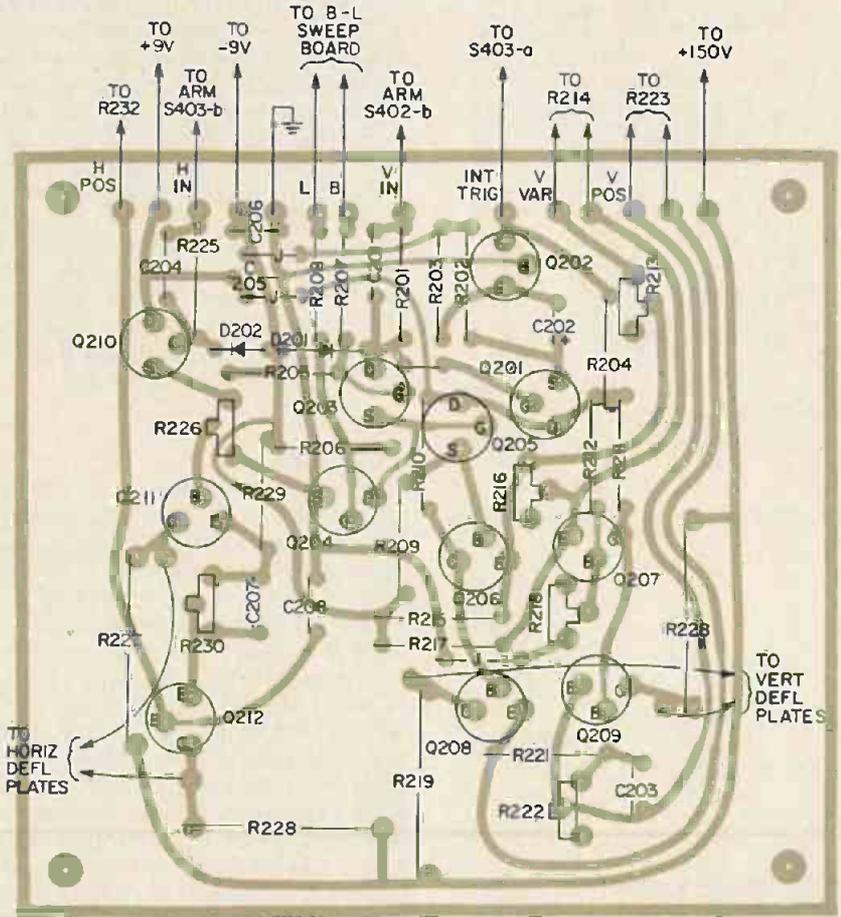


FIG. 10—PRINTED-CIRCUIT FOIL PATTERN for the board for the horizontal and vertical deflection circuits.



NOTE: CONNECTION TO HORIZONTAL DEFLECTION PLATE SHOULD BE MADE SO THAT BEAM SWEEPS FROM LEFT TO RIGHT; VERTICAL DEFLECTION PLATES SHOULD BE CONNECTED SO THAT POSITIVE INPUT TO VERTICAL AMPLIFIER PRODUCES UPWARD DEFLECTION OF BEAM.

FIG. 11—THE DEFLECTION-AMPLIFIER board has three jumpers and six trimmers for circuit calibration and adjustments. Leads to CRT deflection plates should be as short as practical to minimize stray capacitance.

Vertical: 50mV P-P, 1kHz sine wave input; R214 at min resistance, S401 at DC
 Horizontal: 2V P-P, 1kHz sine wave to EXT HOR, S403 at 0.4V/DIV
 Sweep: 2V P-P, 1kHz sine wave at EXT TRIG; + SLOPE, AUTO, 0.4ms/DIV, DC GND

Power Supply - 100 Board			
TEST POINT	VOLTAGE		POSSIBLE CAUSE
	DC	AC P-P	
C103	-1100	40	D101 thru D106
D107A	-950	< 1	D107-D113
C107	+145	< 1	C105, T101, CRT
C108	-19	0.6	D115, D116
C110	+18	1	D118, D119
Q101E	-9.4	< 5m	D117, Q101
Q102E	+9.4	< 5m	D120, Q102

Trig & Vert Amp - 200 Board			
Q201S	+1 to +2	=5m	
Q202C	+5	=2	
Q205G	0	50m	D201, Q205
Q205S	+1 to +2	45m	Q205
Q206E	Follows 0.6V below Q205S		
Q207E	+0.5 to +1.5	=0	R218
Q208C	=4	1.0	Q205, R215, R217
Q209C	75	50	Q208, Q209 R224

Horiz Amp - 200 Board			
Q210S	+1 to +2	1.5	Q210, D202
Q211C	+75	60	Q211, Q212, R229

Sweep - 300 Board			
Q301G	0	2	Q301, D301
Q301S	+1 to +2	1.8	Q301
Q302B	-1 to -3 Varied by R307		
Q302C	+1 to +9 SQR Q302, Q303		
Q303C	+1 to +9 SQR	Q302, Q303	
C306	+8	0	D302, D303
Q304B	+7.3 to +8.5 Varied by R317		
R320-R322	+1.5 DC across R _T AT CAL		
IC301 pin 6	0 to +6 RAMP		Q304
Q305S	+1 to +7 RAMP		Q305
IC302 pin 6	+9 to -9 SQR IC302, R327		
IC301 pin 3	0 to +9 SQR IC301		
Q306E	0 to 7 RC Charge; Q306, R278		
Q306B1	+5 SPIKE Q306		
Q307C	0 to +9 SQR Q307, Q308		

A=anode B=base C=collector
 E=emitter G=gate S=source

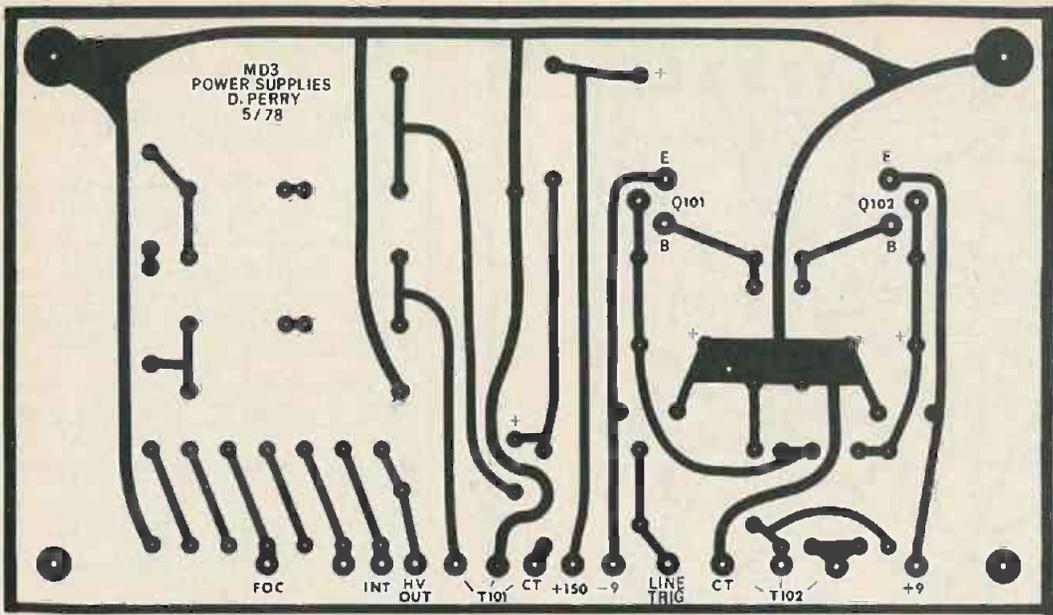


FIG. 12—THIS PRINTED-CIRCUIT PATTERN simplifies construction of the power supply.

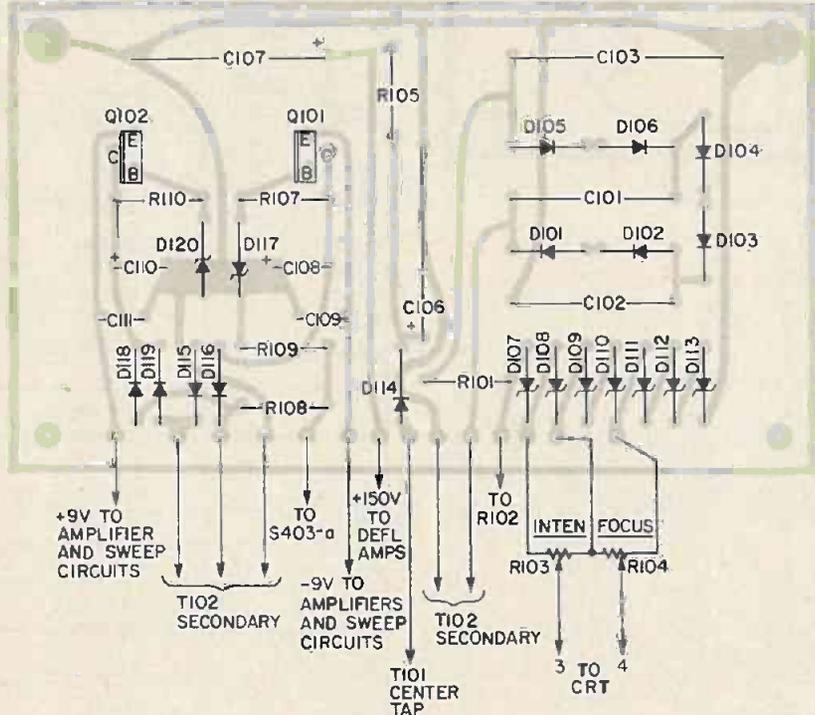
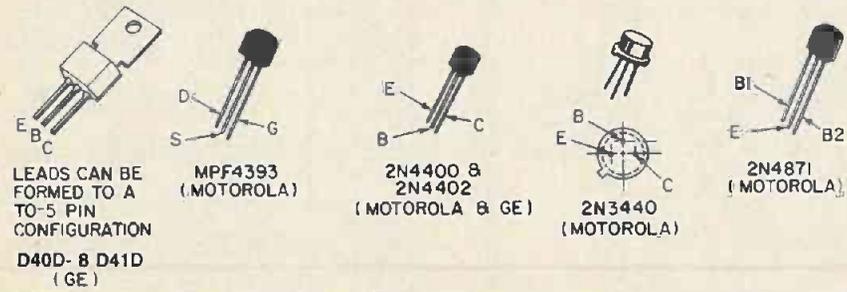


FIG. 13—POWER-SUPPLY COMPONENT LAYOUT is simple. Be careful; some of its voltages are dangerous.



PHYSICAL OUTLINES AND PINOUTS for the discrete devices used in the scope as active circuits. Be especially careful with the installation of the look-alike plastic devices.

calibration accuracy is expected. The timing capacitors must at least be in the same ratio, so if one is 7% high, strive to make them all 7% high. If a $\times 10$ probe is

to be used, the fixed frequency-compensating capacitors (CB) must be held to 5% tolerance.

The scope is constructed on four PC

boards. The foil patterns for the attenuator, sweep circuits, deflection amplifiers, and power-supply PC boards are in Figs. 6, 8, 10, and 12, respectively. The component layouts for those circuit boards are in Figs. 7, 9, 11, and 13.

Initial checkout

A spot can be focussed on the screen with only the power-supply board and CRT circuitry wired in. The 9-volt supplies will each need a temporary 470-ohm load if they are to be tested at this point. Now disconnect the primary of T101 to disable the high-voltage supplies while the sweep and low-level amplifiers are tested. The troubleshooting chart (Table I) shows the voltages to be expected at various test points. Once the Schmitt trigger, sweep generator, baseline generator, and low-level amps are determined to be functioning, the high voltage can be reconnected.

Calibration

Vertical: First display a 200-kHz squarewave and adjust high-frequency compensation control R222 for sharpest corners with no overshoot. With range S402 at 1 V/div and variable R214 at maximum resistance, inject a 2.12 volt RMS (6.0 volts P-P) 100-Hz sinewave, and adjust R216 for a six-division display. Now change the range to 4 V/div and, with variable R214 at minimum resistance ($\div 4$), adjust R213 for a six-division display. With the input grounded, adjust R218 so the trace remains stationary as R214 is rotated. The final step is to display a 1-kHz squarewave, and on each of the ranges from 0.1 to 10 V/div adjust the corresponding trimmer capacitor for the best squarewave with no rounding or overshoot.

Horizontal: With the horizontal atten-
continued on page 110

VERSATILE ANALOG INTERFACE FOR YOUR COMPUTER

Build this simple device to allow your computer to look at the outside world—without complex analog-to-digital conversion.

JOHN R. HANSON

INTERFACING AN ANALOG RESISTOR-CAPACITOR NETWORK TO A digital microprocessor has a wide variety of real-world applications. With this interface and the proper software, you can use the microprocessor to measure the time constant of a resistor-capacitor combination. This concept suggests numerous potential applications, including joysticks, a capacitance meter, proximity switches and more.

The circuits in Figs. 1, 2 and 3 use a minimum of components and a software timing loop to measure the value of the R-C network. A single IC allows you to build up to six of any of the circuits described here. Although this article describes 8080 and BASIC software, adapting the interface to any other type of microprocessor and software processor should be easy.

How it works

All circuits essentially consist of a resistor-capacitor network at the input of any one of the six non-inverting buffers in IC1. When the input of the buffer is low (at ground potential), the output is also low. As the voltage across the capacitor rises above approximately 3, the output changes to a logic high level. The resistor that charges the capacitor is connected to one bit of an 8-bit output port. The output of the buffer is connected to the corresponding bit on an 8-bit input port. Up to eight circuits could be implemented by one 8-bit input port.

Construction

The easiest way to build this circuit is on a small piece of perforated board. We recommend providing a socket for IC1. A small transistor socket works well to hold capacitor C_x (see Fig. 2). Component layout is not critical. The capacitor tester (Fig. 2) works best with a fairly stable +5 V_{cc} , but this is not at all critical in the other circuits.

Software

The real workhorse of all these circuits is a machine-language program called CVAL (see Listing I). The first line of this CVAL routine has a variable called BIT#. Setting one of the eight bits in BIT# to a logic high with the rest set to a logic low level determines which bit of the I/O port to test. Since my sample circuits are connected to the least-significant bit, I set the LSB of BIT# to logic high level by setting BIT# equal to 01 (hexadecimal code). The routine then sets its counter (register-pair HL) to 0. The routine now outputs a logic high to the selected circuit and begins counting. When the buffer output finally goes high, the routine stops counting, outputs a logic low to the circuit, and returns to the calling program with a value in register-pair HL that is equal to the time constant of the resis-

LISTING I.

```

ORG 04400H                                ;PROGRAM OUT OF THE
                                           ;WAY OF BASIC IN LOWER
                                           ;MEMORY
CVAL: MVI E, 01H*                          ;MOVE BIT# TO REG. E
      XRA A                                ;A = 0
      MOV H,A                              ;H = 0
      MOV L,A                              ;L = 0
      MOV A,E                              ;A = BIT# TO BE TESTED
      OUT 01H                              ;TURN ON SELECTED BIT
GO:   INX H                                ;START COUNT
      IN 01H**                             ;CHECK INPUT PORT
      ANA E                                ;MASK ALL BUT BIT#
      JZ GO                                ;JUMP IF BUFFER NOT ON
                                           ;YES
      XRA A                                ;A = 0
      OUT 01H**                            ;TURN BIT# OFF
      RET                                  ;RETURN TO CALLING
                                           ;PROGRAM
    
```

LISTING II

```

MAIN: LXI SP, 04800H      ;SET STACK POINTER
                          (ROUTINE STARTS HERE)
      XRA A                ;A = 0
      OUT 01**            ;OUTPUT 0 TO ALL
                          CIRCUITS
      OUT 0BH**           ;SWITCH OUTPUT = OFF
      MOV D,A             ;SWITCH STATE REGISTER
                          = OFF
ONYET: CALL TDM           ;SHORT TIME DELAY SO
                          CAPS DISCHARGE
      CALL SWON           ;SWITCH BEING TOUCHED?
      CPI 01              ;SEE IF A = 1
      JNZ ONYET          ;CHECK AGAIN IF NOT
                          TOUCHED YET
      XRA D               ;A = 1, EXCLUSIVE OR
                          WITH SWITCH STATE
      MOV D,A             ;D = NEW SWITCH STATE
      OUT 0BH**          ;OUTPUT NEW SWITCH
                          STATE IN LSB PORT 013
OFFYET: CALL TDM         ;PAUSE FOR DISCHARGE
                          AGAIN
      CALL SWON           ;SWITCH STILL ON?
      CPI 01              ;CHECK
      JZ OFFYET          ;JUMP IF STILL ON
      B = 20H, C = 0     ;B = 20H, C = 0
      CALL DEC            ;LONGER TIME DELAY TO
                          DEBOUNCE SWITCH
      CALL SWON           ;SWITCH STILL ON?
      CPI 1               ;CHECK
      JZ OFFYET          ;TRY AGAIN IF IT IS
      TOUCH: MOV D,A      ;A = 0, SWITCH STATE =
                          OFF
      ONLY: OUT 0BH**     ;TURN SWITCH OFF
      JMP ONYET           ;CHECK FOR NEXT TOUCH
      SWON: CALL CVAL     ;GET ACTUAL TIME
                          CONSTANT
      MOV A,L             ;GET LOW ORDER BYTE OF
                          CONSTANT
      CPI 0BH***          ;COMPARE WITH MINIMUM
                          ON VALUE
      JP ON               ;IF IT IS GREATER SWITCH
                          IS ON
      XRA A               ;ELSE MAKE A = 0 TO
                          SHOW IT IS OFF
      RET                 ;THEN RETURN
      ON: MVI A, 01       ;MAKE A = 1 TO SHOW IT
                          IS ON
      RET                 ;NOW RETURN
      TDM: LXI B, 0100H  ;B = 01, C = 0
      DEC: DCR C          ;DECREMENT C
      JNZ DEC            ;C = 0?
      DCR B              ;DECREMENT B
      JNZ DEC            ;JUMP IF BC = 0
      RET                 ;TIME DELAY ALL DONE
    
```

Notes: My origin statement sets this program in the 18th K of memory (04400H). This gets it out of the way of my basic interpreter in the first 13K. Of course it may be relocated and run anywhere in memory.

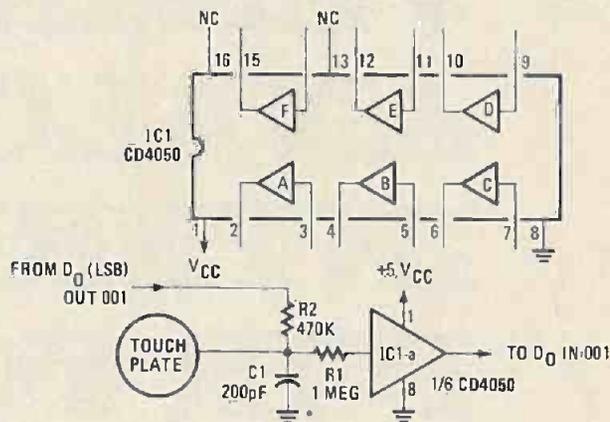
*—BIT #. This variable has one bit high to determine which bit of the I/O port is to be tested.

**—Port numbers specific to my system. May be changed to fit whatever ports are free.

***—Minimum on value. If CVAL reads a value less than this SWON will return, indicating switch is off. This value determines the sensitivity of the touch switch.

8080A mnemonics are used throughout. BASIC is Digital Group Maxi-BASIC Ver. 1.0.

ON). As shown, the program simulates a normally open momentary contact switch. Delete (or insert NOP's) lines TOUCH and ONLY, and the routine simulates a touch-on/touch-off switch. The routine operates by calling CVAL, and seeing if the result is greater than a byte called "minimum on value." The value I show for this is 0B (hexadecimal), which works for the value capacitor shown in Fig. 1 and a fairly positive contact of the touchplate. Lowering this value increases the



* SYSTEM SHOULD BE GROUNDED TO EARTH GROUND FOR TOUCH SWITCH APPLICATIONS

Fig. 1—TOUCH/PROXIMITY SWITCH can be used for touch-ON/touch-OFF control of a device or appliance or, with increased sensitivity, can be used in a proximity-operated intruder or burglar alarm.

sensitivity of the switch. If the switch tends to bounce at all, increase the value loaded in BC in line DBLCHK. I call a short time delay called TDM before each CVAL call to give the capacitor a little time to discharge; but if your application only calls CVAL occasionally, this is not necessary. If the touchplate is a fairly large piece of metal, the switch will trip just by coming near it (adjust the "minimum on value" for the best performance).

This type of proximity switch lends itself easily to security and burglar alarm applications. A single IC provides you with six inputs that could be sequentially polled by CVAL to indicate the status of all doors and windows. The metal plates would be easy to hide and difficult to defeat.

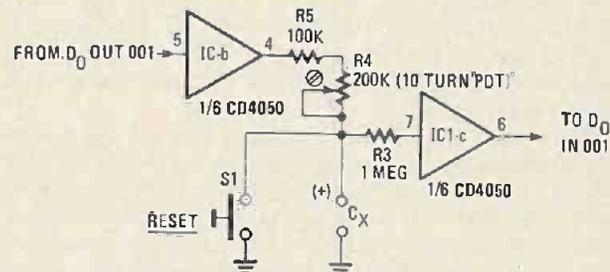


Fig. 2—A CAPACITANCE METER is formed when this interface is used with a microprocessor. The machine prints out capacitor values between 500 pF and 5 μF.

Capacitance meter

Figure 2 shows a circuit that, when driven by Listing III and CVAL, represents an extremely easy way to measure unknown

PARTS LIST

- Resistors 1/4 watt, 10% unless otherwise noted
- R1, R3, R6—1 megohm
- R2—470,000 ohms
- R4—200,000 ohms, 10-turn trimmer potentiometer
- R5—100,000 ohms
- R7—4700 ohms
- C1—200 pF, 10 volts, ceramic disc
- C2—.033 μF, 10 volts, polystyrene
- S1—normally open pushbutton switch
- IC1—CD4050 CMOS non-inverting hex buffer

capacitances. The circuit uses one buffer to charge the unknown capacitance through the calibration potentiometer. The RESET pushbutton insures that large-value capacitors are totally discharged before each test. To calibrate the unit, use one or more good-quality close-tolerance capacitors in the range of 0.005 μF to 0.01 μF , and repeatedly run Listing III, while adjusting R4 until the routine prints the correct value of the capacitors. Listing III could be written in any BASIC that permits calling a machine-language program (calls CVAL in line 60), and then

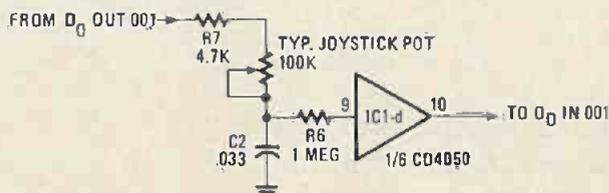


Fig. 3—THE POSITION OF A JOYSTICK CONTROL is printed out in numbers from 10 to 250. When the joystick is operated by a servo, the print-out can be a remote indicator.

LISTING III

```

10 OUT 1,0           ;remarks
                    ;OUTPUT 0 TO PORT 1
20 PRINT "INSERT UNKNOWN CAPACITOR"
30 PRINT "PUSH RESET FOR A SECOND"
40 PRINT "NOW HIT RETURN TO TEST, N-RETURN TO QUIT"
50 INPUT S$
55 IF S$ = "N" THEN GOTO 100
60 LET X = CALL (17408) ;CALL MACHINE LANGUAGE
                    ;CVAL
70 LET X = X*.0001   ;CONVERT TO MICROFARADS
80 PRINT "CAPACITOR EQUALS ";X;"  $\mu\text{F}$ "
90 PRINT " "        ;DO SOME CARRIAGE
                    ;RETURNS
91 PRINT " "
92 PRINT " "
95 GOTO 10          ;NEXT TEST
100 END

```

LISTING IV

```

10 OUT 1,0           ;remarks
                    ;CLEAR PORT 1
20 LET X = CALL(17408) ;CALL CVAL
30 PRINT X           ;SHOW VALUE OF JOYSTICK
                    ;POSITION
                    ;USING THIS FOR LINE 30
                    ; SHOWS AN *
                    ;CORRESPONDING
                    ; TO JOYSTICK POSITION
40 GOTO 10
50 END

```

allows assigning the value returned in register pair HL to a variable (X). The values shown are good for capacitors in the range of approximately 500 pF to 5 μF . Vary the size of the charging resistor to measure other capacitance ranges.

Joystick interface

The circuit shown in Fig. 3, when polled by CVAL, provides a simple way of digitizing the position of a joystick potentiometer. The values shown will cause CVAL to return with a number in HL from about 10 to 250, representing the position of the joystick. Listing IV prints these values for unit checkout. Substituting the alternate line 30 (shown) moves an asterisk back and forth across the display screen according to the position of the joystick potentiometer. Two of these circuits are required to obtain both the X and Y values from the joystick.

These circuits only scratch the surface of the possible applications for this technique. A 4×4 array of touchplates with four 4-input CMOS NOR gates to monitor row status and software drivers sequentially testing the columns could form an inexpensive touchswitch hexadecimal keyboard. Many types of sensors (temperature, pressure, etc.) can be used directly with these circuits, thus allowing you to monitor analog-type signals with a minimum of hassle. A little experimentation will yield a large number of nifty applications, while doing minimum damage to your pocketbook. And your computer will thank you for letting it hear from something other than a keyboard. R-E

PIONEERS IN RADIO

Sir Jagadis Chundar Bose

FRED SHUNAMAN

JAGADIS CHUNDAR BOSE BEGAN HIS SCIENTIFIC career as a professor of physical science in Calcutta (where, as a native, he received two-thirds the pay of European professors with the same qualifications). Interested by Lodge's report on the work of Hertz (1894) he repeated all Hertz's experiments, working, as he said, "with none of those mechanical facilities at my disposal that every European and American scientist takes for granted."

He ran a meticulous series of tests on coherer materials, evaluating the sensitivity of practically all available metals. In these experiments, he discovered that the resistance of a coherer using potassium increased rather than decreased with the passage of an electric wave, thus questioning the validity of then-current coherer-action theories.

He invented an original coherer with spirals of fine wire, usually made of steel, laid in a slot cut in ebonite. The slot was

terminated at each end with brass plugs—one fixed and the other adjustable with a screw. The spiral bits made about a thousand well-defined contacts with each other, claimed Bose, and these contacts could be adjusted with the single screw.

In 1895 at a lecture in Calcutta, Bose transmitted the newly discovered electric waves 75 feet to an adjoining room, tripping a relay that fired a pistol and blew up a small mine.

Possibly Bose's most important work was his demonstration to European scientists that Hertzian waves actually existed in the real world, not merely in scientific papers. He constructed a compact demonstration apparatus using a turntable. This made it possible to perform most of the experiments for which Hertz had needed a long hall. The equipment could be packed in a case only 60 centimeters long and 30 centimeters high and wide (or about 2 feet by 1 foot). Using this equipment he lectured to the Royal Society in London in January of 1897, in

Paris on March 9, and in Germany and in other European countries later.

In working with coherers, Bose noted that they became less sensitive with continuous use, but regained sensitivity if not used for a while. Extending his studies to plants, he became convinced that the boundaries between animal and vegetable life and nonlife were not as rigid as commonly believed. Official science was outraged at this "metaphysical" and "nonscientific" approach, and the Royal Society refused to print his papers for many years. He was regarded as a mystic and was ostracized by the scientific community. To this day, his name rarely appears in any work on electronics. A similar—if not as complete—a suppression appears to have taken place with respect to his quite extensive efforts in the field of biology. Scribner's Encyclopedia states: "Today, when biophysics is a generally recognized discipline"—his theories might not appear so controversial. R-E

WARC-'79

The World Administrative Radio Conference recently adjourned. Many questions regarding frequency allocations were resolved—but many still remain.

STANLEY LEINWOLL*

ON DECEMBER 6, 1979, AFTER 74 GRUELLING days and nights of work, the World Administrative Radio Conference which was held in Geneva (WARC-79) completed its work. One hundred and forty two member countries of the International Telecommunications Union (ITU), which had convened the Conference, adopted and signed a new set of Radio Regulations that will come into force on January 1, 1982. In addition, WARC-79 adopted a large number of resolutions and recommendations relating to radio communications.

WARC-79 was the first general radio conference in 20 years. Its principal objectives were to review and revise, where necessary, many of the Radio Regulations that had been in force since 1960, including the vitally important Table of Frequency Allocations, which assigns frequency bands to all services using the electromagnetic spectrum for communications purposes. It is generally agreed that WARC-79 was the most important radio gathering ever organized by the ITU.

Telecommunications technology has developed at an astounding rate over the past generation, with the appearance of many new and revolutionary techniques, such as miniaturization and communications via satellite. When the last general Radio Conference was held in 1959, Sputnik I was barely one year old. Since then, however, more than 265,000 MHz of additional spectrum has been opened up for use by radio-communication services.

WARC-79 was held in the International Conference Center in Geneva. It was attended by more than 2,000 delegates and observers from 142 countries

*Stanley Leinwoll is Director of Engineering, U.S. for Radio Free Europe—Radio Liberty. He was a member of the United States Delegation to WARC-79.

and 30 international organization, including the International Amateur Radio Union (IARU), and various Broadcasting Unions from all over the world. More than 1,000 meetings of committees, working groups, and sub-working groups were held, and the conference generated thousands of pages of text, including a final document that was more than 1,100 pages long.

In spite of the vast expenditure of time, effort, energy, and money that went into WARC-79, many issues were left unresolved, being either deferred to the work of future conferences, or not clearly defined. Although many delegates expressed satisfaction over the outcome of the Conference, it appeared to some observers that there could be difficult days ahead, especially for amateur radio and shortwave broadcasting, as well as some space services.

As an indication of the potential difficulties that lie ahead, an unprecedented 83 reservations were taken at WARC-79, including five by the United States. A reservation is a statement that a country will not be bound by a decision made at a conference. In the area of shortwave broadcasting alone, 20 countries took reservations, expressing misgivings about the amount of insufficient additional spectrum allocated to this service. The United States was among those countries reserving the right to take whatever steps it deemed necessary to satisfy its shortwave broadcasting requirements.

Of particular concern was the failure of the Conference to allocate any additional spectrum space to shortwave broadcasting in the 6- and 7-MHz bands, even though an additional 850 kHz was added to the broadcasting services in the bands between 9- and 21-MHz. The Conference also recommended that a high-frequency broadcast-planning

WARC be convened several years hence, but many observers felt that planning the high-frequency bands would prove to be very difficult without additional space in the vitally important 6- and 7-MHz bands.

Although it will take years to fully assess the failures and accomplishments of WARC-79, here follow, in a nutshell, the results of the Conference that are of major interest to the readers of **Radio-Electronics**. There will be followed by an analysis of the results in terms of their possible future impact on radio-communications.

High-frequency broadcasting

The Conference allocated an additional 850 kHz to the existing bands between 9- and 21-MHz, including the creation of a new band at 13.6 MHz. (see Table I). The 26-MHz band was reduced by 70 kHz, and no changes were made in the 6- and 7-MHz bands. The net increase in spectrum allocated to HF broadcasting was 33%. (The United States had proposed a 46% increase, which the Soviet Union, which currently has extensive operations outside the bands allocated to shortwave broadcasting, was opposed to any expansion whatsoever.)

The Conference recommended that a HF-Broadcasting-Planning WARC be convened at the earliest possible date (probably 1983). This Conference will be in two sessions: the first will be technical, at which standards and procedures for planning will be determined. The second session, following the first by approximately 18 months, will be devoted to planning the efficient and equitable use of the bands allocated to broadcasting.

Actually, the expansion of the bands is tied to the planning conference, and to the successful completion of the



transfer and reaccommodation of fixed frequencies that are being displaced as a result of broadcast band expansion. WARC-79 set 1989 as the date when the expanded portions of the high-frequency spectrum would become available to the broadcasting service.

Twenty countries, including the United States, Canada, Great Britain, Federal Republic of Germany, Iran, People's Republic of China, Israel, Spain, Portugal, and Saudi Arabia, indicated concern over the success of the planning conference in light of inadequate expansion of the shortwave broadcasting bands, especially in the 6- and 7-MHz bands. They all took reservations dealing with high-frequency broadcasting.

The United States made a strong protocol statement at the conclusion of WARC-79 against jamming now being directed against some of its broadcasts, and reserved the right to take necessary and appropriate measures to protect its broadcasting interests as long as jamming continues.

Future impact on HF broadcasting

In addition to the concern expressed

by many countries that no planning procedure could succeed without sufficient additional spectrum space, a further complicating factor involves present levels of out-of-band broadcast operations. Because of the serious congestion in the shortwave broadcast bands a number of countries have moved their broadcasting services into bands now allocated to other services. The Russians, for example, currently schedule a great many transmitters out-of-band. In the region between 5900- and 5950- kHz, as a case in point, Russian broadcast transmitters operate on every 5 kHz channel.

As a consequence, it is feared by some experts that in the very near future additional countries, spurred by the inequity of the present situation, will authorize expanded out-of-band operation. The Final Acts of WARC-79 come into force on January 1, 1982, and it is possible that at that time, or even before, many countries will begin to expand the bands without waiting for the planning WARC, or for the reaccommodation procedure to be completed. That could develop into a potentially serious situation in terms of the success

of a planning conference, because countries that have already satisfied their broadcasting requirements are not likely to take a planning conference as seriously as they should. Under such circumstances, still other countries, observing what is happening, may get on the bandwagon to rush their shortwave broadcasting services out of band.

The United States is dedicated to the success of the planning WARC, and will be watching this situation with particular concern.

Amateur radio

The Amateur Service has been allocated additional bands at 10.100-10.150 kHz on a secondary basis, 18,068-18,163 kHz on an exclusive basis, including amateur satellite, and at 24,890-24,990 kHz, also including amateur satellite on an exclusive basis. The availability of the latter two bands to the amateur service requires the satisfactory transfer of assignments to other bands of services already operating in those bands.

The amateur service in the 7100-7300 kHz band was almost dealt a crippling blow at WARC-79, when the Conference voted in late November to allocate that band to shortwave broadcasting on a worldwide basis. However, after some frantic behind-the-scenes deliberations, it was agreed to restore the band to the amateur service in the western hemisphere, with a footnote stating that the use of that band by the amateurs would not impose constraints on the broadcasting service using the same band in other parts of the world.

Future impact on amateur radio

It appears that the "constraints" footnote will enable some European, African, and Asian broadcasters to take liberties

continued on page 109

TABLE I

Summary of WARC-79 Shortwave Broadcast Band Expansion

Band (MHz)	Current Allocation	New Allocation	Net Change
6	5950-6200 kHz	5950-6200 kHz	0
7	7100-7300* kHz	7100-7300* kHz	0
9	9500-9775 kHz	9500-9900 kHz	+125 kHz
11	11700-11975 kHz	11650-12050 kHz	+125 kHz
13	Not Allocated	13600-13800 kHz	+200 kHz
15	15100-15450 kHz	15100-15600 kHz	+150 kHz
17	17700-17900 kHz	17550-17900 kHz	+150 kHz
21	21450-21750 kHz	21450-21850 kHz	+100 kHz
26	25600-26100 kHz	25670-26100 kHz	-70 kHz

Total

+780 kHz

*Allocated to the Amateur Service in western hemisphere, and to broadcasting elsewhere.



PUT YOUR

Digital capacitance meters do a lot more today than just measure capacitor values!

MARTIN BRADLEY WEINSTEIN

CAPACITANCE METERS HAVE BEEN around for decades. Surprised? The hullabaloo in the last year or so over the new wave of digital capacitance meters makes them seem like the newest instrumentation available, but capacitance has needed measuring for lots of reasons for a long, long time.

Believe it or not, measuring the value of capacitors *isn't* the most useful function a capacitance meter can be put to.

History

In the past, many schemes have been used to measure capacitance. Capacitance has been determined by calculations of the surface area (A), of metal plates, the dielectric constant (K) of an insulator, the distance (d) between plates, and the number (n) of plates. The formula, $C = \frac{KA}{d}(n-1)$ (0.224), is used to determine capacitance in picofarads for area in square inches and distance in inches.

Time and frequency measurements have been used to determine capacitance when the capacitor is placed into an oscillator or delay circuit. Another, simply implemented scheme involves passing a signal of known frequency and amplitude through the capacitor under test. Signal losses are determined through the formula for capacitive reactance, $X_c = \frac{1}{2\pi fC}$ and knowledge of the

design of the attenuator path. And, of course, precision bridges are an excellent way to measure a wide range of capacitance values with high accuracy.

Today's digital capacitance meters use analog-to-digital conversion techniques. The basic task is to measure the time that it takes to charge a capacitor to a known voltage through a known resistance.

Why measure capacitance?

For most applications, the exact value of a capacitor doesn't matter. You've heard that valid piece of advice many times by now, no doubt. So why not just take what the capacitor is labelled with to be its actual value and forget it?

Many times you can, but not always. For AC coupling, for DC blocking and bypass applications, for power supply filters, for degitchers—no problem. But for notch filters, bandpass filters, band-reject filters, phase-shift oscillators, single-sideband quadrature filters, oscillators, neutralizing, tuning, and many other applications, precision becomes more of a necessity than a virtue.

In many applications, while the precise capacitance value doesn't make a great deal of difference, it's important to *match* capacitances.

How tolerant should you be?

Capacitor tolerance, usually expressed as a *percentage* value, is usually specified either by design rules-of-thumb or the specific criteria of a given application.

A .001 μ F ceramic, for example, might well be offered by a manufacturer with a -20%/+80% tolerance—meaning that its actual value could be any-

where between .0008 and .0018 μ F and still meet its specifications.

The circuit you need it for, on the other hand, may require .001 μ F \pm 1%. Buying a 1% cap can be both expensive and frustrating. It's much easier to survey the capacitors you have on hand. First, set yourself some limits:

$$\text{Limits} = \frac{(\text{Target value}) \times (1 \pm \frac{\text{percentage}}{100})}{100}$$

Similarly, you can determine within what tolerance of its nominal value any given capacitor is by calculating:

$$\% \text{ Tolerance} = \frac{(\text{Measured} - \text{Nominal value}) \times 100}{\text{Nominal value}}$$

Measuring temperature

Of course! Capacitors are available with stated temperature coefficients, stated as parts-per-million-per-degree-Centigrade. Normally, not even the newest digital capacitance meters could take care of measuring the small capacitance change produced by small changes in temperature; there is, however, a range of temperature coefficients between 500 and 1000 that permit some of today's more accurate instruments to measure temperature changes of just a few degrees accurately and repeatedly.

Note that to work effectively, the capacitor would have to be used as a transducer in conjunction with a cable no more than a few feet in length, calibrated at a known temperature (or a few), and the instrument itself (which may or may not be temperature-tolerant in terms of its own accuracy) thermally

CAP METER TO USE

isolated or separated from the capacitor/transducer.

The cable length, of course, contributes some capacitance to the measured total.

Capacitances that are not capacitors

We are very used to thinking of capacitance solely in terms of its manifestation in capacitors. But capacitance is an electrical characteristic arising out of physical laws, while a capacitor is simply a component.

Theoretically, all conductive surfaces not electrically connected to each other exhibit capacitance between each other. In practical terms, many things have capacitance:

Cables; adjacent printed-circuit traces, on either side of the printed circuit board; switches; relays, including reed relays; microphones; quartz crystals; semiconductor junctions; neon lamps; antenna-ground systems; adjacent windings of a coil (even though electrically connected at DC, there is a substantial potential difference between windings at RF); connectors; liquid crystal displays, and more.

While capacitance is not the primary, most sought-after, characteristic of these components, the fact that they have capacitance which we have a newfound capability to measure is of substantial value to us.

Measuring cable capacitance

The fact that an open pair of conductors in a cable exhibits capacitance leads to an invaluable collection of cable-troubleshooting techniques.

First, the capacitance for a number of standard cables, such as coax, twin-lead, and ribbon cable, is an integral part of their specifications. That value is expressed in various ways, such as in

terms of capacitance-per-meter, capacitance-per-foot, capacitance-per-mile or some other convenient capacitance-per-unit-length expression.

But even without access to the published data, that information can easily be determined for any cable, using your capacitance meter, with this relationship:

$$\text{Capacitance per-unit-length} = \frac{\text{Measured capacitance}}{\text{Number of units of length}}$$

As you will see in a moment, determining that value for each cable you commonly use can be a tremendous aid.

Determining cable length

Imagine having a huge spool of wire—

TABLE 1

DIGITAL CAPACITANCE METERS—A REPRESENTATIVE SAMPLING

Manufacturer	Model	Range	Best Accuracy	Price
B&K-Precision Dynascan Corp. 6460 W. Cortland St. Chicago, ILL 60635	820	0.1 pF-1 farad	0.5%	\$140
	830	0.1 pF-199,900 μ F	0.2%	\$199
CIRCLE 92 ON FREE INFORMATION CARD				
Continental Specialties Corp. 70 Fulton Terrace New Haven, CT 06509	300†	1.0 pF-199,900 μ F	0.1%	\$250
CIRCLE 93 ON FREE INFORMATION CARD				
Data Precision Corp. Electronics Ave. Danvers, MA 01923	938	0.1 pF-1,999 μ F	0.1%	\$149
CIRCLE 94 ON FREE INFORMATION CARD				
Optoelectronics, Inc. 5821 N.E. 14th Avenue Fort Lauderdale, FL 33334	CM1000A	0.1 pF-10,000 μ F	1%	\$200 (Assm.) \$150 (Kit)
CIRCLE 95 ON FREE INFORMATION CARD				
Sencore 3200 Sencore Drive Sioux Falls, SD 57107	CA55	1.0 pF-200,000 μ F	1.0%	\$495
CIRCLE 96 ON FREE INFORMATION CARD				
IET Labs, Inc. 761 Old Country Rd. Westbury, NY 11590	CM-500†	1.0 pF-200,000 μ F	0.1%	\$299
CIRCLE 97 ON FREE INFORMATION CARD				

say telephone cable, on a spool big enough to be a college dormitory's prize coffee-table—and not knowing how much is there.

Imagine stringing intercom cable through a building and not knowing which of two cable ends goes all the way across the building, and which to the next room.

Ah, but you do know, given the capacitance-per-unit-length of the cable and your trusty capacitance meter.

Once again, the calculation is easy enough for the simplest of four-banger calculators:

$$\text{Cable length} = \frac{\text{Measured capacitance}}{\text{Capacitance-per-unit-length}}$$

Since the capacitance per-unit-length for most cables is relatively small, and the range of capacitance measurable with most capacitance meters extends quite high, the problem of very long cable lengths may be solved accurately by using that method.

Inspecting for cable flaws

The third arrangement of our basic relationship is especially useful.

A cable of known length and capacitance-per-unit-length can be inspected for open, shorted, or physically distorted conductors with a capacitance meter. Simply, the actual measured value of capacitance is compared to the value determined by:

$$\text{Capacitance} = (\text{Cable length}) \times (\text{Capacitance per-unit-length})$$

Here's how to interpret the results. A capacitance reading lower than the calculated value indicates either an open (or broken) conductor or severe stretching. Generally, a reading only a *little* lower than the calculated value shows stretching; a reading a few percent or more lower usually indicates a break.

The distance to a cable break can also be determined by calculating for cable length.

A capacitance measurement reading higher than the calculated value indicates a short—even a short of significantly high impedance—or insulation failure somewhere within the cable, or severe crimping. Unauthorized taps into a cable would also result in a higher-than-calculated reading.



DETERMINING VALUES of ordinary capacitors is only one of the many uses of these versatile meters, such as the model 830 shown above from B&K—Precision, Dynascan Corp.

Printed circuits

Under the banner of "good technique," we've been told how to design our printed-circuit board layouts to reduce a number of problems, most of which boils down to unintentional capacitive coupling: They include ringing, spurious oscillation, propagation delays, phase shifting, frequency shifting, unwanted pick-up of signals, cross-talk, noise, loading factors, and more.

Obviously, if the design-frequency criteria are known, a circuit's tolerance for additional, incidental, or stray capacitance can be calculated. And an actual PC board can be inspected with a capacitance meter even before parts are mounted to see whether or not the specs are met.

Other components

We have mentioned a number of "other" components that have capacitance. Capacitance measurements can be performed on those components for either of two broadly defined reasons.

First, capacitance measurements are a jim-dandy way of determining a component's suitability for application at a given frequency, using capacitive reactance as the key. For example, while you might use a reed relay at DC, would you use it at HF? VHF? UHF? Sure, it depends on how you're using it and what the circuit and the signal are; but you can save yourself a lot of trial and error—and error and error—with a little preliminary measurement and calculation up front.



DIGITAL CAPACITANCE METERS come in a variety of sizes. This one, the Data Precision 938, fits in your pocket.

Second, since capacitance varies with geometry, as we've seen at the beginning of this discussion, capacitance measurements can be used, either directly or indirectly, to determine whether or not a given component falls inside or outside of tolerance for given specifications, such as arcing point voltage (determined by spacing between electrodes), capacitive loading (encountered in TTL, CMOS and other IC technology) and more. Membrane switches and liquid-crystal displays are two excellent examples of components that can be "inspected" with a good capacitance meter.

Checking insulators

Remember our basic capacitance

formula? For a simple capacitor of two plates, it reduces to $C = 0.224 \frac{KA}{d}$

Want to determine the dielectric constant of a given insulator? Build it into your own capacitor. The dielectric constant of air is either 1 or close enough to be considered 1. So two plates of known geometry (or, as we'll see in a moment, undetermined geometry) and separation will have different capacitance values with materials other than air between them. As a result, the ratio of those values to the value with air between yields the dielectric constants for these materials.

Want to try for yourself? Start with a piece of window glass and two pieces of coated PC stock. You should get a K for window glass of about 8.

By the way, in applying the formula with unequally sized plates, it's best to use the smaller area in your calculations; also, where the plates are not precisely opposite each other, use the overlapping area.

Capacitive transducers

General Motors recently announced developments in transducer technology for monitoring critical carburetor adjustments, and for determining the fuel level within a tank.

The transducers in both of those cases were capacitors.

Obviously, since capacitors don't require (in fact, forbid) contact between their terminals, they are a natural choice in selecting transducers that will provide consistently accurate performance over extended use and they'll exhibit little or no wear.

You can make your own capacitive transducers, and check their performance characteristics and actual capacitance values with your meter.

For rotational (or angular displacement) measurements, try coupling to the shaft of an old tuning or trimming variable capacitor.

For linear motion, parallel plates or concentric tubes do quite well. For example, you could use a piece of PC board (say 12 × 12 inches) glued to the underside of a drawer as one plate of a capacitive transducer, and a second piece of PC board, foil side down, at the bottom of the drawer's cavity as the other. An RF signal coupled between them could hold in a relay (through a transistor). Sliding the drawer open would reduce the coupling, thus allowing the relay to drop out and sounding an alarm.

In fact, a cheap capacitor microphone will demonstrate changes in capacitance with air pressure, providing an easy and quick-responding barometric transducer.

The more you play the game, the more you'll learn. R-E

TROUBLESHOOTING BETA TRANSPORT MECHANISMS

*How to locate and solve
cassette loading/unloading problems in Beta-format
video cassette recorders.*

FOREST BELT

WHEN THE MECHANICAL AND ELECTRONIC functions combine as they do in video cassette recorders, a technician can find himself somewhat confused. Where do you begin to diagnose?

Your best bet probably is to depend on my *Easi-Way Servicing* technique. It offers a logical, step-by-step approach to diagnosing a defective component. The method adapts well to mechanical troubleshooting, even though it originated as an electronics diagnostic procedure.

Let's use that troubleshooting technique to deal with a few common symptoms. Complex though the threading/unthreading operation may seem, it really consists of only a few specific stages. Not many symptoms can actually appear in the operation.

To observe loading/unloading symptoms most conveniently, take the top cover off the recorder. Then, remove the plastic cover from the cassette-lift assembly (omit the cassette) and press the lift assembly down into its ready-to-load position until it latches.

To initiate loading when there's no cassette in the lift compartment, just depress the cassette-in switch. That switch is accessible at the front center of the lift assembly (See Fig. 1), when the assembly is latched down. Now you can see for yourself how the problem you are troubleshooting affects the threading or unthreading mechanism.

Will not load

The symptoms can be separated into two parts. The rare one is when the cassette-lift mechanism pops back up as soon as you push it down. In other words, it won't latch and loading cannot proceed.

A little reasoning and inspection tells

you that the cause must be mechanical. The EJECT button slide might be jammed, leaving the trip post for the cassette lift unable to move back for latching. The latching levers are on the right side on the lift assembly; the EJECT button slide is on the left. A linkage bar reaches across underneath.

However, when the EJECT button slide is stuck, it usually leaves the main AC motor on. That's something you would notice right away. (The AC motor and head drum do not rotate during loading, but they do run during the unloading and eject cycle.)

It's far more likely that the lift-latching mechanism has become bent or that some obstruction is holding the latching post out of position. Reach in with a thin probe (a soldering aid works) and try manipulating the latch.

The more common "won't-load" symptom, however, is simply that the tape fails

to thread after the cassette has been inserted and the lift latched down.

Again, push down the cassette-lift assembly without the cassette inserted. Press the cassette-in sensing switch. If nothing happens, that could actually end your mechanical analysis. You then proceed with an electronic tracing procedure until you find some logic signal (voltage), or lack of it, that is inhibiting operation. Once the flaw is located, you may have to return to mechanical observation or testing to find the actual trouble . . . and even then perhaps revert to electronic troubleshooting. Let's troubleshoot one case with that symptom, to give you some notion of the procedures involved.

Press down the lift and push the cassette-in switch. You expect the threading motor to turn on and drive the ring counterclockwise, but nothing at all happens. You can't even hear the threading motor try to run. It's time to investigate the

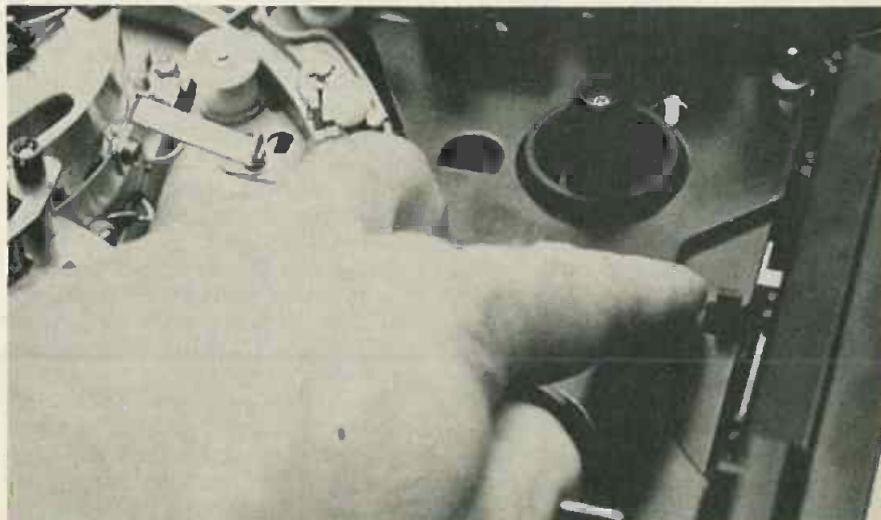


FIG. 1—THE CASSETTE-IN SWITCH is located at the front center of the lift assembly. Depress it manually to initiate the automatic loading process.

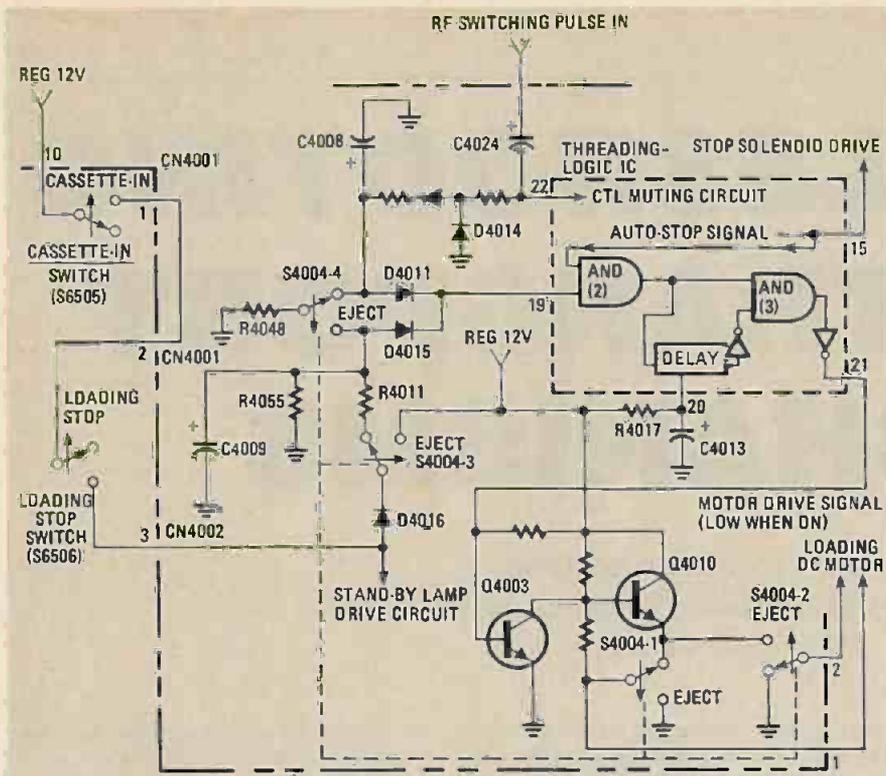


FIG. 2—BASIC THREADING CIRCUIT contains many safety interlocks that prevent damage to the machine during the tape loading process. A microswitch detects when the cassette is in place.

electronic functions of the recorder.

Note—occasionally that test results in the normal operation of the mechanism. Yet, with the machine reassembled, it will not load. If that happens, check the plunger on the cassette-in switch. It may not be closing the switch—usually the fault of looseness inside the compartment or a misadjusted lift assembly.

For further testing the front panel must come off—and the bottom pan that hides two front-panel screws. **Be careful when you handle the uncovered chassis; some AC voltages may become exposed.**

For tracing a problem, a logic probe or a voltmeter can be used. **BUT REMEMBER:** you're tracing logic signals, not merely voltages. On a voltmeter some signals are normally high and some are normally zero or low.

Probably, you will find it simpler to start your check with the cassette-in switch. Referring to Fig. 2, you should find a logic high at both sides of the switch, with your finger holding the switch down. That is true also for both sides of switch S6506. It should remain closed until the threading-ring cam opens it at the end of loading.

Diode D4016 conducts a logic high, as do R4011 and D4015. Verify both! You should then find a logic high at pin 19, the threading-logic input for the IC.

At this point you must consider additional factors: Check pin 20 of the IC. Suppose you find it at a logic high. You recall that this would inhibit gate AND-3 and keep IC pin 21 at a logic high, which, in turn, keeps the threading motor off.

However, remember that you are making tests that may have consumed some time. If your tests took longer than 10 seconds or so, that has allowed time for the delayed-inhibit signal (at pin 20) to build up a logic high. And that's *normal*, under such circumstances.

To check the later stages of threading-logic properly, you must give the system a "fresh" start. Press the EJECT button and let the cassette-lift rise. Then push it back down and again press the cassette-in switch. Now measure IC pin 20 again. It should show a logic low for several seconds. If you wait, you'll find that it rises again to a logic high.

Recycle the cassette-lift assembly again, and check the logic state on IC pin 21 or at the base of Q4003 (both are the same, electronically). The logic state there should be low at the outset. If it is not, check the auto-stop line (IC pin 15). The IC will not deliver a logic low to pin 21 unless the auto-stop line shows a logic high. And don't forget to recycle the cassette-lift assembly, using the EJECT button if it takes you longer than ten seconds to find each test point.

With a logic low at IC pin 21 touch the logic or voltmeter probe to the junction of R4025 and R4026 (or the collector of Q4003 or base of Q4010). This junction should show a logic high.

One machine we tested loaded intermittently. The above junction measured at a logic high, but at times it would jump to a logic low. A poor solder joint between R4025 and the printed-circuit board was the cause. A faulty Q4003 could cause the same symptom.

Even if a logic high shows at the base and emitter of Q4010, a fault in the EJECT switch or its board connections might keep the voltage from the DC motor. For example, one such machine came from its shipping carton with the motor interconnect plug not positioned firmly on its pins on the PC board.

Another thought when servicing this particular symptom: Remember that a linkage or a solenoid must release the brakes on the cassette-reel turntables. Otherwise the brakes hold the tape in the cassette. When the time-delay runs out, the IC logic stops the voltage from reaching the threading motor. Yet, when you try to trace the fault with the cassette out of its holder—as just described—the threading proceeds properly. That's because there's no tape to hold the threading mechanism back. It can be frustrating to try to trace if you forget that particular odd characteristic.

A defect in the gear drive between the threading motor and the threading ring can stop movement, and will bring the electronic-delay into effect after ten seconds. So will something jamming the threading ring. In both cases, you must track the trouble electronically unless you find that the delay mechanism itself is the cause; then you seek a mechanical explanation.

Finally, don't forget that the IC itself can become defective. However, explore all other possibilities before replacing it.

Does not unload

Here's another symptom that is not uncommon. It can create a feeling of real difficulty. However, it's not all that tough to get into the mechanism to unwind the tape (very carefully) so you can test the mechanism and electronic functions. But don't do that before you have tried troubleshooting the electronics.

Troubleshooting in that case goes much the same as for threading. Drop the end panel for access to the EJECT switch. On the front of the machine, press the EJECT button down and see that it latches. Observe the mechanics to make sure the Eject slide moves properly.

Press the STOP button to unlatch the Eject slide. Raise the end panel almost into position and press the EJECT button again. Make sure the tab projecting from the Eject slide contacts the Eject switch properly (see Fig. 3).

Again drop the end panel. Latch the EJECT button down. With your finger, push the Eject switch backward to its Eject position. If the unthreading mechanism does not work now, you must trace the logic through the system again. Hold the EJECT switch back as you trace. Check the auto-stop line first; if it goes low from any cause, unthreading cannot proceed.

Remember also that *unthreading* requires a proper signal from the pulse generator that forms part of the video-head drum. Check the diodes first. Do they

Mechanical Easi-Way Servicing

To use my *Easi-Way Servicing* technique most effectively when electronics and mechanical functions combine, remember this dictum:

Analyze the mechanical functions first, then analyze the electronic functions that cause them or control them.

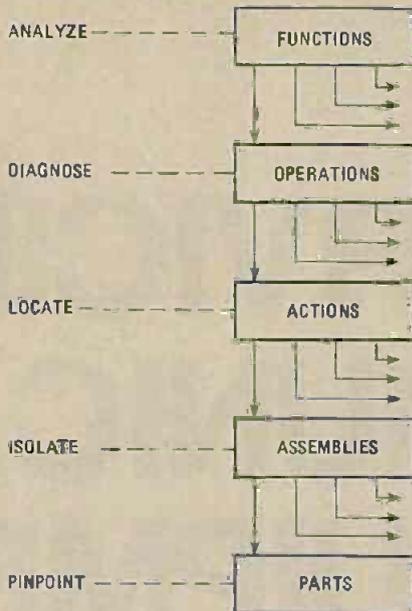
Keep to that rule at every level of the *Easi-Way Servicing* chart.

For example, first you "analyze the mechanical functions." Having decided which function is inoperative, you can then look for the particular electronic function that causes (or inhibits) the mechanical function.

Next, you "diagnose which mechanical operation" has ceased working within the function. Or, if you already know that the trouble is electronic, you diagnose the electronic section that is preventing operation.

Occasionally, in chasing an electronic fault, you'll find yourself back at a mechanical diagnosis. For example: You work your way down the chart, step by step, eventually finding a tape-slack detector switch holding the auto-stop line low, thus inhibiting operation. Yet, when you examine the tape, it's tight. If the switch is OK electronically, you'll probably find that it or its actuator is misadjusted mechanically.

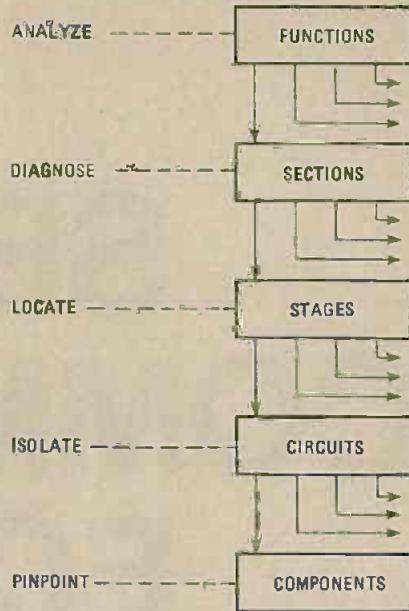
EASY-WAY™ SERVICING* (MECHANICAL)



*TRADEMARK AND COPYRIGHT
1978 BY FOREST BELT

Obviously, the better you know the recorder you're working on, the easier you can spot potential causes of inhibit signals—whether they are actually protecting something or merely getting in

EASY-WAY™ SERVICING* (ELECTRONIC)



*TRADEMARK AND COPYRIGHT
1978 BY FOREST BELT

the way of operation. If the machine is unfamiliar to you, this *Easi-Way* brand of reasoning helps immensely to narrow down the field of search.

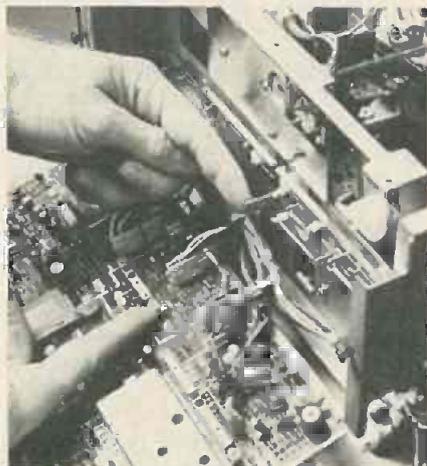


FIG. 3—MAKE SURE that the tab projecting from the Eject slide contacts the Eject switch properly.

deliver a DC voltage (a logic high) to D4011 (see Fig. 2)? If not, use your scope to trace back and find where the pulse disappears. If a logic high is present, make sure that D4011 passes it along to IC pin 19.

If you have to get the cassette out but the Eject mechanism does not work, take off the main cover (and the bottom pan). Remove the four screws that hold the cassette-lift cover. The two screws on the right side are hard to reach when the cassette lift is not raised, but a short, stubby or right-angle Phillips screwdriver will get at it.

First, pull the tape-tension arm toward the cassette and lift the tape clear. The

rest of the tape easily comes off from around the video-head drum. Don't let your fingers touch the drum nor any more of the tape than is unavoidable. And then try to touch only the tape edges. Again, move the tension arm and disengage the tape from around the lead guide post on the threading ring.



FIG. 4—WITH THE CASSETTE CLEAR, a small-tipped object such as a pencil may be used to unlatch the tape cover.

Work the cassette upward at the rear first, being especially careful near the left-rear corner where the cover opener is located. Raise the cassette upward, don't forget to make sure that the tape has not caught on something.

Once the cassette is clear, poke a pencil or a small-tipped object into the left-rear corner to unlatch the tape cover (Fig. 4). Only then should you wind the tape back into the cassette by hand. Do not leave

the cover closed because you will crimp the tape and perhaps break it.

Now you can proceed with the mechanical and electronic diagnosis.

Other symptoms

The threading motor could keep turning even after loading appears complete. A little thought and study of the schematic suggests various possibilities: threading-stop switch misadjusted and not opening, or defective. Of course, any malfunction that inverts the logic from the IC onward could leave voltage applied to the DC motor.

If, for example, transistor Q4003 should open, the logic would remain high on the base of Q4010 and the motor would continue to receive operating voltage. An open R4024 or 4026 would have the same result, as would a collector-emitter short in transistor Q4010. Similarly, an IC defect that prevents pin 21 from going high can keep the threading motor turning.

Far more troublesome are symptoms in which loading or unloading proceeds only partially. Generally, that kind of problem will prove to be mechanical. And yet, an intermittent microswitch can introduce symptoms that show up only at certain points of strain on the mechanism. You can usually identify those by applying a bit of pressure somewhere in the vicinity of the threading ring, but finding the faulty switch may take a bit of electronic investigation.

R-E

SERVICING COMMUNICATIONS EQUIPMENT

Can your service shop use some additional income? Consider getting into the installation and repair of commercial two-way radios.

GREG GRAMBOR

HAVE YOU EVER NOTICED HOW LONG IT takes between service calls on today's solid-state TV sets? It's going to get a lot longer, too, when varactor tuners catch on. Many TV service shops are beginning to look elsewhere for sources of income, and this article will examine one of those alternatives—the two-way radio business.

Almost anyone with some training and experience in TV servicing can qualify as a communications technician with just a little extra study and familiarization with two-way radios. First, you need that all-important First or Second Class Radiotelephone Operator's license. However, if you know electronics well enough to troubleshoot a 21-inch color TV chassis, you should have no problem getting the license. Just a few evenings spent with a book like *The Radiotelephone Operator's Q&A Manual* (published by Rider Books) or with the appropriate *Ameco Study Guide*, and you'll be able to take the FCC tests with confidence and, most likely, with success. Without a solid background in basic theory, it may take a bit more effort, but it's certainly not beyond anyone's reach.

Familiarization with the type of units you'll be servicing might take a little more effort. There are some home-study courses available in two-way radio repair, but if you're in a hurry, you might try

some other methods. One way to gain some preliminary, hands-on experience would be to invest in some old used units with schematics and service manuals. Then, take them apart section by section and rebuild them the way many schools teach TV service techniques. At the same time, brush up on transmitter basics with a good text like *The Radio Amateur's Handbook*, published by the American Radio Relay League, or *The Radio Handbook*, published by the Radio Society of Great Britain. Both books are considered standard industry texts.

If you own a larger shop and can use another employee, you could hire an experienced licensed technician and start building profits as you learn from him. This means you'll immediately have to purchase some test equipment, the kind normally not found in an average TV repair shop. You'll have to do this eventually, but if you hire an experienced communications technician you'll just do it sooner.

A primary test instrument is an FCC-type-accepted frequency meter. Every licensed land-mobile radio transmitter must have its frequency checked and certified once yearly by a licensed technician (this could be you)! So even if your customer's radios need no other service for an entire year (highly unlikely), the radios will generate at least one service call each per year. For a better look at

some of the other test equipment you'll need let's visit an actual two-way radio repair shop, Electronic Specialty Services (Palisades Park, NJ).

This business began as a TV repair service but is presently a successful communications shop. Although owner-operator Joseph Mannino says he is phasing-out the home-entertainment side of the business to concentrate on communications, he contends that there is no reason why anyone cannot maintain both types of customers if desired.

When we asked him what test equipment would be needed to start taking in two-way radios, in addition to the usual instruments found in a TV repair shop, he mentioned first a good-quality, FCC-type-accepted frequency meter. You also need a type-accepted deviation meter, a type-accepted wattmeter that can be used to read both forward and reflected power, a good-quality dummy load that is able to dissipate at least 100 watts, a 50-MHz (or better) oscilloscope (if you don't already own one) and a high-quality signal generator with a calibrated attenuator. Helpful, although not essential, would be a good RF probe, a digital voltmeter (DVM) and a set of high-grade alignment tools (less-costly alignment tools tend to crack coil cores in communications equipment). If you want to work on pocket paging devices (which can be lucrative) you need a sequential synthesized audio generator



AN ALTERNATIVE

with at least dual-tone capability.

All this equipment represents a considerable investment, and you should be careful not to go in underfinanced. If you prefer, you can start slowly, buying equipment unit-by-unit over a long period of time. There is also a brisk trade in used, reconditioned units that are perfectly adequate. You don't need a small fortune to get started.

Add a few other basics such as VHF and UHF antennas on your roof for conducting air checks, plus hardware like coax connectors, cable and mobile-type interconnection plugs, and you're ready.

Before you take the plunge, here are a few additional points to consider: Your customers will be relying on you to maintain their *business* communications. The two-way radio system will be one of their most important business machines. They'll expect prompt service, sometimes at odd hours. Their incomes will depend on it; and in the case of public safety radios (police, fire and ambulance), *lives* will depend on it. This may be a bit more demanding than repairing home-entertainment equipment, but it will be considerably more rewarding.

Building up the business

About the only way to effectively get started is to go out and drum up business. If you're presently running a TV service shop, this could mean taking time from it

to call on likely prospects.

What are your best prospects? Those businesses that use mobile units are, of course, your obvious targets. These would include sales organizations, trucking firms, service companies such as appliance repair shops, and construction companies. If you're near any developing areas, watch for stories of new neighborhoods starting up volunteer fire companies or ambulance squads. It's possible that you can get in with your bid and pick up a nice, steady account.

Many busy executives and professionals in all sorts of fields would appreciate the concept of mobile communications both for themselves and for their key employees. Invest in a little local advertising and spread the 'word of mouth' about your new venture . . . you may be surprised at the results.

The best way to assure an income base is by combining sales and service contracts. Selling the equipment plus having your customer sign a service contract with you lets you earn the profit on the merchandise you sell, plus what you earn on repairs and maintenance for at least the length of the contract. This is a more efficient way of doing business than just waiting for service calls.

Another way to spur equipment sales is to install a community repeater in your area. A repeater is usually set up at the highest point in your neighborhood that

you can lease or otherwise gain access to. As its name implies, the device picks up weak signals from mobile radios and inexpensive base stations, and amplifies them for a wider range. Repeaters operate automatically and usually require little maintenance. A properly operated repeater in a good location can cover up to about 75 miles. The FCC says you cannot operate a community repeater for profit, but you can bill your customers for its use, enough to cover operating expenses and your salary. The main object of the repeater is that it becomes the basis for mobile-equipment sales.

What kinds of technical work will all this get you into? Except for the fact that you'll be working with transmitters and receivers instead of just receivers, troubleshooting techniques won't be much different. If you can trace a signal through a circuit, take voltage readings, interpret waveforms and solder components, that's half the battle won. You'll be installing mobile and base radios, repairing them, and maintaining them with yearly, required-by-law frequency and modulation certifications, which must be performed by someone with a First or Second Class FCC Radio-telephone Operator's license. You'll also assure yourself of a steadier income than can be provided by the home-entertainment service field in these times of more reliable solid-state equipment.

R-E

DIAL-UP SOFTWARE NETWORKS

*Does your personal computer want to talk to others?
Has it developed a thirst for information and programs?
If so, look into inexpensive software networks that you can access via telephone.*

JULES H. GILDER

IMAGINE READING ABOUT NEWSMAKING events two minutes after a reporter halfway around the world files his story! How about getting an hourly news summary, or domestic and international news whenever you want it? Would you like to make and confirm travel arrangements from the comfort of your own home? Wouldn't it be nice to know what the weather was like in the city you are going to, just before you leave?

Would you like tips on buying, selling and financing a home? If you were selling your home you might want to list it on a nationwide basis. Or if you were thinking of moving to another city, it would be nice to get an idea of what kinds of houses were available there, and what the prices were like.

These are just a few of the hundreds of services offered by America's latest utilities. Instead of supplying you with gas, electricity or telephones, *these utilities supply you with information.* The information is available instantly and is only a phone call and a few key-strokes away.

For years, science fiction writers have portrayed the home of the future as being tied into huge central data banks. More recently, home computer makers have been telling us how useful their computers are, but have shown us few home-oriented applications. Well, the future has arrived, our home computers now have access to all kinds of data! All the equipment that you need is your own computer, an *acoustic coupler* or *modem* to allow your computer to use the telephone and, of course, the telephone itself.

What is an information utility?

While the term "information utility" tells us what such a service supplies, it

really doesn't shed much light on how it does it. Information utilities are computer systems, often using large mainframe computers or several minicomputers, that are accessed by an outside terminal or computer through the regular telephone system. These computers are set up to handle many users simultaneously and usually have available a wide variety of databases and other useful programs.

To make use of these programs and databases, you must subscribe to the computer service and be issued a user identification number and password.

There are two information utilities, each about a year old, that have been designed to serve the home/hobby computer market. The more popular of the two is called The Source. The other one is MicroNET. While on the surface the two seem to be in direct competition, a close look at the services offered by each shows that The Source offers much more than MicroNET and, in the long run, is cheaper too.

Both first require you to submit an application form indicating which of your credit cards (Master Charge or Visa) you want your charges billed to (both accept only "plastic" money). Upon acceptance, you will receive your ID number and password.

Looking at the initial outlays, it would appear that MicroNET is significantly cheaper. Its registration fee is only \$9 (actually, only \$4, since you get a \$5 rebate) compared to the \$100 required for The Source. In addition to the initial registration fee, however, it is also necessary to pay for the time that you use on these remote computers. You pay a fee for each hour (or part thereof) that you are connected to the utility's computer. For MicroNET, this

fee is \$5 per hour, any time of the day or night, while for The Source the fee varies depending on the hour. From 6 PM to 7 AM local time, and all day on weekends and holidays, the hourly charge is only \$2.75 an hour, significantly less than MicroNET. The picture changes considerably, however, if you wish to use The Source during business hours, when the cost runs \$15 an hour.

And don't let the initial registration fees fool you. While MicroNET has a low out of pocket investment to start with, that initial saving is quickly eaten up by the hourly connection charges. When you're using these remote networks, time flies by without your even noticing it!

How they work and what they offer

You sign on to either system in essentially the same way. After you enter your ID number, the system requests you give your password. Since you wish to keep this secret to prevent unauthorized access to your file, the password is typed in "blind"; that is, it is not displayed on the screen as you enter it via the keyboard.

Having done this, you are ready to take full advantage of the system's capabilities.

Both networks offer a lot. They give mainframe computing power to your home microcomputer. Each permits you to write programs in languages that may not be available on your home computer. For example, they both offer Extended BASIC, FORTRAN and Assembly Language programming capabilities. In addition, MicroNET has APL, PASCAL and SNOBOL, while The Source has COBOL and RPG II. Both offer text editors and word pro-



cessors, as well as a variety of game programs for entertainment.

From the remote computing standpoint, both services offer comparable capabilities. But when we leave this area and look at the *other* services provided by these information utilities, we begin to see the difference between them.

With The Source you have instant access to the United Press International wire service. Through it you can have your choice of a daily news summary, domestic news, international news, an hourly news summary, Washington Hotline, special features, sports news, financial news, weather and a host of other features.

In addition to UPI, The Source also gives you access to two *New York Times* databases. One is the *New York Times* News Summary, whose categories include front page headlines, national news, business news, metropolitan New York news, advertising news, editorials and obituaries. The second is the *New York Times* Consumer Data Base which contains abstracts from the *New York Times* and *over sixty other* major publications. The abstracts are grouped into categories to make searching easier.

If you are more interested in business than in current affairs, information utilities offer a comprehensive set of business and financial programs and information. Included are programs for accounts payable and receivable, gen-

eral ledger, payroll and data base management. Both also provide trading statistics and information on stocks, bonds and options.

Electronic mail is here

While the U.S. Postal Service and several major communications companies are still talking about electronic mail, The Source already has it. When you first connect to The Source, the system will check to see if anyone has left you a message or mail. If so, the words MAIL CALL will appear on your computer's screen as soon as you've finished signing on. To "pick up" your mail, all you have to do is type the word MAIL, followed by the word READ. The system will then display the sender's account number, the time at which the letter was posted and the subject of the letter. After you read the letter, you may file it, forward it to someone else, or delete it (throw it away).

As with ordinary mail, The Source's electronic mail allows you to request a "return receipt" so that you are certain that your letter has been received.

The system also allows for the writing and sending of form letters and for multiple-address mail (for which there is a charge of 15¢ for the second and each subsequent address). Multiple address-mail can be sent from a previously stored mailing list.

While MicroNET doesn't have a specific electronic mail system, it does

allow the user to post a message on a bulletin board that can be read only by the person for whom it is intended. As with any bulletin board, physical or electronic, the person for whom a message is intended must look at the board first before he knows that there is a message for him.

CB comes to computers

With Citizens band radio as popular as it is, it's not surprising that one of the networks, MicroNET, should offer a computerized version of CB radio. If you use this feature, you are asked to enter your "handle" (name) and the channel you want to tune to. After indicating your choice (e.g. Channel 19), you are told how many people are listening to the same channel and how many are actually taking part in the conversation. You may then choose to be part of the active group, or just to sit on the sidelines and "listen" (read from your CRT display). As is the case with real CB transmissions, if two people try to speak at the same time, there is no assurance that either message will get through ungarbled.

While MicroNET has chosen the CB approach to allow any user to speak with any other user or group of users on "public airwaves," The Source has decided that "private lines" are more desirable and as such has implemented
continued on page 108

MORE

A look at the driver stages of the new super Class A amplifiers that achieve high output while maintaining a near-zero level of distortion.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

IN THE MARCH ISSUE, WE EXAMINED THE design of the new Super Class-A amplifier output stage developed by JVC. The Super-A design is intended to provide nearly the full efficiency of a Class-B amplifier circuit with no notch-distortion or switching distortion.

In discussing power amplifiers, it is usual to emphasize the design of the output stage since it is that stage that actually delivers power to the speakers. However, there are a number of amplifier characteristics that are determined by earlier stages, such as the driver or voltage-amplifier stages. Those characteristics include frequency response, gain, thermal drift, slew-rate, etc. The driver stage may also have a great bearing on the distortion characteristics of the entire amplifier.

Driver-stage distortion

In developing a driver circuit for their new Super Class-A amplifier, JVC's engineers examined first the three types of distortion that can be found in a common-emitter amplifier circuit. Figure 1 shows the input/output characteristics of a common-emitter amplifier circuit that is driven with constant current. Those characteristics are commonly

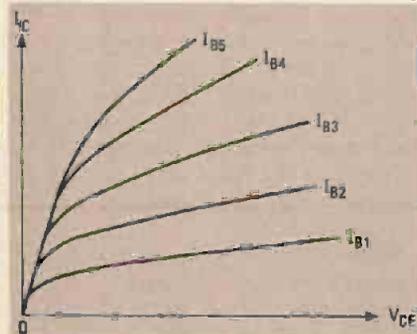


FIG. 1—INPUT/OUTPUT CHARACTERISTICS for a common-emitter stage. Collector current versus collector-to-emitter voltage is shown for a number of fixed values of base current.

called the V_{CE} - I_C characteristics. Note that in this diagram each curve rises to the right. That means the even with a constant input-signal current, the collector-current (I_C) increases as the collector-to-emitter voltage (V_{CE}) increases. It follows that the gain of the stage varies as V_{CE} varies. That variation of gain normally amounts to around 10% in the pre-driver stage, since variations of V_{CE} roughly coincide with those of the power supply voltage. JVC calls that type of distortion the V_{CE} distortion is illustrated (in exaggerated form) in Fig. 2.

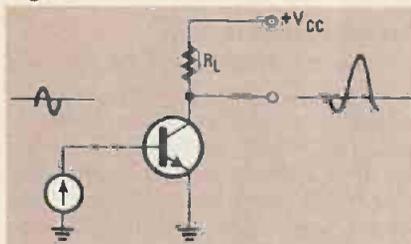


FIG. 2—SINGLE-STAGE COMMON-EMITTER amplifier. Variations in collector current as the collector-to-emitter voltage changes causes distortion.

A second form of distortion that occurs in common-emitter amplifier circuits arises because of the capacitance between the collector and base of the common-emitter transistor stage. Commonly called C_{ob} , that capacitance varies with the collector-to-base voltage (V_{CB}) in such a manner that it increases as V_{CB} decreases. In the common-emitter amplifier circuit, the C_{ob} variation of capacitance results in distortion, the nature of which is illustrated in exaggerated form in Fig. 3. In the course of the development of the Super-A Class circuit, JVC called that type of distortion ΔC_{ob} distortion.

The third and final form of distortion associated with a common-emitter circuit is known as ΔV_{BE} distortion. The input/output characteristics of a com-

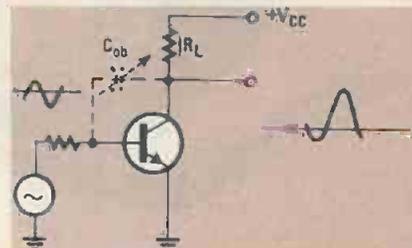


FIG. 3—JUNCTION CAPACITANCE within the transistor also causes distortion. That capacitance, called C_{ob} , varies in accordance with the collector-to-base voltage.

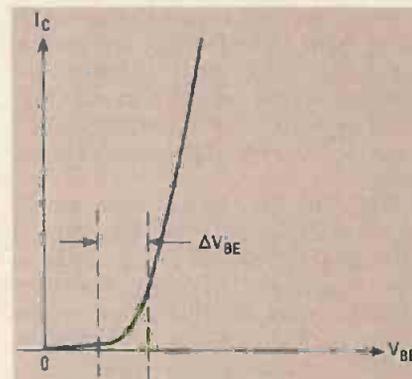


FIG. 4—INPUT VOLTAGE versus output current for a common-emitter stage. Operation in the nonlinear portion of curve causes distortion of the output signal.

mon-emitter circuit is shown in Fig. 4. Note the relationship between input voltage and output current. It is logarithmic. Therefore, if input and output are compared in terms of voltage, a high level of distortion is present. Figure 5 shows the general nature of that distortion, again in exaggerated form for the sake of clarity.

Several approaches are possible for reducing the ΔV_{BE} distortion. The use of constant-current drive or the connection of a current feedback resistor to the emitter might be one possible approach. Another approach might be to attempt to cancel the ΔV_{CE} distortion and the ΔV_{BE} distortion with each other by

SUPER CLASS A Amplifiers

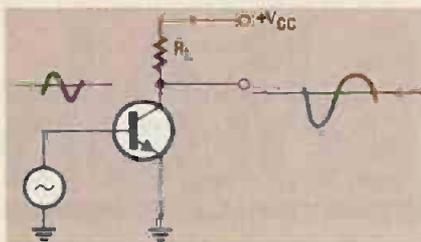


FIG. 5—DISTORTED OUTPUT WAVEFORM is caused by nonlinear operation of common-emitter transistor stage.

choosing an appropriate driving impedance, since those distortions are essentially mirror-images of each other.

Figure 6 shows a typical input/output characteristic of a common-base amplifier circuit. It shows the collector current (I_C) vs. the collector-to-base voltage (V_{CB}) for a number of fixed values of emitter current (I_E). In this circuit, variations of I_C caused by variations of V_{CB} are almost non-existent. It should be noted, of course, that current gain of the circuit is 0 dB (gain equals 1.0). However, the very fact that gain is not influenced by variations of V_{CB} is made use of in the familiar cascode amplifier circuit.

Cascode amplifier circuits are often

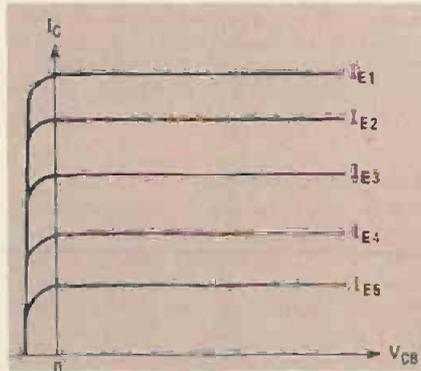


FIG. 6—INPUT/OUTPUT CHARACTERISTICS for a common-base amplifier stage. Collector current versus collector-to-base voltage is shown for a number of fixed values of emitter current.

used in high-frequency applications such as RF amplifiers because of their excellent frequency response resulting from the absence of the effects of capacitor C_{ob} . So, in that sense, there is nothing particularly new or different about them. However, when analyzed from the viewpoint of distortion and considered for their application in audio equipment, they have proven to be superior as a low-distortion amplifier circuit. The basic circuit of a cascode amplifier is illustrated in Fig. 7.

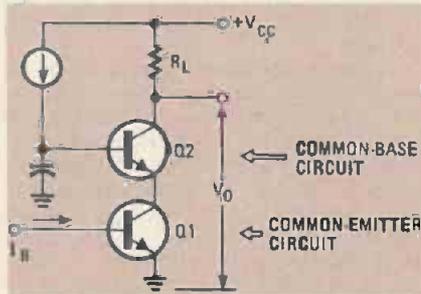


FIG. 7—SUPER CLASS-A DRIVER STAGE consists of cascaded common-emitter and common-base amplifier stages. Combination drastically reduces distortion.

That type of amplifier circuit provides excellent linearity through a combination of the common-emitter and common-base circuits, since the forms of distortion created by each of those circuits are effectively cancelled by each other. In the cascode circuit, input-signal current I_B is first amplified β times through the common-emitter transistor Q1 which has a large current gain. The signal is then applied to the emitter of the common-base transistor Q2, where it is amplified a times. Therefore, the output voltage across R_L is equal to:

$$V_O = \alpha \beta R_L I_B$$

Note that the input signal is considered to be in the form of a current (I_B) and not in the form of a voltage. In actual applications, a signal-source im-

pedance on the order of kilohms will suffice. That combination suppresses ΔV_{BE} distortion. Then, since an almost constant voltage is present at the emitter of the common-base circuit Q2, the V_{CE} of Q1 takes on a constant value regardless of the presence of the input signal. Therefore there is no variation of gain and C_{ob} due to the variation of V_{CE} or V_{CB} . The variation of gain due to any variation of I_C is negligible. Furthermore, the gain of Q2 can be considered to be 1.0 because of the characteristics of a common base circuit. As a result, nonlinear components disappear almost completely from the output-voltage V_O . Thus, the driver stage of JVC's Super-A circuit takes complete advantage of the properties of cascode operation and, according to JVC, reduces the distortion figure in the voltage and driver stages of an amplifier by one complete order of magnitude compared with conventional amplifiers.

Needless to say, there are many forms of distortion other than those that have been compensated for both in the driver and power stages of JVC's new Super-A Class amplifier products. Nevertheless, both in the driver and power stages, the most common drawbacks of semiconductors have been compensated for through the use of these new circuit approaches. As a result, the distortion (or, more properly, the harmonic distortion) of the Super-A circuit is far lower than the practical lower limit at which ordinary harmonic distortion meters function. The distortion level, in fact, lies far lower than the noise level of the amplifier. Typically, the harmonic distortion level of JVC's new A-X9 integrated amplifier measured by means of a spectrum analyzer for a test signal at 1 kHz and an output of 105 watts (the amplifier is rated at 100 watts from 20 Hz to 20 kHz, 8-ohm loads) was an infinitesimal 0.0005%, according to JVC. R-E

Denon Model DR-750 Stereo Cassette Deck



CIRCLE 106 ON FREE INFORMATION CARD

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

DENON IS THE TRADE NAME USED BY NIPPON Columbia Company, Ltd., of Japan, many of whose products are distributed in the United States by American Audiopoint, Inc., a division of the Discwasher Group (1407 N. Providence Rd., Columbia, MO 65201). Denon's *model DR-750* is a top-of-the-line two-headed stereo cassette deck. While most of us have been conditioned to think that a high price for a cassette deck is synonymous with three-headed operation (and conversely, that two-headed decks should cost less) our lab and listening tests on the *model DR-750* completely disprove that idea. Aside from the deck's inability to monitor recordings as they are made, the *model DR-750* is one of the best-performing cassette decks we have ever evaluated.

The unit can be operated either horizontally or vertically (as shown in Fig. 1). The cassette compartment at the upper left accepts direct insertion of the cassette tape, which makes for extremely accurate positioning of the shell. A transparent plastic door can then be swung down while the tape is in motion for protection against dust or dirt. The digit-tape counter, RESET pushbutton, MEMORY switch and POWER on/off switch are all positioned along the top edge of the machine.

Transport controls are all soft-touch, logic-control types and include PAUSE/MUTE, RECORD, play, stop, rewind and fast-forward pushbuttons. The PAUSE/MUTE pushbutton is rather novel. With the deck in the record mode and this button depressed, a blank space is recorded on the tape. Releasing the pushbutton then brings the tape transport into the pause mode, while subsequently depressing and holding the button again results in muted recording. To reactivate the recording, you just hit the play pushbutton after having brought the unit into the pause mode.

The twin meters serve as either VU or peak-reading record-level indicators. Meter response time in the peak mode is a mere 10 ms,

while in the VU mode response time is around 300 ms. The bottom section of the front panel contains a playback level control, a bias adjustment control (continuously variable to encompass all types of currently available tapes), a tape-selector switch (it determines equalization), and line record-level and microphone record-level controls.

Along the very bottom of the panel are a headphone jack, a timer set switch (to be used with an external clock timer, if that is desired), a VU-peak selector switch for the meters, a multiplex filter switch (to eliminate subcarrier output components from tuners when recording stereo FM programs), the Dolby on/off pushbutton switch, and left and right microphone input jacks. The real panel of the *model DR-750* contains the line-input and line-output jacks.

Depressing the RECORD pushbutton on the *model DR-750* places the machine in a standby state, which is shown by a tiny red indicator light just above the RECORD button. Unlike the situation with most other tape recorders, where it is necessary to depress record and play simultaneously to begin recording, once the RECORD button is depressed, you then simply press the play pushbutton to start the transport. This approach has the advantage of not requiring the machine to be placed in the pause mode (with the heads usually up against the tape) while you set up the proper record levels, or are waiting for the appropriate moment to initiate recording. As with most logic-controlled transport systems, it is possible (and perfectly safe) to go from any transport mode to any other without having to go through the stop mode.

While it is possible (and even advisable) to fine-tune the bias on this machine to optimize it for virtually any type of tape, recommended settings for the variable-bias control are provided for some 50 popular brands and styles of tape; these are listed in the owner's manual.

MANUFACTURER'S PUBLISHED SPECIFICATIONS.

Speed Deviation: $\pm 0.5\%$. **Fast Wind Time:** 70 seconds (for C-60 cassette). **Bias Frequency:** 100 kHz. **Signal-to-Noise Ratio (Dolby on, cobalt tape):** 65 dB. **Frequency Response:** cobalt or ferric oxide LH tape, 35 Hz to 18 kHz, ± 3 dB. **Wow and Flutter:** 0.04% WRMS, 0.1% unweighted. **Channel Separation:** better than 35 dB. **Crosstalk:** better than 65 dB (1 kHz). **Input Sensitivity:** line, -20 dB; microphone, -70 dB. **Output Level:** line, 1.0 volt; microphones, 1 mW into 8 ohms. **Power Requirements:** 120/200/220/230/240 VAC, 50 to 60 Hz, 38 watts. **Dimensions:** 16.33 W \times 11.93 H \times 8.9 inches D. **Weight:** 27.5 lbs. **Suggested Retail Price:** \$1400.

RADIO-ELECTRONICS AUDIO LAB

R.E.A.L. SOUND

RATES

DENON DR-750
CASSETTE DECK

EXCELLENT

Copyright © Gernsback Publications Inc., 1979

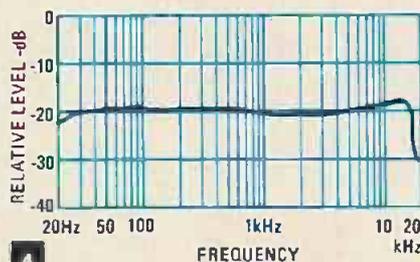
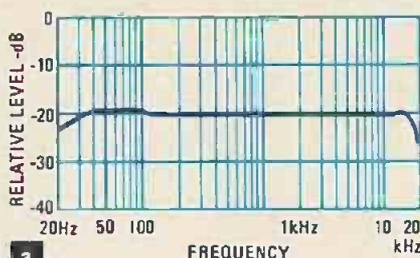
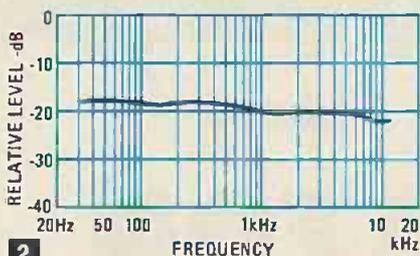
Optimizing beyond these nominal settings is rather tedious, since it involves making short recordings of tones, playing them back and comparing levels of the mid-frequency and high-frequency test tones recorded. The process must be repeated (tweaking the bias control for more or less bias, depending upon the results observed on the meters) until the mid- and high-frequency recorded tones are reproduced at the same levels. Here, of course, is where a three-headed machine would offer a distinct advantage, since you could monitor the results of the adjustments as they were being made. Our tests were made using the nominal settings recommended for the tape samples we used.

Lab measurements

Using the TDK prerecorded test tape AC-337, we first checked the playback response only. This test tape requires a playback equalization of 120 μ s and 3180 μ s (the standard value for ferric-oxide tapes). The recorded tones extend only from 40 Hz to 12.5 kHz, hence the limited curve shown in Fig. 2, which was flat within ± 2.0 dB over that range.

Using TDK's test tape AC-342 (a constant 3-kHz tone recorded at -10 -dB level from a reference of 250 pWb-per-mm), we were able

to measure speed accuracy by "counting" the playback frequency on our digital frequency counter. Speed deviation was well within the specified limits, measuring fast by less than 0.3%. The same tape was used to measure playback-only, wow-and-flutter, which proved to be an amazingly low 0.04% WRMS or 0.07% unweighted.



Interestingly enough, the record/play wow-and-flutter measurements made when we recorded our own 3-kHz tone and played it back on the Denon deck itself turned out to be exactly the same as the figures obtained from the prerecorded test tape, indicating that the double process (record/play) did not introduce additional wow-and-flutter components.

Table 1 summarizes our other test results. Denon type DX-3 C60 tape was used as the low-noise ferric-oxide sample, and TDK-type SA tape was used for the high-bias (cobalt-ferric) tape tests. Frequency response for the record/play function, using the Denon tape, extended from 20 Hz to 18.5 kHz, as shown in Fig. 3 (for the -3-dB rolloff points). Overall record/play response of the TDK-SA sample tape turned out to be somewhat better, extending to below 20 Hz and out to 19.5 kHz, as in Fig. 4.

In analyzing the headroom (the level above 0 dB for 3% distortion) shown in Table 1 for both types of tape, you should keep in mind that on the model DR-750, the 0 dB marking on the level meters corresponds to a magnetization level of 200 pWb-per-mm. Many tape-deck manufacturers arbitrarily calibrate their meters so that 0 dB actually represents a lower recording level (e.g., 165 pWb-per-mm); the result is that such decks tend to show a higher headroom figure that is really decep-

TABLE 1
RADIO-ELECTRONICS PRODUCT TEST REPORT
Manufacturer: Denon (American Audloport) Model: DR-750
CASSETTE TAPE DECK MEASUREMENTS

	R-E Measurements	R-E Evaluation
FREQUENCY RESPONSE MEASUREMENTS		
Frequency response, standard tape (Hz-kHz ± dB)	20-18.5, 3.0	Excellent
Frequency response, CrO ₂ Tape (Hz-kHz ± dB)	20-19.5, 3.0	Superb
Frequency response, other (see text) (Hz-kHz ± dB)	N/A	N/A
DISTORTION MEASUREMENTS (RECORD/PLAY)		
Harmonic distortion at 0 VU (1 kHz) (%)	1.5/2.5	Very good
Level for 3% THD (dB)	+4.0/+1.0	Very good
SIGNAL-TO-NOISE RATIO MEASUREMENTS		
Standard tape, Dolby off (dB)	58.0	Superb
Standard tape, Dolby on (dB)	67.0	Superb
Cobalt tape, Dolby off (dB)	57.5	Excellent
Cobalt tape, Dolby on (dB)	65.0	Excellent
MECHANICAL PERFORMANCE MEASUREMENTS		
Wow and flutter (% WRMS)	0.04% (0.07% unwt'd)	Superb
Fast wind and rewind time, C-60 tape (Seconds)	67	Very good
COMPONENT MATCHING CHARACTERISTICS		
Microphone input sensitivity (mV)	0.29	
Line input sensitivity (mV)	72	
Line output level (mV)	1000	
Phone output level (mV)	82 (8 ohms)	
Bias frequency (kHz)	100 kHz	
TRANSPORT MECHANISM EVALUATION		
Action of transport controls		Superb
Absence of mechanical noise		Superb
Tape head accessibility		Very good
Construction and internal layout		Excellent
Evaluation of extra features, if any		Excellent
CONTROL EVALUATION		
Level indicator(s)		Excellent
Level control action		Excellent
Adequacy of controls		Very good
Evaluation of extra controls		Excellent
OVERALL TAPE DECK PERFORMANCE RATING		Excellent

TABLE 2

OVERALL PRODUCT ANALYSIS

Retail price	\$1400
Price category	High
Price/performance ratio	Good
Styling and appearance	Superb
Sound quality	Excellent
Mechanical performance	Superb

Comments: All the characteristics that we expect of a top-quality stereo cassette deck are very much in evidence in the Denon DR-750. All, that is, except the three-headed configuration that would have permitted you to monitor recordings as they are being made. As for any design compromises that may have been necessary in a machine with a common record/play head, you can forget about them. The *Sensustip* head, is far less brittle than ferrite and can therefore be machined with a super-narrow gap of between 1.0 and 1.2 microns. With this narrow gap, less magnetic saturation and high linearity can be obtained, improving high-frequency playback characteristics. Yet the magnetic characteristics are such that despite the narrow gap, enough flux can be developed for proper recording when the head is in the record mode.

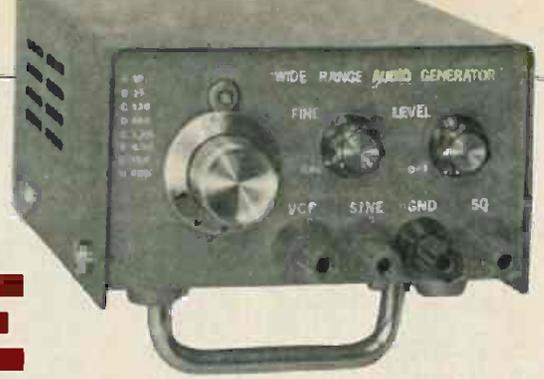
Aside from the slight difference in high-end frequency response, we found that using either low-noise ferric-oxide or cobalt-ferric (high-bias) tape yielded almost the same signal-to-noise ratios, evidence of a well-balanced and carefully calibrated design. We would have thought that a deck in this price category (obviously intended for a more sophisticated recordist) would include accessible Dolby record and play calibration points. After all, if tapes vary in their bias requirements and sensitivity, they will also vary insofar as optimum Dolby calibration is concerned. While we encountered no problems in this area with the tapes we tested, optimum Dolby usage with other tapes may be affected. The Denon DR-750 is an elegant, well constructed and good-looking machine, and, if price is no obstacle, it should produce excellent cassette recordings of even the best program source material available, including live recordings.

tive. A headroom of +4 dB above 200 pWb-per-mm (which also coincides with +4 dB above the Dolby calibration level) is quite respectable for a machine setup for low-noise ferric-oxide tape.

The signal-to-noise ratio (referenced to a 3% THD recording level) was almost identical for both types of tapes, measuring 65 dB or better with Dolby on.

Summary

Our overall product evaluation is shown in Table 2, along with our summary comments concerning this rather high-priced machine. Undoubtedly, some of the high cost of the model DR-750 can be attributed to its magnificent transport-control system, two-motor drive, and logic-control electronics. R-E



WIDE-RANGE AUDIO GENERATOR

A wide-spectrum source of audio signals is a necessity for much bench work. Here's one you can construct for about \$30.

RICHARD SCHROEDER

AS AN ELECTRONICS TECHNICIAN, I TEST and repair a large number of oscilloscopes, recorders, amplifiers, filters, etc. This work requires the almost continual use of an audio-type signal source.

I work in a shop where I can lay my hands on a lot of sophisticated test equipment, and yet I usually reach for my Wide Range Audio Generator. Why? Because it's small, light, easy to operate, and it supplies the signals I most often need. Besides, it's good-looking and I built it myself.

Whether you're a technician, engineer, or just an electronics hobbyist, I believe you'll find that the instrument described in this article is one of the most useful pieces of equipment you could own.

For instance, note its frequency range of 10 Hz to 50,000 Hz, without any range switching—that represents a spread of 3½ decades. This feature is really great for checking the frequency response of amplifiers or filters, because with just a twist of the wrist you can sweep the whole audio spectrum and then some. A FINE FREQUENCY control is also provided to give the extra frequency resolution that is sometimes needed.

The generator can supply a sinewave signal of over 4 volts RMS into a 1000-ohm load with a distortion figure of around 1%. It can also produce a simultaneous squarewave signal that will drive the popular 5-volt TTL circuits.

Another nice feature is its DC-coupled voltage-controlled-frequency input (VCF) so you can use the instrument as a sweep-frequency generator, a step-frequency generator, or an FM-theory demonstrator.

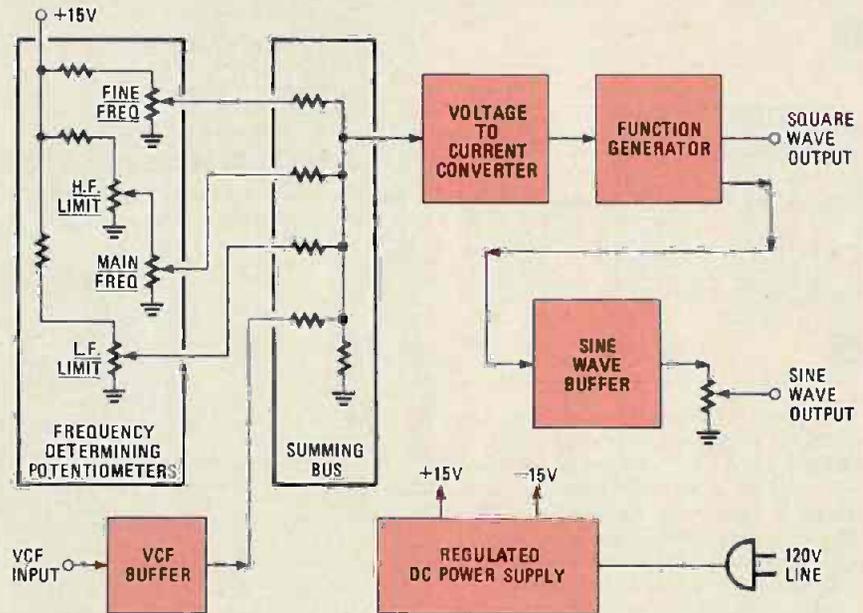


FIG. 1—BLOCK DIAGRAM of the Wide Range Audio Generator. Shaded areas indicate major components. Note, also, the frequency-determining section and summing bus.

All its input and output circuitry is fully buffered, protected and DC-coupled, which contributes to its super-flat (constant-amplitude) output over the entire frequency range (with a total variation of less than 0.25 dB).

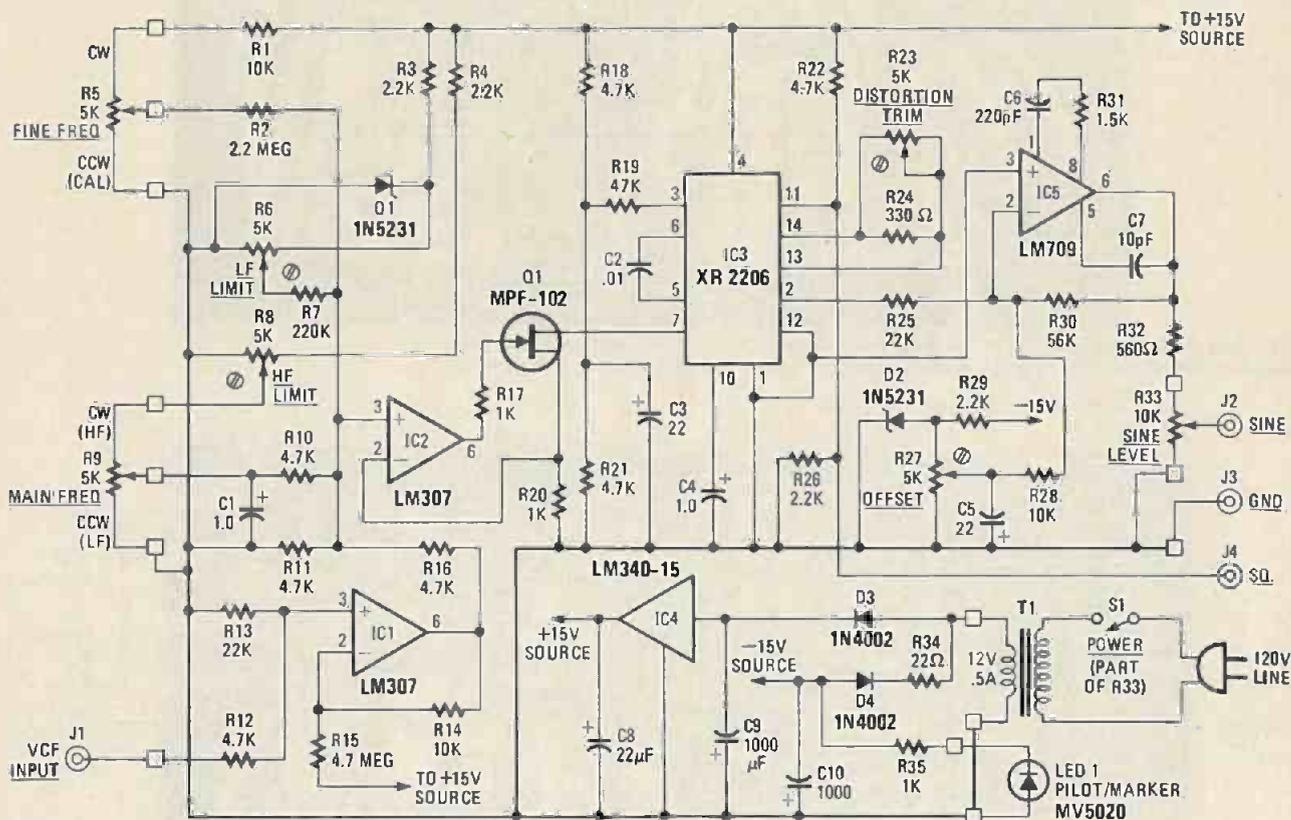
Its on-board regulated power supply ensures that its output frequency and amplitude remain constant even under adverse line-voltage conditions.

Add to all of this a 3- X 5-inch etched circuit board that contains most of the components, plus the fact that the whole instrument can be constructed for around \$30—and I think you'll agree it's a fine little instrument.

How it works

Refer to the block diagram in Fig. 1 and note the following basic components:

1. The frequency-determining potentiometers and their associated trimmers for setting the upper- and lower-frequency limits.
2. The VCF input with its associated buffer stage.
3. The summing bus that receives signals from the frequency-determining potentiometers and/or the VCF stage.
4. The voltage-to-current converter.
5. The function generator.



NOTE:
 IC1, 2, 5:
 PIN 4 TO -15V; PIN 7 TO +15V.
 CAPACITOR VALUES IN μF UNLESS OTHERWISE NOTED

FIG. 2—FULL SCHEMATIC of the Wide Range Audio Generator. Power supply appears at lower right. VCF input (J1) permits external control of output frequency.

6. The sinewave buffer stage and its associated output-level control and output terminal.

7. The regulated DC power supply.

Briefly, here's how the instrument works: The function generator produces the sinewave and squarewave signals. The sinewave signal is amplified, buffered and fed to the output control and terminal. The squarewave signal becomes attenuated and fed to its output terminal.

The frequency of these signals is controlled by the current that flows out of the frequency-control input of the function generator. This current is produced by the voltage-to-current converter, which is controlled by the summing-bus output. The summing-bus output level is controlled by signals reaching it from the frequency-determining controls and/or the VCF stage.

Let's analyze the circuit in more detail. The heart of the instrument, of course, is the XR2206 IC function generator.

Actually, two factors control its output frequency:

1. The value of the capacitor that is connected between pins 5 and 6 (in this case, $0.01 \mu\text{F}$).

WIDE-RANGE AUDIO GENERATOR SPECIFICATIONS

Frequency Range: (MAIN FREQUENCY CONTROL)	10 Hz—50 kHz, with no range switching
Frequency Range: (FINE FREQUENCY CONTROL)	100—200 Hz total, regardless of MAIN FREQUENCY control setting
Sinewave Output Level:	0—4 volts RMS into 1000 ohms
Sinewave Distortion:	Approximately 1% over entire frequency range
Sinewave Output Level Variation vs. Frequency Change:	Less than 0.25 dB over entire frequency range
Squarewave Output Level:	4 volts peak, positive from ground current-sink type compatible with most TTL circuits
Squarewave Rise and Falltimes:	Less than 0.5 μs
VCF (Voltage Controlled Frequency) Input:	27,000-ohm input impedance, DC-coupled, with a voltage-to-frequency relationship of 0.120 volt-per-kHz. A voltage swing of approximately 6.1 volts will sweep the frequency 3½ decades.
Size:	Approximately $5\frac{1}{2} \times 3 \times 6$ -inches

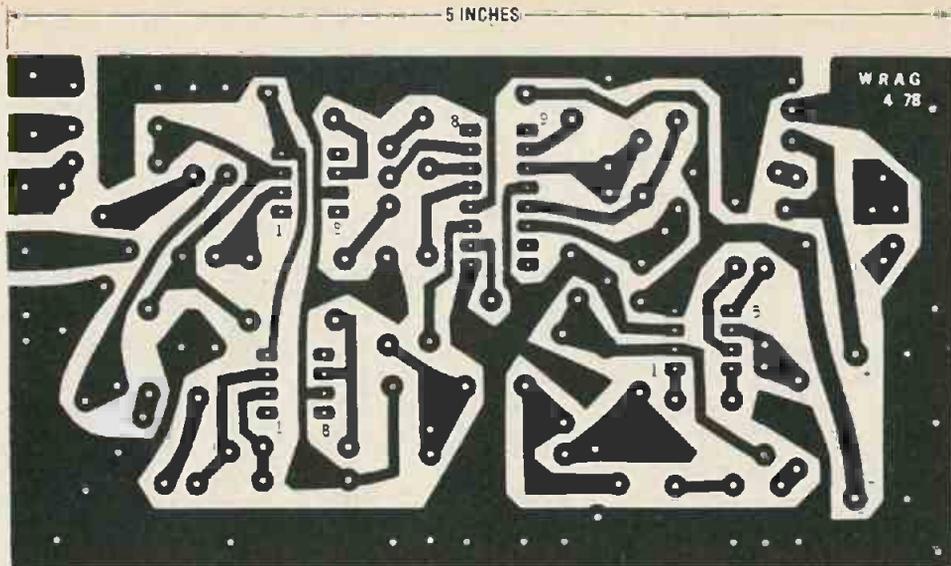


FIG. 3—FULL-SCALE reproduction of foil pattern of the Wide Range Audio Generator for those wishing to use PC board. Since parts placement is not critical, perforated board may also be used.

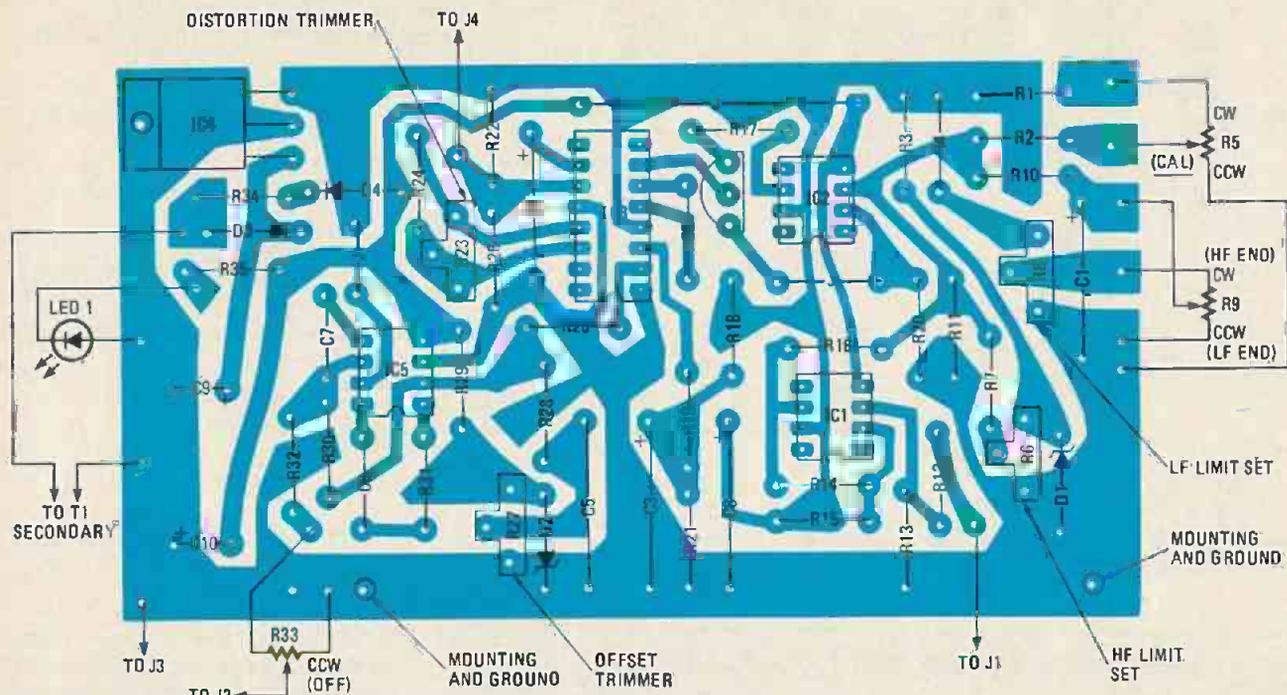


FIG. 4—PARTS PLACEMENT DIAGRAM for the Wide Range Audio Generator. Make certain that the polarities of diodes, transistors, IC's and electrolytics are observed!

2. The current that flows from its frequency-control point (pin 7) to ground.

To make the generator frequency respond to voltage instead of current, a voltage-controlled current-sink was added. It is shown as the voltage-to-current converter in Fig. 1. By referring to the schematic diagram of Fig. 2, you can identify its basic parts: op-amp IC2, R17, R20 and Q1.

The circuit design is such that the FET is inside the negative-feedback loop of the op-amp. Any current that flows out of the function generator's frequency-control point (pin 7) must also flow through the FET and the 1000-ohm resistor (R20) to ground. The positive voltage that is developed across the resistor is directly proportional to the current flowing through it

The op-amp supplies the same voltage across the resistor that it "sees" at its noninverting positive input.

This means that the current is proportional to the input voltage of the op-amp, and thus, we have a voltage-to-current converter. In this configuration, as the input voltage goes more positive, the frequency increases and vice versa. The voltage never goes negative with respect to ground.

Note the simple resistor summing bus connected to the input of the voltage-to-current converter. You can see from Fig. 2 that voltages from the frequency-control potentiometers and/or voltages from the VCF circuit will be summed and will affect the generator's frequency.

Both of the frequency-control potentiometers have positive voltage applied to

their elements. The voltage applied to the MAIN FREQUENCY control is set by trimmer R8, which determines the upper frequency limit. The lower frequency limit is set by trimmer R6, which adds a small positive voltage to the summing bus when both the frequency controls are in their fully counterclockwise position. The high-resistance value of R2 in the FINE FREQUENCY control circuit limits the frequency change to around 100 Hz, regardless of where the MAIN FREQUENCY control is set. The FINE FREQUENCY control has its full counterclockwise position labeled CAL (calibrated) to make the MAIN FREQUENCY dial calibration marks applicable.

The VCF stage consists of op-amp IC1 and several associated resistors. This stage is basically a noninverting amplifier with unity gain and an intentional DC

offset at its output. A voltage divider consisting of resistors R12 and R13 reduces the input signal level and also protects the op-amp. The output of this VCF stage feeds the summing bus and, of course, influences the generator frequency. The VCF input has a definite voltage-to-frequency relationship that works out to be 0.120 volts-per-kilohertz at any MAIN FREQUENCY control setting.

Now, let's look at the sinewave buffer/amplifier stage. Sinewave signals from pin 2 of the function generator are fed to

GENERATOR PARTS LIST

Resistors, 1/4 or 1/2 watt, 5%

R1, R14, R28—10,000 ohms
 R2—2.2 megohms
 R3, R4, R26, R29—2200 ohms
 R5, R9—5000 ohms, potentiometer, audio taper, panel mount (Radio Shack 271-1720 or equal)
 R6, R8, R23, R27—5000 ohms, trimmer, PC mount
 R7—220,000 ohms
 R10—R12, R16, R18; R21, R22—4700 ohms
 R13, R25—22,000 ohms
 R15—4.7 megohms
 R17, R20, R35—1000 ohms
 R19—47,000 ohms
 R24—330 ohms
 R30—56,000 ohms
 R31—1500 ohms
 R32—560 ohms
 R33—10,000 ohms, potentiometer, audio taper, panel mount with SPST switch (Radio Shack 271-215 or equal)

Capacitors

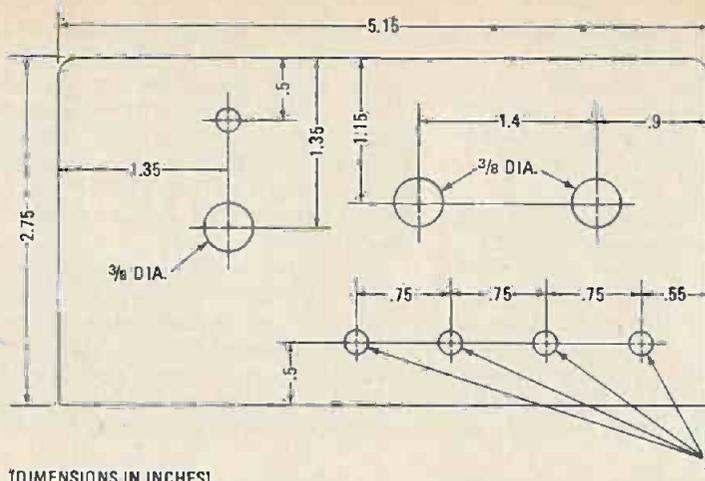
C1, C4—1 μ F, 25 volts, electrolytic, axial leads
 C2—.01 μ F, 50 volts, Mylar
 C3, C5, C8—22 μ F, 25 volts, electrolytic, axial leads
 C6—220 pF, 50 volts, Mylar or mica
 C7—10 pF, 50 volts, Mylar or mica
 C9, C10—1000 μ F, 25 volts, electrolytic, PC leads

Semiconductors

D1, D2—1N5231 or 1N751 Zener diode, 0.1 volts, 1/2 watt, 25% tolerance or better
 D3, D4—1N4001, rectifier diode, 50 PIV or better, 1 amp
 Q1—MPF102 FET transistor (Motorola)
 IC1, IC2—LM307
 IC3—XR-2206 (Exar), see Market Center ads in back of magazine
 IC4—LM340-15 or 7815 3-terminal voltage regulator, T-220 case
 IC5—LM709
 LED1—MV5020 or similar general-purpose type

Miscellaneous

T1—power transformer, 12-14 volts secondary, 500 mA
 S1—part of R33
 J1, J2, J4—RED Insulated banana jack or 5-way binding post
 J3—BLACK Insulated binding post or 5-way binding post
 Cabinet—Radio Shack 270-253 or equal
 Knobs—2 Radio Shack 274-415 or one 274-391
 IC sockets, line cord, small angle brackets, hookup wire, etc.



(DIMENSIONS IN INCHES)

FIG. 5.—DRILLING GUIDE for location of front panel components (not drawn to scale). Use masking tape over drilling areas to avoid scratching the finished surface.

the inverting (negative) input of op-amp IC5 through resistor R25. Feedback resistor R30 sets the gain of this stage at 2.5, which is adequate to produce an output of around 4.5 volts RMS (into an open-circuit load).

Trimmer R27 and its associated Zener diode, capacitor and resistor comprise a negative voltage system to null out or offset the positive DC component present at the sinewave-output point on the function generator. This adjustment is normally set so that the sinewave output of the instrument has a zero DC component.

The values of compensation capacitors C6 and C7 were chosen to give the amplifier stage a flat frequency response well beyond the 50-kHz upper limit of the instrument. Trimmer R23 provides a means of adjusting the sinewave for minimum distortion.

Note that the squarewave signal from the function generator is fed directly to its output terminal. Resistors R22 and R26 limit the peak voltage to around 4 volts, which is adequate to drive TTL circuits.

The power supply is fairly conventional, using a 12-15-volt transformer and two half-wave rectifiers to produce both positive and negative voltages. The positive voltage of around 20 is fed to a three-terminal voltage regulator (IC4) that produces a stable +15 volts. The negative voltage from the rectifier system is left unregulated, and, among other functions, it provides current for the LED pilot light.

Most of the other components we have not discussed yet are used for stability and biasing purposes.

Construction

Several construction methods are open to you. You can choose either the perforated-board, or the PC-board methods; however, the following information will, for the most part, apply to PC-board construction.

If you decide on using a PC board, you

can construct your own board using the foil pattern shown in Fig. 3.

If you plan to drill the circuit-board holes, a No. 60 drill bit works well for all the holes, except for the trimmer potentiometer holes, which should be drilled with a No. 55 bit. You will also need a 1/4-inch bit for the voltage-regulator mounting hole and the two circuit-board mounting holes.

After the drilling has been completed, thoroughly burnish the copper foil with fine sandpaper or steel wool to remove any photo-resist and tarnish.

Soldering should be done with a high-grade 60/40 solder and a pencil-type soldering iron with a 35-watt/650°-700° rating.

Take special care to properly install polarized components such as diodes, transistors, IC's and electrolytic capacitors. If you carefully follow the parts-placement diagram in Fig. 4, you should have no problem.

Sockets or Molex pins are recommended for installing the IC's. The IC's can be soldered in place, but with a sacrifice in their serviceability. Jumper wires should be made of around 22-gauge, solid, tinned wire and installed on the component side of the PC board.

When all the components have been installed on the board, it is wise to make a final close inspection to confirm the parts are properly placed and the soldering is complete. The board is now ready for installation in the cabinet and for testing and adjustment.

You may want to make some preliminary tests and adjustments on the circuit board out on the bench, by temporarily wiring the transformer, potentiometers, output terminals, etc., to the board; or you may want to install all the parts into the cabinet with the board in its finished form. In either case, you should use the following testing and adjustment procedure.

Testing and adjustment

The testing and adjustment procedure

requires a VTVM or DMM along with an oscilloscope and a frequency counter; however, if you don't own a counter or an oscilloscope, we'll show you a few tricks near the end of this article on how to adjust your instrument using only a meter.

Let's assume, however, that you have all the desired equipment. Connect the meter (set to the 5-10 VAC range), oscilloscope and counter to the sine-wave output point on the circuit board. Preset all trimmers to their mid-range and apply power. If the LED pilot light has been wired, it should glow, indicating that the power supply is probably working correctly.

The oscilloscope should display a sine-wave (possibly distorted) that varies in frequency as the MAIN FREQUENCY control is turned. Use this control to set the frequency to around 1 kHz as indicated on the counter, and adjust distortion trimmer R23 to produce a sine-wave that "looks normal" on the oscilloscope. If you're a "purist," a distortion meter will achieve this adjustment best, but eyeballing works for most of us. At this point the meter should indicate a sine-wave level of around 4.5 volts that the oscilloscope will show as around 13 volts P-P.

If your oscilloscope is DC-coupled, adjust trimmer R27 for zero DC offset on the sine-wave. Next, use the oscilloscope to check the squarewave, it should look symmetrical and have a peak positive amplitude of around 4 volts.

Now, turn the MAIN FREQUENCY and FINE FREQUENCY controls to their full counterclockwise position (lowest frequency), and adjust low-frequency limit trimmer R6 for a 10-Hz frequency, as shown on the counter. Then, turn the MAIN FREQUENCY control to its full clockwise position, and adjust high-frequency limit trimmer R8 for a 50-kHz frequency. Check the range of the FINE FREQUENCY control. This control should vary the frequency around 100 to 200 Hz, regardless of where you set the MAIN FREQUENCY control.

Because of interaction between the low- and high-frequency limit adjustments, it may be necessary to repeat the adjustments several times. Also, if you have trouble getting the instrument to work at 10 Hz, try interchanging IC1 with IC2. This may provide a "better" op-amp in the somewhat critical voltage-to-current-converter circuit.

Once these upper and lower frequency-limit adjustments have been made, then you can place calibration marks on the MAIN FREQUENCY control knob. It's advisable for the instrument to be in its final form for this step.

The prototype unit was calibrated using small letters and a corresponding chart to identify the various frequencies. This system works well for many applications; however, you will have to decide on how many frequency-point markings you

will need or perhaps you may want to use conventional fine-line marks with their corresponding frequencies on the dial itself. You can obtain the press-on letters and numbers for this from most electronic-supply distributors or hobby-craft stores. To protect the lettering, apply several coats of clear acrylic lacquer on the front panel.

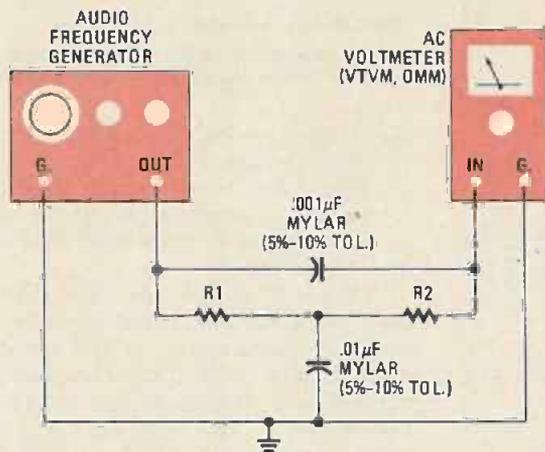
You can use the drilling guide shown in Fig. 5 to position the front-panel components. You will probably have to construct some angle brackets to mount the circuit board to the cabinet. Keep in mind that these brackets must hold the board so that its bottom edge is very close to the

cabinet floor, because otherwise the top edge of the board won't allow the cabinet cover to fit properly.

Make sure to expose some bare metal on the floor of the cabinet in the area around the angle brackets so as to ground the circuit-board foil to the cabinet for shielding purposes.

In our model, the LED pilot light/dial indicator was mounted in a small vinyl grommet and secured with glue, but you could use a standard LED mounting clip just as easily.

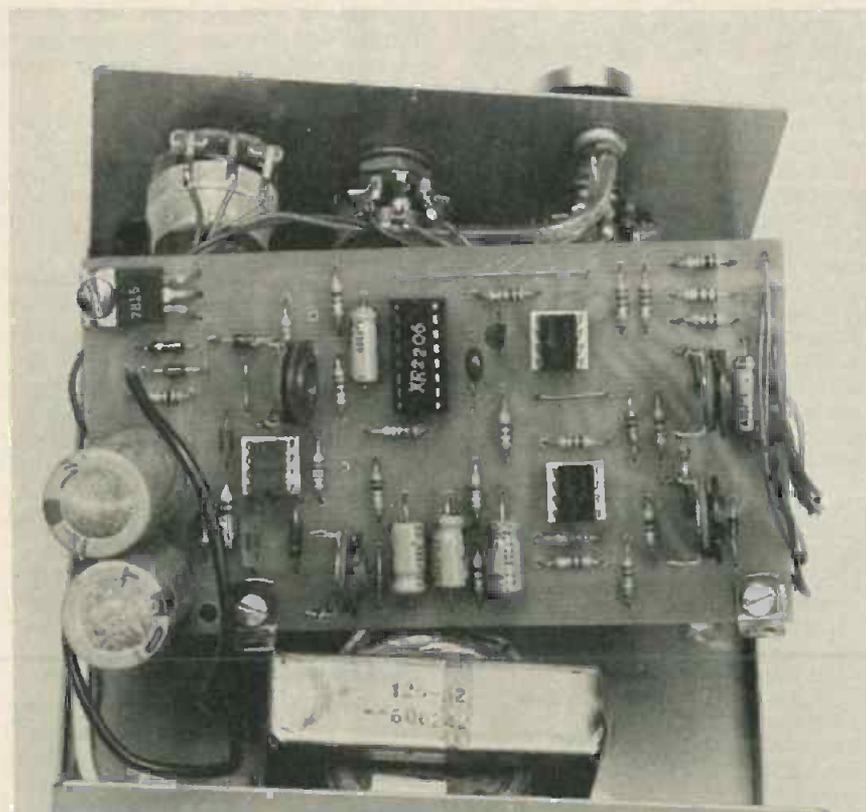
Although the Radio Shack cabinet (described in the Parts List) comes in attractive colors, you may want to repaint it to



NOTCH FREQUENCY		R1	R2
10	Hz	5.1 M	5.1M
22	Hz	2.4 M	2.4 M
34	Hz	1.5 M	1.5 M
51	Hz	1 M	1 M
82	Hz	620K	620K
130	Hz	390K	390K
190	Hz	270K	270K
220	Hz	240K	240K
340	Hz	150K	150K
510	Hz	100K	100K
820	Hz	62K	62K
1300	Hz	39K	39K
1900	Hz	27K	27K
2200	Hz	24K	24K
3400	Hz	15K	15K
5100	Hz	10K	10K
8200	Hz	6.2K	6.2K
13	kHz	3.9K	3.9K
19	kHz	2.7K	2.7K
22	kHz	2.4K	2.4K
34	kHz	1.5K	1.5K
51	kHz	1K	1K

R1 & R2: 5% OR BETTER, ¼ OR ½ WATT.

FIG. 6—DIAGRAM AND COMPONENT TABLE for use in construction of bridge network for calibrating Wide Range Audio Generator with only VTVM or DMM.



COMPLETED CIRCUIT BOARD prior to installation in cabinet. Note angle brackets at bottom of board for mounting purposes. The use of lockwashers is a good idea.

Useful hints

Here are a few miscellaneous hints you might find useful:

Although the Parts List calls for audio-taper-type potentiometers for the MAIN FREQUENCY, FINE FREQUENCY, and OUTPUT LEVEL controls, you can substitute linear-taper controls for at least the FINE FREQUENCY and OUTPUT LEVEL controls. The MAIN FREQUENCY control could also be a linear type, but the low-frequency end of the dial calibration would be so compressed that the marks would be difficult to read and the frequency hard to adjust.

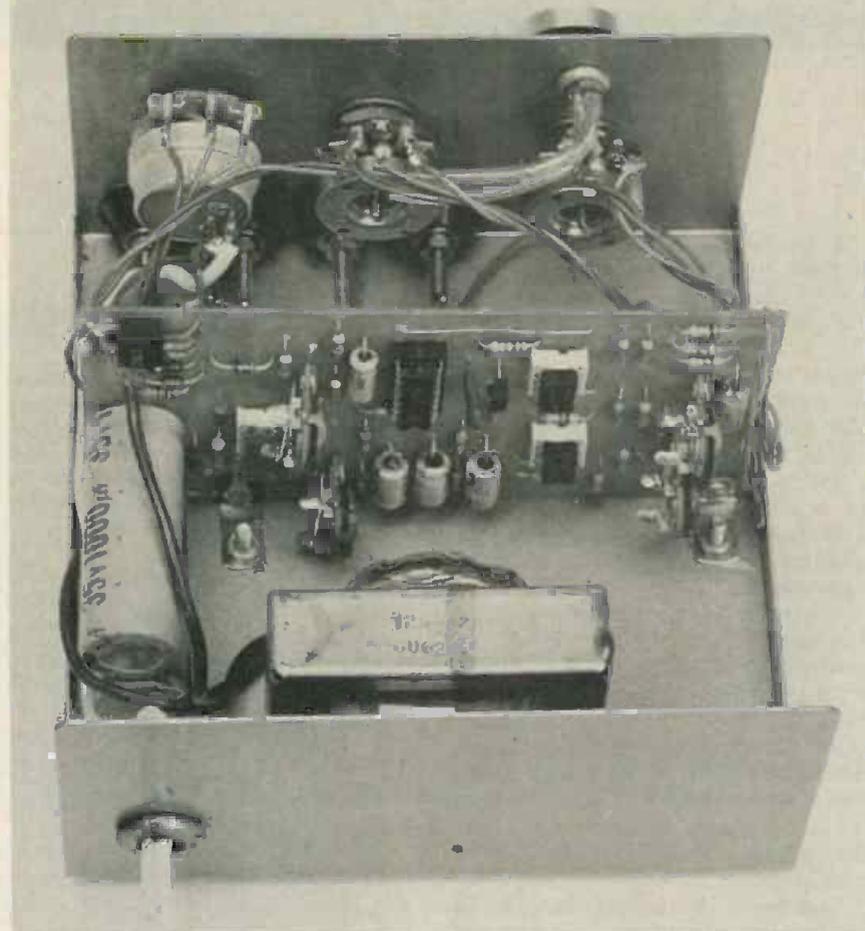
Because most AC meters (as well as some oscilloscopes and counters) work poorly at a 10-Hz frequency, try using an LED as a frequency indicator when calibrating the MAIN FREQUENCY dial at its counterclockwise, 10-Hz end. To do this, simply connect an LED to the sinewave-output terminals and adjust the output level high enough to provide a bright illumination. With the MAIN FREQUENCY dial set to its full counterclockwise position, slowly adjust low-frequency limit trimmer R6 to the highest frequency you can comfortably count by observing the LED flicker; this frequency will be about 4–6 Hz. Then, adjust trimmer R6 to slightly increase the frequency, just to the point where the LED flickers are beyond what the eye can follow, and the frequency will be close to 10 Hz.

When you wire the LED pilot light indicator, remember that the terminal closest to the flattened edge connects to R35 on the circuit board, and the other terminal connects to ground.

You can check the squarewave output without an oscilloscope by using a DC voltmeter. If all is correct, the meter will measure about +2 volts (if the waveform is four volts peak-to-peak, the portion of the waveform measured by a DC meter will be two volts). Also, the sinewave DC offset can be adjusted by connecting the DC voltmeter to the sinewave output and setting OFFSET TRIMMER R27 for zero DC on the meter.

If you want the instrument to cover a different frequency range from that specified here, you can do this easily by simply adjusting the low-frequency and high-frequency limit trimmers. For example, you can set the frequency range for 20 Hz–20 kHz, or 50 Hz–10 kHz, or other frequencies. Changing the value of C2 allows a 3¹/₂-decade spread in a different part of the frequency spectrum; for example, if C2 is changed to 0.005 μ F, the frequency can be set for 20 Hz–100 kHz; or if C2 is 0.1 μ F, the frequency range will be 1 Hz–5 kHz. So, by changing either the frequency limits or the value of capacitor C2, the instrument's frequency range can be altered to suit your needs.

With these hints, you should have no trouble at all in calibrating your instrument properly. R-E



INTERIOR VIEW of fully-assembled unit showing details of point-to-point wiring. Angle brackets should contact bare metal in cabinet to assure good ground for shielding purposes. Binding posts are located just beneath front panel controls.

cover up the small nicks and scratches that usually occur during drilling. This repainting also gives the instrument a customized look, and it seems to make the press-on lettering procedure work better. A tilt-up stand was made from an old rack panel handle mounted with two angle brackets.

Calibration without a counter

As promised, here are a few ways to calibrate the frequency dial without using a frequency counter.

If you have a well-calibrated signal generator and an oscilloscope, why not try the old Lissajous-pattern method of identifying an unknown frequency by comparing it with a known frequency? To do this, simply feed the known frequency signal to the vertical or Y-input of the oscilloscope, and feed the unknown frequency signal to the horizontal or X-input of the oscilloscope; then, when the unknown signal matches the known signal, you will observe a stationary or a slowly turning circle or ellipse pattern.

If your oscilloscope is a more professional model with a triggered, calibrated timebase, you can measure the unknown frequency (f_x) by reading the period or time of one or more cycles of the wave-

form, and then calculating the frequency by using the formula, $f_x = 1 \div t$ where t is the time interval measured in seconds (on the scope screen) of one complete cycle.

And here is another method to use if your *only* means of calibration is a VTVM or DMM:

This method uses a simple bridged-T network that acts as a notch filter or attenuator at its known resonant frequency. By connecting it between the generator's output and the voltmeter's input (as the unknown frequency is varied), it can be identified by the definite dip or null that appears on the voltmeter as the unknown signal approaches and reaches the known resonance of the filter.

Construct the network using the diagram and frequency-determining resistor chart shown in Fig. 6. Lay it out in such a way that you can easily change the resistors, which will be necessary to change the various resonant frequencies. Use as close-tolerance components as possible. The chart shown in Fig. 6 lists the resistors needed to produce 22 useful resonant frequencies. Connect the filter as shown in Fig. 6, and you should be able to identify at least these 22 frequency points on the instrument's dial.

STEREO REMOTE CONTROL UNIT

THIS IDEA DESCRIBES A PASSIVE STEREO remote-control unit. Nothing is more aggravating than to relax for the evening in your favorite chair, intent on enjoying your stereo system—and then the telephone rings, or someone comes to the door. That requires you to get up, dash to the stereo to turn the volume down, and then dart to the phone or the door. The unit described here eliminates the problem. Merely turn the volume down on the control beside your armchair, then attend to the disturbance. The control also eliminates the constant getting up and down to raise the volume for your favorite programs. Another handy feature is the remote balance control that permits you to achieve perfect stereo sound, regardless of where you are situated in the listening area.

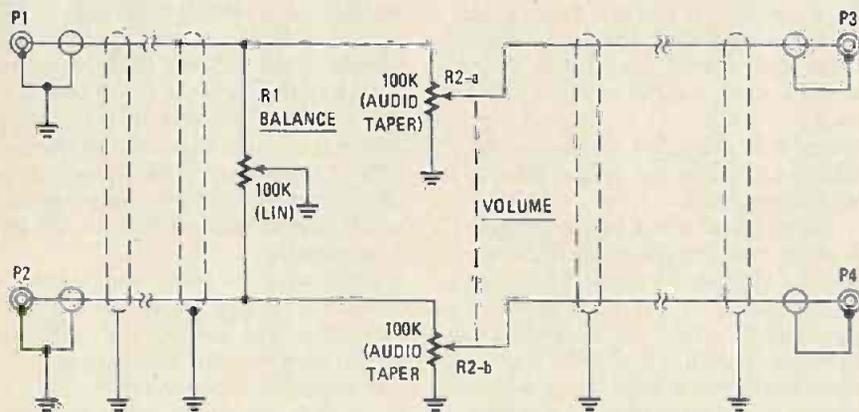
The remote-control unit takes advantage of the versatility of today's stereo components. It is connected between the preamplifier and power amplifier, or in the tape-monitor section—depending upon the configuration of your stereo system. The entire project can be built for about \$10.00:

The connecting cables used were two shielded two-conductor cables tied together. That turned out to be a quite flexible and compact bundle. The cables used were 15 feet long, but they could be up to 30 feet long without producing any drastic sound degradation. Be sure to terminate the stereo end of the cables in the proper connections.

The enclosure used for the project is a $2\frac{1}{4} \times 4 \times 1\frac{1}{2}$ inch plastic utility box. The aluminum cover was brushed and aluminum knobs were used to match the stereo system.

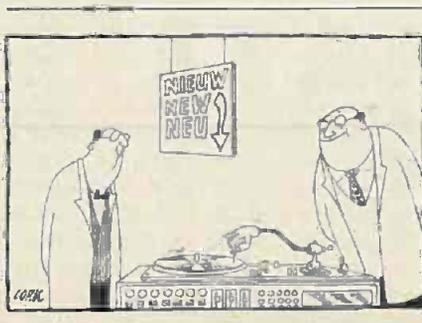
The performance of the remote control unit turned out to be quite good. The crosstalk is -62dB at 1 kHz and -55dB at 20 kHz. The frequency response was totally unaffected for all practical purposes. Some experts claim that it is less detrimental to the sound quality of the system to extend the lead length between the preamplifier and power amplifier than it is to extend the speaker leads of the system.

That project has turned out to be an indispensable part of my stereo system and I am quite sure that it will be just as desirable for others, too, once they try it.—Dennis Eichenberg R-E



P1,2,3,4 - RCA TYPE PHONO PLUGS (OR WHATEVER IS COMPATIBLE)

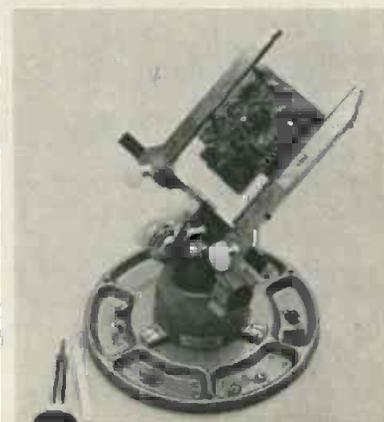
The complete schematic diagram of the project is shown in Fig. 1. Both of the potentiometers used in the project were found in a potentiometer assortment obtained from a mail order outfit, although similar types can be purchased almost anywhere. An alternative to the two potentiometers would be a joy-stick control wired with one side potentiometer used for each channel and the front or rear potentiometer to be used for the balance control.



NEW IDEAS

This column is devoted to new ideas, circuits, device applications, construction techniques, helpful hints, etc.

All published entries, upon publication, will earn \$25 plus a Circuit Board Holder, Standard Base and Tray Base Mount from Panavise Products, Inc. (See photo below.) Selections will be made at the sole discretion of the editorial staff of Radio-Electronics.



I agree to the above terms and grant Radio-Electronics Magazine the right to publish my idea. I declare that the attached idea is my own original material and that its publication does not violate any other copyright. I also declare that this material had not been previously published.

Title of Idea

Signature

Print Name

Date

Street

City

State

ZIP

Mall your idea along with this coupon to:

New Ideas
Radio-Electronics
200 Park Ave. South
New York, NY 10003

Sony Wrote the Book on VTR— Now It's on Tape!

Until now, learning about video recorders meant poring over very technical textbooks—if you could find them. Or enrolling in a highly specialized school.

But with the new Sony Basic Video Recording Course, you can easily learn everything about video tape recording using video itself as a teaching tool. At your own pace, whenever it's most convenient for you. The Sony course clearly demonstrates the theory, operation and characteristics of every major VTR unit. Including EIAJ, Betamax, VHS, U-matic, Quad and SMPTE Types A, B and C.

You'll learn everything from the fundamentals of magnetism to the sophisticated processes used in color recording. And at the end of each lesson you'll find a thorough self-review test, so you can be sure you fully understand each subject before going on to the next one.

You can order a preview tape, individual tapes on a specific subject or the entire course in Betamax or U-matic format.

COURSE CONTENTS:

The course consists of eight color video cassettes ranging from 23 to 30 minutes in length and eight supplementary booklets:

1. ELEMENTS OF MAGNETIC RECORDING, 2. VIDEO RECORDING, 3. SCANNER SYSTEMS, 4. TAPE FORMATS, 5. TAPE TRANSPORTS, 6. SCANNER SERVOS, 7. LUMINANCE PROCESSING, 8. COLOR SIGNAL PROCESSING.

The Sony Basic Video Recording Course will make you an expert on video tape recording. Whether you already own, sell or service video equipment or just have an electronics background and want to understand how it really works—this course is what you've been waiting for.

It would be hard to find a better teacher than the leader in the field—SONY.



Sony Basic Video Recording Course

I'm interested in learning VTR technology. Please send me:

BASIC VIDEO RECORDING COURSE

(8 cassettes/booklets, customized album and binder supplied)

Betamax 1 hr. 2 hr. \$395.00
(Reg. price \$503.00)

¾" U-matic \$487.00

These prices available for limited time only. (Reg. price \$623.00)

INDIVIDUAL LESSONS

(Price per cassette/booklet)

Betamax 1 hr. 2 hr. \$61.00

¾" U-matic \$76.00

Circle lesson # and indicate quantity desired in space provided.

1, 2, 3, 4, 5, 6, 7, 8

PREVIEW TAPE

Betamax 1 hr. 2 hr. \$12.50

U-matic \$28.00

Add appropriate sales tax and \$1.75 per cassette (\$14.00 for complete course) for handling and shipping. (UPS in continental U.S. If outside, add \$15.00 for export charges, plus collect freight charges; special handling is extra.) Make check or money order payable to Sony Corporation. If charging to your Sony account, fill in number and enclose purchase order.

For phone orders, call: (213) 537-4300 Ext. 474 or visit your local Sony dealer.

We honor VISA or Master Charge via phone or mail.

Name _____

Address _____

City _____ State _____

Zip Code _____ Phone # _____



VISA/Master Charge Number _____ Exp: Date _____

Signature _____

Mail to: Sony Video Products Company, Tape Production Services, 700 W. Artesia Blvd., Compton, California 90220.

NOTE: Tapes returnable if defective when received. Please allow two weeks for delivery.

SONY VIDEO COMMUNICATIONS

Sony, Betamax and U-matic are registered trademarks of the Sony Corp.

CIRCLE 32 ON FREE INFORMATION CARD

MAY 1980 87

What is frequency companding and how will it jam more channels into the RF spectrum?
 HERB FRIEDMAN, COMMUNICATIONS EDITOR

UNLESS YOU'RE INTO READING THEORETICAL articles in the Journal of the Audio Engineering Society you have probably never heard of a device humorously called a *freakwee* (from *frequency*). It was originally intended to create high-pitched animation voices, such as the ones Walt Disney used for the Three Little Pigs when they sang "Who's afraid of the Big Bad Wolf." Notwithstanding the Three Little Pigs, Donald Duck, or Mickey Mouse, the *freakwee* is the latest tool for RF spectrum management—*spectrum management* being bureaucratic gobbledygook meaning "How in heck do we jam more channels into the RF spectrum."

The plain facts are that we are fast running out of frequencies for radiotelephone communications, and for several years we've been using all sorts of tricks to reduce the bandwidth required by a single channel. First, we restricted the bandwidth of AM stations; then we substituted SSB for AM, literally cutting the required bandwidth in half. For FM modulation, the FCC simply decreed "split channels" with a 5 kHz-maximum bandwidth. Yet with all this, we are gobbling up spectrum faster than we can free channel space.

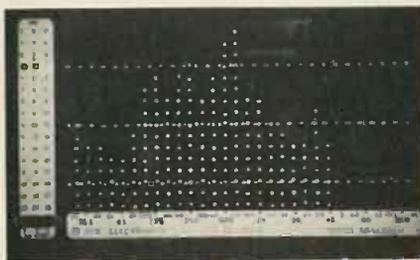


FIG. 1

The latest thoughts on spectrum management are to narrow the required bandwidth even farther through *voice frequency companding*, which is nothing more than the Hollywood animator's *freakwee* decked out in engineering expertise. A quick-and-dirty look at *companding* will give you a good idea of what to expect in communications for all services, probably including amateur and CB.

Let's start out with something we're all familiar with, SSB. You know that by varying either the receiver's tuning,

the frequency of any local oscillator or the BFO, will change the pitch of the received voice signal, yet the rate of speech—the syllabic rate—does not change. As the receiver is tuned towards the sideband frequencies the voice pitch increases, and the deepest *basso* can be changed to a lyric soprano by simply adjusting the tuning.

Now keeping this in mind, let's look at Hollywood. In the early days of ani-

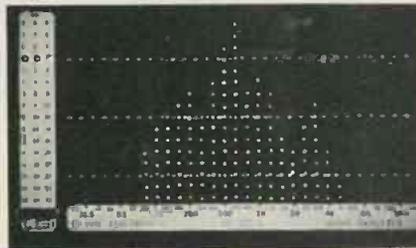


FIG. 2

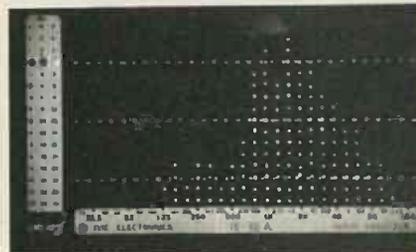


FIG. 3

imation the "pixie" voice was created by making a recording of a performer speaking or singing at a slower than desired syllabic rate: let's assume half the normal rate so the word SLOWLY was really spoken as S-L-O-W-L-Y. By playing the recording back at twice the normal speed the word would be reproduced at the "normal" syllabic rate while the pitch of the performer's voice would be twice normal—a "pixie" voice. Actually, Hollywood had no standard record/playback ratio, they used the one that worked the best, and music was rescored so the notes would be correct on playback.

As you might imagine, the procedure was cumbersome, taking much trial and effort to obtain the voice effects desired by the director.

Someone along the line, probably a radio amateur, realized that you could attain the same effect electronically

by simply combining an SSB exciter and receiver in the same cabinet, adjusting either the exciter or receiver's frequency to obtain special-effect voicing. Thus was born the *freakwee*, a device that can change the pitch of voice frequencies without changing the syllabic rate.

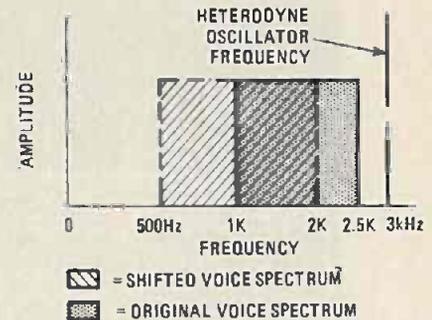


FIG. 4

If we split the *freakwee*, or whatever we chose to call the device, into two distinct sections called the frequency compressor and the frequency expander, we can compress the bandwidth during transmission, and expand it back to normal at the receiver. And this leads us directly to RF spectrum management and the *frequency compander*. (I bet that Walt Disney, for all his brilliance, never imagined that the Three Little Pigs would eventually provide the pathway for modern telecommunications.)

Normally, in SSB, there is no bandwidth compression. If the modulation frequencies are, say, 500 to 2500 Hz, the transmitted bandwidth is at least 2500 Hz. We get the frequency compression by giving up the voice frequencies not needed for intelligence and then sliding the required voice frequencies into the space of the unneeded frequencies, restoring the proper relationship at the receiver. It sounds complicated but it's easily understood by referring to Figs. 1 through 4.

Figure 1 is a photograph of a real-time analyzer's display of the voice frequencies of a male saying the word "follow". Note the considerable bass (low frequency) energy, and rather low high-frequency energy. Figure 2 is the same word, but the analyzer's response has been corrected to match the low frequency attenuation of the ear at "normal" listening level—virtually

continued on page 95

General Electric has just published your favorite book. Again.

We have added over 90 pages of MRO types and related information. And we have presented ICs in easier-to-use fashion than ever before. The latter are now shown in chart form and are grouped under various application headings—such as Preamps—in descending order of power dissipation.

As before, our unique parts ID numbering system tells you at a glance almost all you need to know when making a replacement.

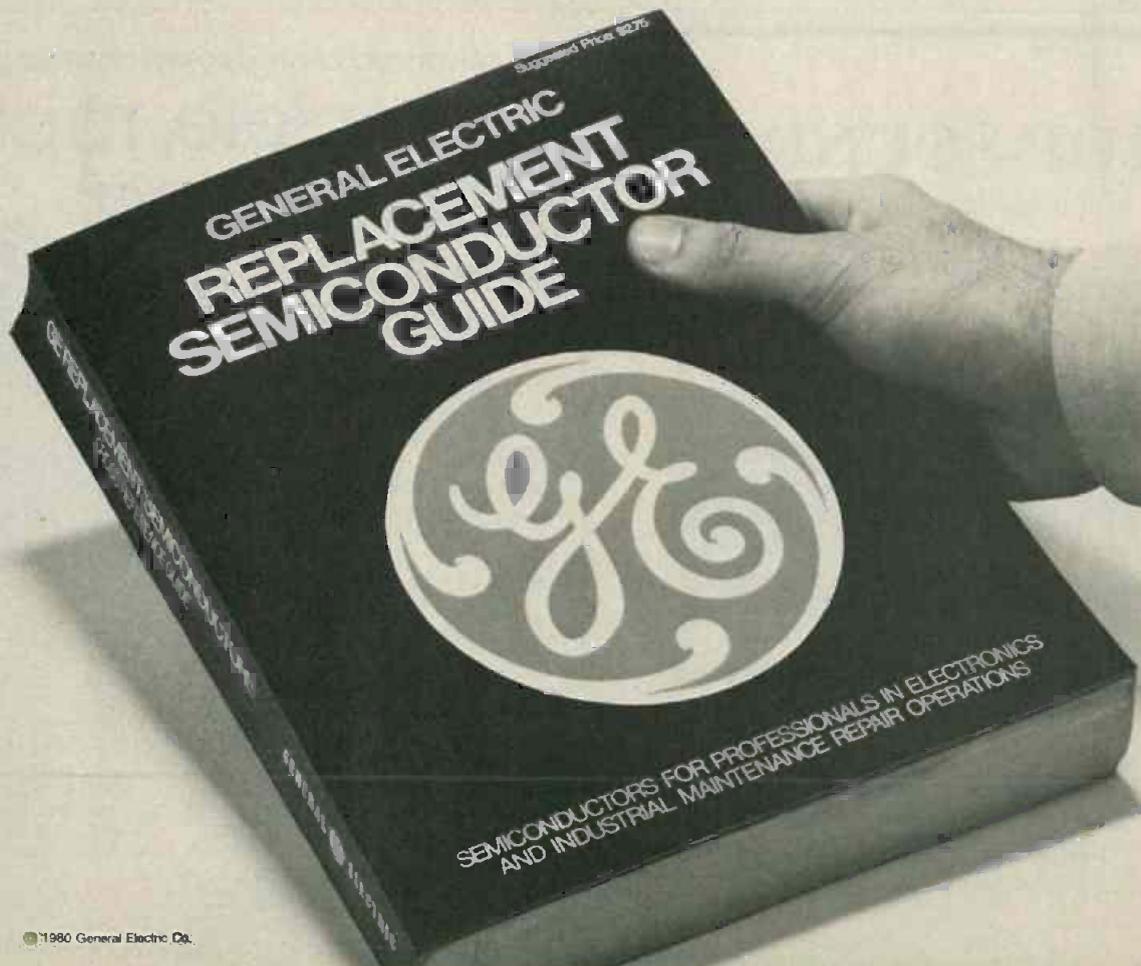
Thus, GE5ZD3.3 stands for a 5-watt, 3.3-volt zener diode by General Electric.

Keeping up with the industry is how General Electric helps you stay in touch. With technical literature like this updated Semiconductor Guide... and with the replacement parts you need for the equipment you service.

For your copy of the book you asked us to publish again, see your authorized GE distributor today.

Tube Products Department—Owensboro, Kentucky 42301

GENERAL  ELECTRIC



More information on radio products is available. Use the Free Information Card inside the back cover.

REGULATED CB POWER SUPPLY, model 1139. is a heavy-duty supply using integrated-circuit op-amp regulation to deliver 13.5 volts, 3 amps. Full circuit protection is provided by military-



CIRCLE 111 ON FREE INFORMATION CARD

grade transistors, a foldback circuit for overload sensing, plus an automatic over-temperature protection circuit. Ripple is maintained within a

10-mV level. Suggested retail price: \$27.95.—Gold Line Connector, Inc., 992 Danbury Rd., Georgetown, CT 06829.

MOBILE TRANSCEIVERS, the VHF model C890L02R (25 watts) and the UHF model C790L02R (15 watts), each incorporate a "mini-



CIRCLE 112 ON FREE INFORMATION CARD

control head" that permits remote mounting of the main transceiver module. Included in the head are a channel switch and an on-off switch, a channel-busy light and squelch control. The model C890L02R operates in the VHF frequency band between 150.8 MHz and 175 MHz, and the model C790L02R operates in the UHF frequency and between 450 MHz and 512 MHz. Both of these transceivers operate from an input voltage of 13.8 VDC. Suggested retail prices: model C890L02R, \$499; model C790L02R, \$839.—Standard Communications Corp., Box 92151, Los Angeles, CA 90009.

GENERAL COVERAGE RECEIVER, model DR101, is designed so that the user can scan at any speed any part of the frequency range



CIRCLE 113 ON FREE INFORMATION CARD

between 50 kHz and 29.7 MHz. When the desired station is heard, scanning may be stopped and the frequency monitored. Scanning is done in 100-Hz increments at any desired rate between

TOP-SOUND DS

An easy-to-build super organ!

Free large color catalog!



Electronic organs and kits

Postbox 2109/RE, D 4950 Minden
West—Germany

CIRCLE 27 ON FREE INFORMATION CARD

An advanced alloyed solder absorbing wick...

Complete, rapid desoldering

with GC
Sprig 6S Wick™

Provides these advantages over conventional desoldering wicks:

- Absorption starts immediately, preventing damaging heat build up
- Rapid action results in high production rate, less wick usage, cost savings
- Patented, alloy treated wick, vacuumized for flawless surface
- Non-corrosive, non-hygroscopic, non-conductive
- Unlimited shelf life
- Meets or exceeds government, military, and industrial standards.



Available in three widths for fine, medium, or heavy work; and in technician and industrial reel lengths.

Available in the U.S.A. exclusively from GC Electronics — and from your nearby GC industrial distributor.



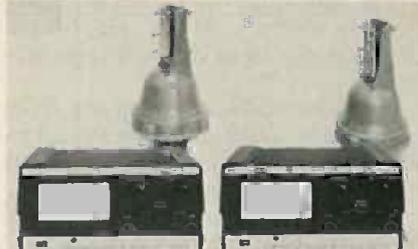
GC ELECTRONICS

400 S. Wyman Street, Rockford, IL

CIRCLE 49 ON FREE INFORMATION CARD

100 Hz-per-second to 2 MHz-per-second. Any combination of reception mode (AM, SSB or CW) and IF filter (ceramic or Collins mechanical) may be used while scanning or monitoring. Price is \$1,150.00.—McKay Dymek Co., 111 S. College Ave., P.O. Box 5000, Claremont, CA 91711.

ANTENNA ROTOR SYSTEMS, models Ham IV and CD-45; the model Ham IV (on the right) is designed for tower-mounted arrays with a 15.0-square-foot wind load area, and features power braking, steel gears, and dual-transformer circuits. The model CD-45 (on the left) handles antenna arrays of up to 8.5-square-foot wind load area when tower-mounted, and has an illuminated readout, all-steel drive and automatic disc



CIRCLE 114 ON FREE INFORMATION CARD

braking. Both units operate at safe voltage levels. Suggested retail prices: the model Ham IV, \$198.00; the model CD-45, \$109.95.—Cornell-Dubilier Electric Corp., 150 Avenue L, Newark, NJ 07101.

CB MICROPHONE, Model K40, contains a speech processor circuit. It uses a circuit to separate the loud and soft portions and then amplifies only the soft portions. It compresses the loud



CIRCLE 115 ON FREE INFORMATION CARD

portions if they are too loud. The new mike prevents splatter and provides gain without distorting speech. Features include an automatic sensitivity adjustment and a high-low tone switch for use in congested and open areas. The mike does not require a battery and attaches magnetically to any steel surface. Suggested retail price \$42.50.—American Antenna, 1945 South St., Elgin, IL 60120.

WEATHER ALERT RADIO, is a compact and lightweight unit designed to monitor both warning tones broadcast by the National Weather Service. It is crystal-controlled for reliable RF reception and the circuitry minimizes interference caused by outside objects. Other features are an FET front end, a switch allowing operation in either the ALERT or MONITOR mode, an emergency battery power supply, and a flashing red light

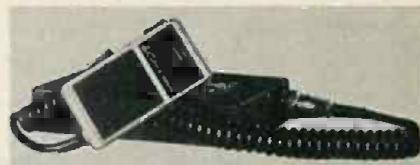


CIRCLE 116 ON FREE INFORMATION CARD

showing status of the battery. Price is \$199.00.—Motorola, inc., 1301 E. Algonquin Rd., Schaumburg, IL 60196.

REMOTE MOBILE CB RADIO, model 66GTL, is a 40-channel AM hideaway radio with the controls

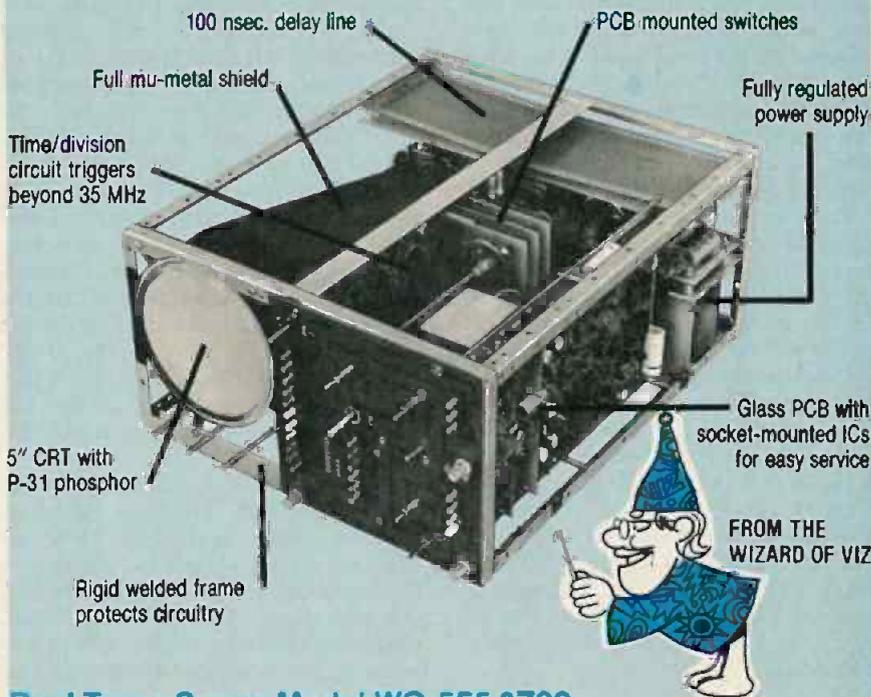
located in the microphone. These controls include an LED channel display and transmit/receive indicator, up/down channel selector, on/off switch volume control, squelch, RF gain, ANL, and an Instant Channel 9 switch. The remote



CIRCLE 117 ON FREE INFORMATION CARD

chassis measures 7 3/4 X 5 1/2 X 1 1/4 inches. Suggested retail price \$199.95.—Cobra Communications, Dynascan Corp., 6460 W. Cortland St., Chicago, IL 60635. R-E

Beauty Deep Down Inside



Dual Trace Scope Model WO-555 \$799

The 15 MHz scope with more accuracy, convenience, versatility and a broader voltage capability (DC thru 600V) than others costing more money. Calibrated X-Y capability. Built-in delay line allows for viewing the full input waveform. "Undershoot and overshoot" can be seen and analyzed. Unique simplified trig hold and adjustment control with LED indicator show trig polarity at a glance. Two direct/X10 LoCap probes supplied.

Also available:
Single Trace Scope, WO-527A, \$575



Beautifully functional
on the outside too

See your local VIZ distributor

VIZ VIZ Mfg. Co., 335 E. Price St., Philadelphia, PA 19144

Brightness problems and where to start checking first.

JACK DARR, SERVICE EDITOR

WE'VE JUST DONE A COUPLE OF COLUMNS on brightness-limiters (February and March 1980 issues.) Brightness problems, however, have been around for a long time before there were any brightness limiters! In general, brightness problems fall into two categories: too much, or too little.

As with all other stages, there are certain basic *key* tests that should always be done before making a diagnosis. There are some old basic reactions that are often overlooked. They key tests are reading *all* of the DC voltages on the picture tube. The fact is that this big bottle is just a plain *vacuum tube*, and works on the same principle that all the others do.

The key is the bias. If that is off, you've got problems. Make the grid of a tube too far negative with respect to the cathode, and it cuts off. No plate current flows. In a CRT, no beam-current. If the grid is too far positive with respect to the cathode, too much current flows and the tube is uncontrollable. In a CRT, the first problem cuts off the raster. The other makes it flare up; brightness can't be controlled even with the brightness control.

Let's look at some facts on raster cutoff problems. In all color picture tubes (and others for that matter), the bias is the voltage *difference* between the grids and cathodes. The cathode is always the reference point—the point to which all others are referred.

In many color-picture tubes, especially the older types, the cathodes will be at about +300 volts and the grids at about +200 volts. The net bias here is -100 volts. If anything happens to *either* voltage, the bias goes off value and upsets the brightness level.

Let's look at some actual problems. In one set the cathodes read +400 volts instead of +300 volts. The Grids were correct at +200 volts. No raster with the high-voltage OK. The higher voltage on the cathodes, instead of biasing the grids to -100 volts, biased the grids to -200 volts. The result was that the pix tube was cut off and no raster. The cause was a video-output tube with an open heater. If that tube draws no plate current, the B+ supply to the cathodes rises to the supply value. The plate current of the video-output tube is quite a bit greater than the beam-current (typically 1.5 mA for full brightness) of the picture tube. If the supply resistor or RF choke to the video-output tube plate opens, the tube does not draw any current and, of course, the bias level is upset.

In another set, we found the CRT cathode voltages high. The plate voltage of the video output was also high. Those circuits are almost always DC-coupled so that each one affects the other. In this one, tests showed that there was an open circuit between the cathode pin of the video-output socket and ground. In this

circuit, the contrast control was the cathode resistor. When varied, it moved the cathode-bypass capacitor nearer the cathode or farther away to control degeneration. The control itself was good, but the lead from chassis to the front panel was broken.

In a later-model set, using the RGB circuit where color and video are fed to the separate cathodes and all grids are common, the cathode voltages were OK, but the grid voltage was zero. The raster was cut off. The grids were supplied a DC voltage from B+ through a two-resistor voltage divider. The resistor to B+ was open. So, the grids were actually biased -200 volts and no raster. Incidentally if the ground-leg resistor had been open, the grids would have gone very high and the raster would flare; just the opposite reaction, but due to the same relationship between the voltages.

In the grid-voltage circuits, we ran into an odd one. The raster was out. Checking, we found the picture tube grids much too low; too far negative. The difference-amplifier tubes were drawing far too much plate current. The supply voltage and resistors were all normal. Further checking showed the cathode voltage (common to all three) was off value. Much lower than it should have been. That made the grids far too positive and the plate current too high, dropping the plate voltage.

The cause of that was an *open* coupling capacitor between the diff-amp cathode circuit and the horizontal blanker. Without the presence of the fairly high blanking pulse, which affected the total current-flow through the common cathode resistor, the bias went off. If you find that condition, scope for the presence of the blanking pulse on the cathodes of the difference-amplifiers.

One final case in the no-raster section. Not too common, but true. After checking around, we found that there was no focus voltage. No focus voltage at all, no raster. In a similar case, the diagnosis was easier; we could see great fuzzy blobs of color moving around on the screen. The focus voltage was down to about 1 kV instead of the normal 5 kV. In both of those cases, replacing the focus rectifier cleared up the problems.

Summing up; Whenever you run into problems associated with the brightness circuitry, be very sure to read *all* of the DC voltages on the picture tube (Don't forget the focus voltage!) It often helps to make a scratch-paper list of them and

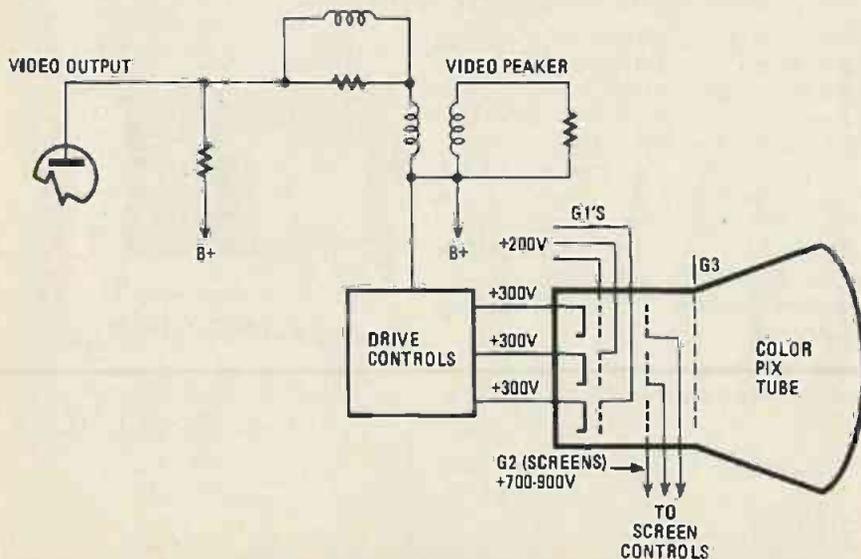


FIG. 3

then compare them with the voltages shown on the schematic. You must know what they should be, though! In one letter I received, a technician said "All of my voltages on the picture tube are off value! I measure only +200 volts on the grids when they should be +300 volts, and +300 volts on the cathodes when they should be +200 volts!" I pulled the schematic very quickly and looked. He was right; the schematic *did* say +200 volts on the cathodes and +300 volts on the grids! My schematic now has a note on it: Grid and cathode voltages *reversed*! Figure 1 shows the typical voltages found on the picture tube in practically all of the older color sets, and a lot of the new ones. It would be a good idea to memorize them, then you won't be booby-trapped as this poor feller was.

Next month we'll take up exactly the opposite problem: raster much too bright and flaring. R-E

service questions

VERTICAL JITTER

This Quasar has an intermittent vertical jitter, and pulls up from the bottom about an inch. Just got another one, same model—and it has the same problem! I've tried quite a few things, no luck. Help!—J.S., Newberry, SC.

There are two main suspects for this: one is a bad solder joint somewhere (be sure to check all ground connections on boards!) The second possibility is a resistor drifting under load. Both of these can sometimes be caught by heating/cooling things. Make sure that all socket contacts are very tight, too. Tubes, plugs and sockets, etc.

Scope the B+ lines feeding the vertical and sync stages. Look for signs of vertical-frequency pulses, indicating a bad filter. Also, before you go, try replacing that little 50-mF electrolytic capacitor in the vertical output cathode. This would seem to be in the convergence circuits, since the capacitor is over on the convergence board, but it's a vital part of the vertical output cathode circuit.

LED STEREO INDICATOR BLOWS DIODES

I've got one in for service now! It's a LED stereo level indicator, made by Formula International of California. Supposed to work up to 100 watts-per-channel. When I try it, I get up to almost full power, and it blows one of the diodes in the input! Schematic enclosed. Please help.—N.S., Virgin Islands.

Well, it's a good thing you sent the schematic! No listing of this in any of my data. That input circuit looks like a half-wave voltage doubler. They show IN60 germanium diodes used. These are rated

at only 30 volts PIV and 50 mA current: The most likely thing, it seems is that your voltage is too high at full power.

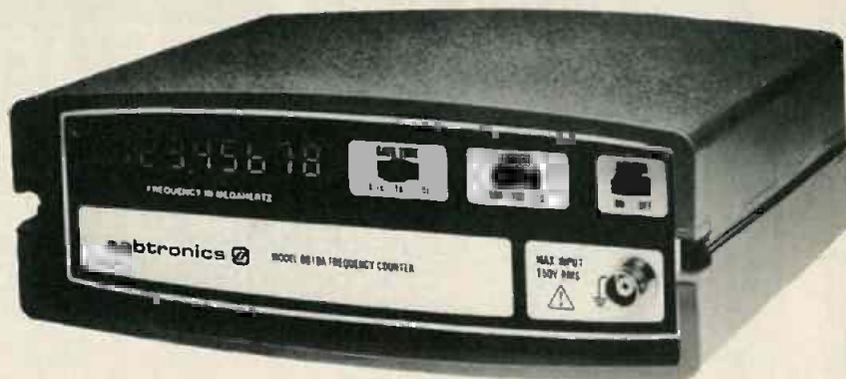
Try replacing these with stock silicon diodes; they ought to work well enough. Pick types with at least 100 volts rating, and something like 500 mA minimum current. While you're at it, make sure that both of those electrolytics are OK and matched.

NO HIGH VOLTAGE

We've got one that's simple, but we can't find it! Several men have had a run at it, and it isn't fixed yet! Problem: no high voltage, or none to speak of (about 1 kV). As you said, I tried a neon lamp near

the 1K3 high-voltage rectifier, and it glows brightly. Two new tubes did no good at all! We're still going in circles.—R.A.H., Ft Hood, TX.

Stop circling; that heat'll get you down. Now, you seem to have a case of RF on the high-voltage rectifier. The tube is OK. Try this; get a solid-state stick rectifier. RCA SK-3068, etc. Connect the anode of this to the 1K3 plate lead and the cathode to the high-voltage lead to the tube. Now check and see if you get high voltage. If you do, then you've got something wrong in the 1K3 socket. The tube probably isn't getting any heater voltage—bad socket contact, or something like that. R-E



Model 8610A 600 MHz Frequency Counter Kit Only \$99.95

Now you can forget about price/performance trade-offs when you select a frequency counter. In Sabtronics' Model 8610A you get all the characteristics of superior performance at a low, affordable price.

This frequency counter uses the latest LSI technology and has the performance and input characteristics you demand: guaranteed frequency range of 20 Hz to 600 MHz (10 Hz to 700 MHz typical); 3 gate times (0.1 sec., 1 sec., and 10 sec.); excellent sensitivity; resolution to 0.1 Hz; battery operated for portability and an accurate time base with excellent stability.

The 8-digit LED display features lead zero blanking, overflow indicator and gate activity indicator with automatic decimal placement. You would expect to find all these features only on high-priced lab instruments - or from Sabtronics advanced technology. Offering the best price/performance values has made Sabtronics one of the worlds' largest producers of Frequency Counters and Multimeters.

Making Performance Affordable

sabtronics INTERNATIONAL INC.

5709 North 50th Street, Tampa, Florida 33610
Telephone 813/623-2631

To: Sabtronics International, Inc., 5709 N. 50th Street, Tampa, FL 33610

Please send me

(qty) Model 8610A Frequency Counter kit(s) @ \$99.95 ea \$ _____
Shipping and Handling @ \$5.00 per kit * \$ _____
(qty) Model AC-120 AC Adapter/Charger(s) @ \$7.95 ea \$ _____
(qty) Model NB-120 NiCd Battery set(s) @ \$18.95 ea \$ _____
Florida residents add 4% Sales Tax \$ _____

TOTAL \$ _____

check money order Master Charge Visa.

Acct. # _____

Expiry Date: _____

(allow 2-3 weeks clearance time for personal checks), No C.O.D.

Name _____

Street _____

Apt. _____

City _____

State _____

Zip _____

*Continental U.S. only. AK, HI, PR: \$6.00. Canada: \$7.50. Foreign: \$21.00 (airmail).

**Blonder-Tongue's
new boosters are
making a lot of 'noise.'**

Disappear.

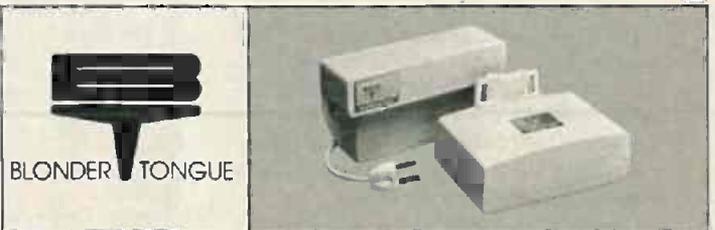
With the lowest noise figure on the market for a crisp, clean, clear T.V. reception.

Rather than a bigger, more expensive antenna, a booster may be just what your customers need to get a better picture. Your distributor can tell you. And when he does, ask him about the new line of Galaxy boosters from Blonder-Tongue.

He'll tell you they outperform any other booster made. With a lower noise figure which means less snow . . . a better picture.

So ask him all about the extraordinary new line of boosters Blonder-Tongue has just come out with. They're getting a great reception. Because that's precisely what they give.

Ask your electronics distributor for more information.



CIRCLE 62 ON FREE INFORMATION CARD

everything below 100 Hz is gone. Now it is a fact of hearing that the low frequencies provide the characteristic by which we recognize a voice—they contain little intelligence. It is the 500-to-2500 Hz range that carries the most intelligence. But look at Fig. 3, which is the same word spoken by the same male in a clear, distinct whisper; note how the energy is concentrated between approximately 1000 and 6300 Hz. Since there is little intelligence between 2500 and 6300 Hz we can eliminate everything above 2500 Hz. Now we're left with a band of frequencies approximately 1000-2500 Hz which is sufficient to convey information, and we have a "hole" between literally DC and 1000 Hz. For compression we slide the 1000-2500-Hz voice frequencies into the "hole", as shown in Fig. 4.

The "slide" is accomplished by beating the remaining voice frequencies against a 3000-Hz signal in a mixer. After filtering so that only the difference frequencies remain, we are left with the bandwidth of 500-2000 Hz representing the original bandwidth of 1000-2500 Hz. If the frequencies of 500-2000 Hz are used to modulate an SSB transmitter, the transmitted bandwidth is 500 Hz less than would be required for voice frequencies of 1000-2500 Hz.

At the receiver, the received 500-2000 Hz is again beat against a 3000-Hz signal that reinverts and expands the frequency range to 1000-2500 Hz, the original voice frequency bandwidth.

For simplification I have used nice round numbers and assumed a constant voice level. As shown in Figs. 1 through 3, however, the voice level is *not* constant. The actual voice energy to be companded will more closely resemble Fig. 3, the reduced high-frequency energy allowing us to slide the bandwidth even farther into the lower frequencies. Bandwidth savings up to 30% are feasible. In plain terms, that is translated into at least 12 additional CB channels in the space presently allotted to 40 channels. About 30% more QRM-free radiotelephone amateur radio frequencies, and certainly additional FM channel spectrum—though exactly how frequency companding will affect FM is unknown at this time.

With all the mixing and filtering required you can well understand why frequency companding had to wait for the IC and its large-scale integration. Figure a year or three and someone will come along with the entire compander system on one or two IC's. Come what may, when frequency companding does give us additional channel density for a given RF spectrum, keep in mind that it all started with the high-pitched voices of the Three Little Pigs. R-E

Explorer/85

100% compatible with all 8080A and 8085 software & development tools!

No matter what your future computing plans may be, Level "A"—at \$129.95—is your starting point.

Starting at just \$129.95 for a Level "A" operating system, you can now build the exact computer you want. Explorer/85 can be your beginner's system, OEM controller, or IBM-formatted 8" disk small business system... yet you're never forced to spend a penny for a component or feature you don't want and you can expand in small, affordable steps!

Now, for just \$129.95, you can own the first level of a fully expandable computer with professional capabilities—a computer which features the advanced Intel 8085 cpu, thereby giving you immediate access to all software and development tools that exist for both the 8085 and its 8080-1 predecessor (they are 100% software compatible)—a computer which features onboard S-100 bus expansion—plus instant conversion to mass storage disk memory with either 5-1/4" diskettes or standard IBM-formatted 8" disks.

For just \$129.95 (plus the cost of a power supply, keyboard/terminal and RF modulator, if you don't have them already), Explorer/85 lets you begin computing on a significant level... applying the principles discussed in leading computer magazines... developing "state of the art" computer solutions for both the industrial and leisure environment.

Level "A" Specifications

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an 8155 ROM-I/O—all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

Level "A" makes a perfect OEM controller for industrial applications and is available in a special Hex Version which can be programmed using the Netronics Hex Keypad/Display.)

PC Board: glass epoxy, plated through holes with solder mask
• I/O: provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader... provision for 24-pin DIP socket for hex keyboard/display... cassette tape recorder input... cassette tape recorder output... cassette tape control output... speaker output... LED output indicator on SOD (serial output) line... printer interface (less drivers)... total of four 8-bit plus one 6-bit I/O ports • Crystal Frequency: 6.144 MHz • Control Switches: reset and user (RST 7.5) interrupt... additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard • Counter/Timer: programmable, 14-bit binary • System RAM: 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems... RAM expandable to 64k via S-100 bus or 4K on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F800 leaving 0000 free for user RAM/ROM. Features include tape load with labeling... tape dump with labeling... examine/change contents of memory... insert data... warm start... examine and change all registers... single step with register display at each break point, a debugging/training feature... go to execution address... move blocks of memory from one location to another... fill blocks of memory with a constant... display blocks of memory... automatic baud rate selection... variable display line length control (1-255 characters/line)... channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling... examine/change contents of memory... insert data... warm start... examine and change all registers... single step with register display at each break point, a debugging/training feature... go to execution address... move blocks of memory from one location to another... fill blocks of memory with a constant... display blocks of memory... automatic baud rate selection... variable display line length control (1-255 characters/line)... channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling... examine/change contents of memory... insert data... warm start... examine and change all registers... single step with register display at each break point, a debugging/training feature... go to execution address... move blocks of memory from one location to another... fill blocks of memory with a constant... display blocks of memory... automatic baud rate selection... variable display line length control (1-255 characters/line)... channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

Netronics R&D Ltd., Dept. RE-5

333 Litchfield Road, New Milford, CT 06778

Please send the items checked below—

- Explorer/85 Level "A" Kit (ASCII Version), \$129.95 plus \$3 p&h.
- Explorer/85 Level "A" Kit (Hex Version), \$129.95 plus \$3 p&h.
- 8k Microsoft BASIC on cassette tape, \$64.95 postpaid.
- 8k Microsoft BASIC in ROM kit (requires Levels "B," "D," and "E"), \$99.95 plus \$2 p&h.
- Level "B" (S-100) Kit, \$49.95 plus \$2 p&h.
- Level "C" (S-100 6-card expander) Kit, \$39.95 plus \$2 p&h.
- Level "D" (4k RAM) Kit, \$69.95 plus \$2 p&h.
- Level "E" (EPROM/ROM) Kit, \$5.95 plus \$0.95 p&h.
- Deluxe Steel Cabinet for Explorer/85, \$49.95 plus \$3 p&h.
- ASCII Keyboard/Computer Terminal Kit (features a full 128 character set, upper & lower case, full cursor control, 75 ohm video output convertible to baudot output, selectable baud rate, RS232-C or 20 ma, I/O, 32 or 64 characters by 16 line format, and can be used with either a CRT monitor or a TV set (if you have an RF modulator), \$149.95 plus \$2.50 p&h.
- Hex Keypad/Display Kit, \$69.95 plus \$2 p&h.
- Deluxe Steel Cabinet for ASCII Keyboard/Computer Terminal, \$19.95 plus \$2.50 p&h.
- Power Supply Kit (±8V @ 5 amps) in deluxe steel cabinet, \$39.95 plus \$2 p&h.
- Gold Plated S-100 Bus Connectors, \$4.85 each, postpaid.
- RF Modulator Kit (allows you to use your TV set as a monitor), \$8.95 postpaid.
- 16k RAM Kit (S-100 Board expands to 64k), \$199.95 plus \$2 p&h.
- 32k RAM Kit, \$329.95 plus \$2 p&h.
- 48k RAM Kit, \$459.95 plus \$2 p&h.
- 64k RAM Kit, \$589.95 plus \$2 p&h.
- 16k RAM Expansion Kit (to expand any of the above up to 64k), \$139.95 plus \$2 p&h each.
- Intel 8085 cpu User's Manual, \$7.50 postpaid.
- Special Computer Grade Cassette Tapes, \$1.90 each or 3 for \$5, postpaid.
- 12" Video Monitor (10 MHz bandwidth), \$139.95 plus \$5 p&h.
- North Star Double Density Floppy Disk Kit (One Drive) for Explorer/85 (includes 3 drive S-100 controller, DOS, and extended BASIC with per-



registers... single step with register display at each break point... go to execution address. Level "A" in the Hex Version makes a perfect controller for industrial applications and can be programmed using the Netronics Hex Keypad/Display.



Hex Keypad/Display.

Hex Keypad/Display Specifications

Calculator type keypad with 24 system defined and 16 user defined keys, 6 digit calculator type display which displays full address plus data as well as register and status information.

Level "B" Specifications

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards and includes: address decoding for onboard 4k RAM expansion select-able in 4k blocks... address decoding for onboard 8k EPROM expansion select-able in 8k blocks... address and data bus drivers for onboard expansion... wait state generator (jumper select-able), to allow the use of slower memories... two separate 5 volt regulators.



Explorer/85 with Level "C" card cage.

Level "C" Specifications

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Explorer's deluxe steel cabinet, Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors

Level "D" Specifications

Level "D" provides 4k or RAM, power supply regulation; filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to FFFF in 4k blocks.

Level "E" Specifications

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

Order A Coordinated Explorer/85 Applications Pak!

Experimenter's Pak (SAVE \$12.50)—Buy Level "A" and Hex Keypad/Display for \$199.90 and get FREE Intel 8085 user's manual plus FREE postage & handling!

Student Pak (SAVE \$24.45)—Buy Level "A," ASCII Keyboard/Computer Terminal, and Power Supply for \$319.85 and get FREE RF Modulator plus FREE Intel 8085 user's manual plus FREE postage & handling!

Engineering Pak (SAVE \$41.00)—Buy Levels "A," "B," "C," "D," and "E" with Power Supply, ASCII Keyboard/Computer Terminal, and six S-100 Bus Connectors for \$514.75 and get 10 FREE computer grade cassette tapes plus FREE 8085 user's manual plus FREE postage & handling!

Business Pak (SAVE \$89.95)—Buy Explorer/85 Levels "A," "B," "C" (with cabinet), Power Supply, ASCII Keyboard/Computer Terminal (with cabinet), 16k RAM, 12" Video Monitor, North Star S-1/4" Disk Drive (includes North Star BASIC with power supply and cabinet, all for just \$1599.40 and get 10 FREE 5-1/4" mini-diskettes (\$49.95 value) plus FREE 8085 user's manual plus FREE postage & handling!

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE 800-243-7428

To Order From Connecticut Or For Technical Assistance, Etc. Call (203) 354-9375

sonalized disk operating system—just plug it in and you're up and running!)

- \$699.95 plus \$5 p&h.
- Power Supply Kit for North Star Disk Drive, \$39.95 plus \$2 p&h.
- Deluxe Case for North Star Disk Drive, \$39.95 plus \$2 p&h.
- Experimenter's Pak (see above), \$199.90 postpaid.
- Student Pak (see above), \$319.85 postpaid.
- Engineering Pak (see above), \$514.75 postpaid.
- Business Pak (see above), \$1599.40 postpaid.

Total Enclosed \$ _____
(Conn. res. add sales tax) By—
 Personal Check M.O./Cashier's Check Visa Master Charge
(Bank # _____)

Acct. # _____
Signature _____ Exp. Date _____
Print Name _____
Address _____
City _____
State _____ Zip _____

Send Me Information

new products

More information on new products is available. Use the Free Information Card inside the back cover.

MAGNETIC SCREWDRIVER, No. 70035, holds a choice of 4 interchangeable bits in place, including $\frac{1}{16}$ and $\frac{1}{8}$ -inch slotted bits and No. 1 and 2 Phillips. Also holds screws in place. Features a fatigue-free handle containing a storage compartment, and a tempered aluminum shaft. Price is \$6.70—Vaco Products Co., 1510 Skokie Blvd., Northbrook, IL 60062



CIRCLE 151 ON FREE INFORMATION CARD

DIGITAL MULTIMETER, model 2815, is a $3\frac{1}{2}$ -digit portable instrument featuring protection against RF interference. The unit retains accuracy in strong RF fields and as a result, can be used near two-way radios up to 450 MHz. This com-



CIRCLE 152 ON FREE INFORMATION CARD

compact system also offers high resolution, 0.1% accuracy, and excellent overload protection, resisting damage up to 1000 volts AC/DC peak.

Other features are a large LCD readout that can be used in sunlight, and auto zero and auto

polarity. The model 2815 is powered by a 9V battery and comes with test leads, tilt stand, operating manual and spare fuses. Price is \$150.—B & K Precision, 6460 W. Corland St., Chicago, IL 60635.

PRODUCTION CABLE STRIPPER, model 49A, is designed to give a clean strip in three seconds to both flat and round-conductor-type flat cable. Air pressure, controlled by pushbutton, holds the cable in place, then fractures and removes unwanted insulation. Can handle materials such as



CIRCLE 153 ON FREE INFORMATION CARD

polyester, silicon, rubber and even "hard-to-strip" Teflon and causes no heat damage. Measures $1\frac{1}{2}$ inches high X $1\frac{1}{2}$ inches wide X $1\frac{1}{4}$ inches deep. Price is \$2,150.—Carpenter Mfg. Co., Inc., Fairgrounds Dr., Manlius, NY 13104.

DIGITAL POWER SUPPLY/VOLTMETER, model DG-5, is intended for substituting and measuring critical control voltages for many electronic devices. The power supply has a 5-amp regulated output over the 0 to 30 VDC range, and 3 low-



CIRCLE 154 ON FREE INFORMATION CARD

current voltage supplies, 0-15 VDC at 50 mA, 0-20 VDC at 100 mA, and 0-30 VDC at 200 mA. The ± 200 volt meter can monitor the 4 output voltages, or an external voltage, with an accuracy to .05%. Price is \$269.95.—PTS Electronics, Inc., P.O. Box 272, Bloomington, IN 47402. R-E

DMMs from Keithley. Call your nearest distributor.

- ALABAMA**
Huntsville
PIONEER 205/837-8300
- ARIZONA**
Phoenix
METERMASTER 602/243-4111
Tempe
JENSEN TOOLS, INC. 602/968-6231
- CALIFORNIA**
Los Angeles
METERMASTER 213/895-4340
Palo Alto
METERMASTER 415/968-0313
San Diego
METERMASTER 714/560-4841
- CONNECTICUT**
Middletown
EIL/MANCIB DIVISION 203/346-8846
- FLORIDA**
Orlando
PIONEER 305/859-3600
Palm Bay
EIL INSTRUMENTS, INC. 305/725-8300
- ILLINOIS**
Chicago
METERMASTER 312/593-8650
PIONEER 312/437-9680
- INDIANA**
Indianapolis
PIONEER 317/849-7300
- MARYLAND**
Baltimore
PIONEER 301/792-7500
Gaithersburg
PIONEER 301/948-0710
Timonium
EIL INSTRUMENTS, INC. 301/771-4800
- MASSACHUSETTS**
Burlington
EIL/MANCIB DIVISION 617/272-9450
- MICHIGAN**
Ann Arbor
PIONEER 313/455-9090
Livonia
PIONEER 313/525-1800
- MINNESOTA**
Minnetonka
PIONEER 612/935-5444
- NEW JERSEY**
Fairfield
AMPOWER 201/227-7720
- NEW YORK**
Great Neck
INSTRUMENT MART 516/487-7430
Long Island
EIL INSTRUMENTS, INC. 516/231-8333
New York
ADVANCE 212/687-2224
Rochester
AMPOWER 716/377-1020
ELECTRONIC INSTRUMENT CORP.
716/328-4350
- NORTH CAROLINA**
Greensboro
PIONEER 910/278-4441
- OHIO**
Cleveland
PIONEER 216/587-3600
Dayton
PIONEER 513/236-9900
- OREGON**
Portland
WESTCON, INC. 503/283-0132
- PENNSYLVANIA**
Philadelphia
PIONEER 215/674-4000
EIL INSTRUMENTS, INC. 215/561-4090
Pittsburgh
PIONEER 412/782-2300
- TEXAS**
Dallas
PIONEER 214/386-7300
Garland
METERMASTER 214/271-5671
Houston
QUALITY INSTRUMENT LABS, INC.
713/524-0528
- VIRGINIA**
Alexandria
EIL INSTRUMENTS, INC. 703/354-4330
Virginia Beach
EIL INSTRUMENTS, INC. 804/449-3746
- U.S.A.**
ADVANCE ELECTRONICS 800/223-0474
(except New York)
AMPOWER 800/526-2514
(except New Jersey)

KEITHLEY

Our 130 DMM gives you 0.5% DCV accuracy, a 10A range, a bigger display, easier controls, and lighter weight.

With all the hand-held DMMs around these days, it can be tough to pick the one that's best for you. Some are just too basic; others have a lot of high-priced frills that you may not want. Our Model 130 Digital Multimeter makes that choice a lot easier because it was designed with your needs in mind.

Accurate. The 130 is five times more accurate than many comparably priced analog VOMs, and it also compares favorably with other, more expensive hand-held DMMs. Its basic 0.5% DCV accuracy is probably as much as you'll need outside of lab situations, so you don't have to pay for more than you want. That's long term accuracy—only one calibration adjustment is required, once a year.

Rugged. We built the 130 to be tough enough to take it in real-world situations. The case is 2.5mm (.100") thick and made of high

strength, impact resistant plastic. The LCD window is tough, scratch-resistant polycarbonate. The handsome faceplate is designed for maximum legibility and ease of use—all ranges and functions are color-coded and clearly marked.

And all components are on a single PC board that's mounted to the faceplate, permitting the vital electronics to "float" free of the backing and protecting them from jolts. Yet the whole unit weighs a mere 283g (10 oz.)—one of the lightest units around.

Easy to use. Our 15mm (0.6") LCD display is 60% larger than that of many other pocket DMMs. Both range and function are easily selected with one hand—no complicated pushbuttons. And a rear panel mounting screw lets you use the 130 while it's mounted to a stand or special holder, even without taking it out of its optional carrying case.

And that's no fluke.

Keithley quality. Like all Keithley products, precision components and user-oriented design are built right in to the 130. Full overload protection, a 10A current range, auto zero and auto polarity round out the list of standard features. And a full

line of accessories expands its capabilities to 40kV, 200A and 700MHz. But the real measure of Keithley value is how we give you all this performance at a sensible price.

KEITHLEY

Keithley Instruments, Inc.
28775 Aurora Road
Cleveland, Ohio 44139
(216) 248-0400

Now available through
your local distributor.



\$99

[CASE \$10.00]

U.S.A. price. Prices and specifications
subject to change without notice.

stereo products

More information on stereo products is available. Use the Free Information Card inside the back cover.

AMPLIFIER, model KA-501, is an integrated amp featuring high-speed circuitry. That allows the unit to react quickly to dynamic transient signals without the time-lag that causes distortion; it also produces a damping effect on speakers by controlling excessive speaker cone vibration. This high-speed circuitry has a risetime of 1.0 μ S and a slew rate of $\pm 100V/\mu$ S. Other features include peak-power meters, low-noise, low-distortion circuitry and two tape inputs for recording and monitoring tapes at the same time. *Model KA-501*



CIRCLE 131 ON FREE INFORMATION CARD

delivers 65 watts per channel with 0.03% THD. Price is \$375.—**Kenwood Electronics**, 15777 So. Broadway, Gardens, CA 90248.

CAR SPEAKER SYSTEM, Power Mag 94Z, is a system representing the first 6 x 9 three-way configuration that can handle power produced by the

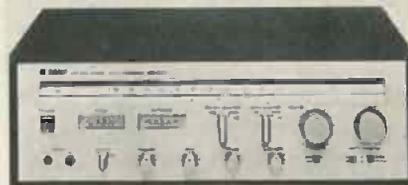


CIRCLE 132 ON FREE INFORMATION CARD

more sophisticated amplifiers. The speakers have a power rating of 125 watts RMS, a frequency response of 25 Hz to 40 kHz and a sensitivity of

93 dB. Features include reflective radiator array, a 40 oz. magnet, piezoelectric midrange and acoustic lens tweeter, bi-amp or conventional hookup, and a 10-year warranty. Price is \$185.—**Electronic Industries, Inc.**, 217 E. 171st St., Harvey, IL 60426.

RECEIVERS, model CR-440 and model CR-240, are two full-featured high-performance units. *Model CR-440* (shown) is rated at 30 watts per channel with 0.02% THD and has two tuning



CIRCLE 133 ON FREE INFORMATION CARD

meters: for signal strength, and zero-center tuning. Other features include a DC amp, visible heat sink, and a continuously variable loudness control. It also has a rec out selector that allows recording from one source while listening to either that or another source. *Model CR-240* is *continued on page 100*

YOU DESERVE IT! GET IT EVERY MONTH!

Come on, treat yourself—and save money, too. Subscribe to Radio-Electronics today, and make sure you get all of the most interesting, most exciting and authoritative electronics reporting in any magazine, month after month. Don't miss a single one of the upcoming issues jam-packed with new-equipment test reports, projects to build, servicing ideas, and news of solid state, computers, hi-fi, hobbies and everything electronic. Save money, too—as much as \$5. off the newsstand price when you subscribe to Radio-Electronics. Come on, you deserve it—check off the money-saving offer you prefer on the handy coupon, and start enjoying Radio-Electronics every month.

Radio-Electronics PROTECT YOUR CAR AGAINST AUTO THEFT

Build a backyard satellite TV receiver
14 nifty things you can fix with a PRAM IC
Build a thunderstorm alarm

How far 1000 TV sets
How super class A hi-fi amplifiers
Circuits that talk back



NIFTY WIRE-WRAP TRICKS

Get The Authority—Every Month

40EO

Name (Please print) _____

Address _____

City _____

State _____

Zip _____

Indicate the offer you prefer:

1 Year—12 issues ONLY \$13.00
(You save \$2.00 off newsstand price.)

Payment enclosed (send one extra issue)

2 Years—24 issues ONLY \$25.00
(Save More! \$5.00 off newsstand price.)

Bill me

Check here if you are extending or renewing your subscription.

Extra Shipping: Canada \$3.00 per year, all other countries \$5.00 per year.

Mail to: **Radio-Electronics**

SUBSCRIPTION DEPT., P.O. BOX 2520 BOULDER, COLO. 80322

IF YOU'RE AN ADVERTISER WHO NEEDS JUST A LITTLE SPACE LIKE THIS 1/6 PAGE, CALL YOUR NEAREST RADIO-ELECTRONICS SALES OFFICE RIGHT NOW. YOU'LL DISCOVER YOU DON'T HAVE TO SPEND A LOT OF \$\$\$ TO REACH THE PEOPLE WHO DO SPEND A LOT.

NEW YORK
Stan Levitan
212-777-6400

CHICAGO
Ralph Bergen
312-446-1444

LOS ANGELES
J.E. Publishing
213-659-3810

Radio-Electronics



For the Best and Latest in Computer Technology...

Look to Howard W. Sams & Co., Inc.

There's something for everyone—from those who want to discover what computers are all about to those who are already utilizing computers and programming. The fundamentals . . . programming . . . interfacing . . . logic—we are the complete knowledge source for home, business, educational and professional users.

The "Starters"



- How To Buy & Use Minicomputers and Microcomputers**
by Barden.

A single source to buying and using a computer in your home or business to handle recreational or practical tasks from playing games to setting up a burglar alarm. 240 pages, No. 21351, \$9.95

- The Howard W. Sams Crash Course in Microcomputers**
by Frenzel.

new

The first complete crash course in microcomputers for everyone—from the average consumer to the Doctor of Science. 264 pages, No. 21634, \$14.95

- Getting Acquainted With Microcomputers**
by Frenzel.

Gives you a complete working knowledge of the microcomputer—organization, operation, and programming. 288 pages, No. 21486, \$8.95

- Fundamentals of Digital Computers (2nd Ed.)**
by Spencer.

Unravels the mysteries of computers and programming. 320 pages, No. 21534, \$9.95

- Introduction to Microcomputers for the Ham Shack**
by Helms.

Gives the radio amateur an opportunity to be in the forefront of utilizing and developing techniques in "computerations." 96 pages, No. 21681, \$4.95

Prepub Offer—Save 10% (expires 3/31/80)

- Microcomputer Primer, (2nd Ed.)**
by Waite and Pardee.

new

Completely revised and broadened to reflect the latest advances in microprocessor technology from the new 8-bit microprocessors to solderless breadboards. An excellent starting point for all those interested in computers. Approximately 368 pages, No. 21653, Prepub price—\$10.75. Regular Price—\$11.95

The "Programmers"

- How to Program Microcomputers**
by Barden.



A popular, complete guide to assembly language programming of the Intel 8080, Motorola MC6800, and MOS Technology MCS 6502 Microprocessors. 256 pages, No. 21459, \$8.95

- BASIC Programming Primer**
by Waite and Pardee.

Covers everything from getting organized to writing a game program. 240 pages, No. 21586, \$8.95

- DBUG: An 8080 Interpretive Debugger**
by Titus and Titus.

Covers program operation and how it's applied to program development and testing. 112 pages, No. 21536, \$4.95

- 6502 Software Design**
by Scanlon.

new

Tells how to program for the 6502 assembly language. Approximately 288 pages, No. 21656, \$9.95

- 8080/8085 Software Design, 2 volumes**
by Titus.

U

Volume 1 gives you an introduction to assembly language programming. 336 pages, No. 21541, \$9.50—Volume 2 is a unique, one-of-a-kind, computer science book for the design engineer. Written in Intel machine code. 352 pages, No. 21615, \$9.95

Two-volume set No. 21659, \$17.50

- TEA: An 8080/8085 Co-Resident Editor-Assembler**
by Titus.

new

U

256 pages, No. 21628, \$8.95

The "Computer Technology" Leaders



- The Z-80 Microcomputer Handbook**
by Barden.

Gives current and prospective users a one-stop source to Z-80 technology—hardware and software aspects and instrumentation problems. 304 pages, No. 21500, \$8.95

- Using the 6800 Microprocessor**
by Poe.

Acquaints you with the hardware and software of the "6800" fun machine. 176 pages, No. 21512, \$6.95

- Computer Graphics Primer**
by Waite.

new

Shows how to create your own graphic affects—from detailed drawings to moving figure animation. Approximately 184 pages, No. 21650, \$12.95

- Microcomputers for Business Applications**
by Barden.

Explains the various types of microcomputers available, points out pitfalls to avoid, and defines computer-related terms, or "buzzwords" in easy-to-understand language. 256 pages, No. 21583, \$8.95.

"Interfacing" Bookshelf



- Microcomputer-Analog Converter Software & Hardware Interfacing**
by Titus, Titus, Rony, and Larsen.

U

Concepts and techniques of interfacing digital computers to analog devices. 288 pages, No. 21540, \$9.50

- TRS-80 Interfacing**
by Titus.

new

192 pages, No. 21633, \$8.95

- Interfacing & Scientific Data Communications Experiments**
by Rony, Larsen, Titus & Titus.

new

160 pages, No. 21546, \$5.95

- Microcomputer Interfacing With the 8255 PPI Chip**
by Goldsborough.

new

224 pages, No. 21614, \$8.95

- Z-80 Microprocessor Programming & Interfacing, 2 Volumes**
by Nichols, Nichols & Rony.

new

800 pages, No. 21611, \$21.95.

- Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming and Interfacing, 2 Volumes**
by Rony, Larsen, and Titus.

U

912 pages; No. 21552; \$20.95



"Reference" Library

- Computer Dictionary & Handbook (3rd Ed.)**
by Sippl and Sippl.

new

The best and latest resource for anyone involved in computers or computer applications. Over 900 pages; No. 21632 \$25.95

- Computer Dictionary (3rd Edition)**
by Sippl and Sippl.

Over 12,000 entries, 640 pages, No. 21652, \$11.95*

"Logic" Cookbooks



- CMOS COOKBOOK**

The well-known author, Don Lancaster presents an information-packed guide to this low-cost, fun-to-work with digital logic family. 416 pages, No. 21398, \$10.50

- TTL Cookbook**
by Lancaster.

336 pages, No. 21035, \$9.50

- The Cheap Video Cookbook**
by Lancaster

256 pages, No. 21524, \$5.95

- IC Op-Amp Cookbook**

by Jung. 592 pages, No. 20969, \$12.95*

- RTL Cookbook**

by Lancaster. 240 pages, No. 20715, \$6.50

- TV Typewriter Cookbook**

by Lancaster. 256 pages, No. 21313, \$9.95

- IC Converter Cookbook**

by Jung. 576 pages, No. 21527, \$13.95

*Tentative price

Look to Sams . . . In the world of computers

ORDER FORM

HOWARD W. SAMS & CO., INC.
4300 WEST 62ND STREET, P.O. BOX 7092
INDIANAPOLIS, INDIANA 46206
(317) 298-5400

Indicate quantity in boxes above and complete ordering information below.

Sub Total _____

Add local sales tax where applicable _____

GRAND TOTAL _____

Bill Me (Shipping and Handling Charge will be added)

Payment Enclosed (No Shipping Handling Charge)

Check Money Order

Master Charge

Bank Americard/Visa

Exp. Date _____

Account No. _____

Interbank No. _____ (Master Charge Only)

Minimum Credit Card Purchase \$10.00 **565**

Please send free 1980 Computer Book Catalog.

Signature _____

Name _____ Last Middle First

Address _____

City _____ State _____ Zip _____

Prices subject to change without notice. All books available from local Sams Distributor. Offer good in U.S. only.

Note: Distributor, computer store and dealer inquiries are welcome.

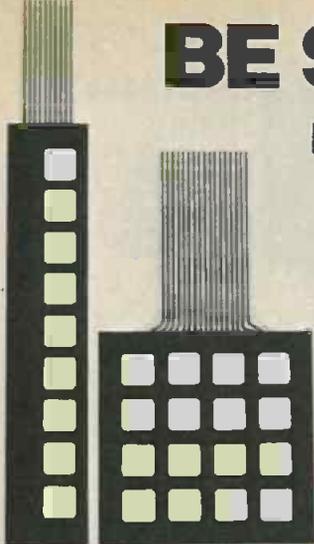
BE SWITCHED

EXCLUSIVE SHELDAHL FLEXSWITCH® KIT

Yours for only \$10.00

Put your imagination and a scissors to work to make the switch you want. Modify the .030 thick, non-tactile panel into a water/dust resistant switching module. Kit includes design guidelines, instructions, membrane switching panel, flexcircuit connector, press-on nomenclature and RFQ checklist.

© 1980 Sheldahl, Inc.



See your local distributor, or order by mail.

Please send me 16 key kit(s) short to ground crosspoint

9 key kit(s) short to ground crosspoint

Enclose \$10 in check or money order for each kit order.

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____



Sheldahl

Mail to:
Sheldahl Inc.
Electrical Products Division
P.O. Box 170
Northfield, MN 55057

STEREO PRODUCTS continued from page 98

rated at 20 watts per channel and has similar performance features. Suggested retail price for the Model CR-440 is \$320; Model CR-240 is \$250.—Yamaha Int'l. Corp., 6600 Orangethorpe Ave., Buena Park, CA 90620.

METAL PARTICLE CASSETTE TAPE, Metal Alloy, provides increased maximum output levels, especially at high frequencies. The tape is housed in a warp-resistant die-cast aluminum shell that features removable plugs, low-mass pressure



CIRCLE 134 ON FREE INFORMATION CARD

pad and transparent slip sheet. The tape has a coercivity of 1050 oersteds, a remanence of 3000 gauss and is 16 μ m thick. Suggested retail price, \$12.99.—TDK Electronics Corp., 755 Eastgate Blvd., Garden City, NY 11530.

PHONO CARTRIDGE, model 110MP, features a bonded elliptical stylus and uses a high-output Permalloy magnet to overcome interference problems. The cartridge provides a frequency



CIRCLE 135 ON FREE INFORMATION CARD

response of 20 Hz-20 kHz and 25-dB channel separation at 1 kHz. Suggested retail price: \$45.—Osawa & Co., (USA) Inc., 521 Fifth Ave., New York, NY 10017.

MICROPHONE, model UC935, uses condenser technology to provide tight cardioid pattern. Specifications include: frequency response, 30 Hz-16 kHz; sensitivity, -68 dB at 1000 Hz (un-



CIRCLE 136 ON FREE INFORMATION CARD

balanced line); Impedance, 600 ohms. Unit contains a foam windscreen. Suggested retail price: \$59.95.—Numark Electronics Corp., 503 Raritan Center, Edison, NJ 08817.

R-E

THIS VISE IS CATCHING.

Catch PanaVise. It tilts, turns and rotates your work exactly where you want. Add our new Tray! It catches small parts you drop, separates tools, and keeps parts sorted. The Tray's wide 8 1/4" diameter of cast metal gives 'no-tip' stability, and has 6 slip resistant neoprene feet. Catch all the PanaVise combinations at your distributors now. Write for FREE brochure and distributor list.

PANA VISE®

Dept. CE 11
2850 29th St.
Long Beach, CA 90806

Shown:
#315 Circuit Board Holder, #300 Base, #312 Tray Base Mount.

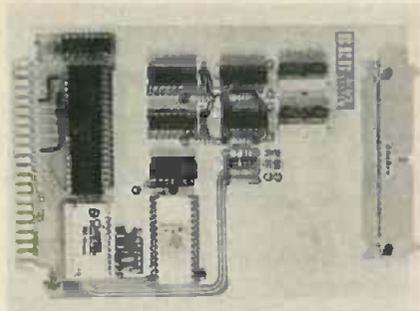


CIRCLE 71 ON FREE INFORMATION CARD

computer products

More information on computer products is available. Use the Free Information Card inside the back cover.

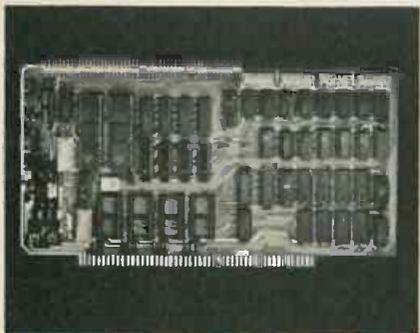
ANALOG INTERFACE MODULE can be used in data acquisition, environment control and DC motor-control applications. Module allows signals to be input from thermocouples, pressure transducers, etc., and output to motors, plotters and servomotors. Available options include a 16-channel multiplexer; 8-, 10- or 12-bit A/D converters; and either one or two 8-bit converters.



CIRCLE 121 ON FREE INFORMATION CARD

Specifications include: maximum A/D conversion time—for the 8-bit converter, 1.8 μ s; the 10-bit converter, 6 μ s; the 12-bit converter, 24 μ s; D/A resolution, 8 bits; multiplex channel off-impedance, 100 milliohm minimum, 50-pF maximum; power requirements, +5 volts \pm 5% at 600-mA maximum. Prices: 16-channel, 12-bit A/D converter, \$257; 8-bit D/A option, \$19.—Wintek Corp., 1801 South St., Lafayette, IN 47904.

SWITCHABLE I/O BOARD, Switchboard, comes assembled or in kit form, has four parallel ports and two RS232/TTY serial ports, plus strobe and attention ports. Switch-programmable parallel ports can be switched for input or latched output;



CIRCLE 122 ON FREE INFORMATION CARD

serial ports are switchable to any of 16 baud rates from 110-19K; and strobe and attention port flip-flops can be switched for positive or negative pulsing. The eight I/O addressed can be located on any boundary divisible by 8. All parts are fully guaranteed for life. Suggested retail prices: kit, \$199; assembled, \$259.—Morrow Designs/ Thinker Toys, 5221 Central Ave., Richmond, CA 94804.

16K MEMORY EXPANSION KITS, Simple Apple II, Simple Sorcerer, and Simple TRS-80 up-grade kits are designed for use with Apple II, Sorcerer and TRS-80 computers. Each kit contains 8

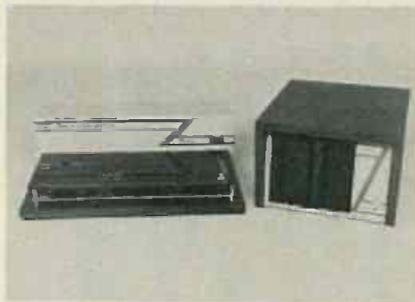
tested 16K RAM's, plus the proper jumper shunts or memory units: components are foam-pro-



CIRCLE 123 ON FREE INFORMATION CARD

tested. Simple installation instructions come with each kit. The Switchboard is fully compatible with the new IEEE S-100 bus standard. Suggested retail price: \$119.—Ithaca Intersystems Inc., Box 91, Ithaca, NY 14850.

COMPUTER SYSTEM, 90 Micro Work Station, is a desk-top system suitable for system development or personal and business applications. The system includes either the Z80-based 90MPS or the 90F/MPS board, and power supply, and comes on a wood-grain base with a hinged plastic



CIRCLE 124 ON FREE INFORMATION CARD

cover. The 90MPS board contains the Z80 CPU; up to 65K bytes of dynamic RAM; up to 14K bytes of ultraviolet erasable PROM (with 2708/2716 sockets); PROM programmer; 1K byte of static RAM; eight 8-bit programmable I/O ports; four counter/timer channels; an RS-232C or 20-mA serial port with selectable baud rate; 2.5 MHz or 4-MHz operation; and a resident PROM monitor with debug capabilities. Also included is a resident DMA-based floppy-disc controller supporting up to four multidensity drives. Available accessories include a floppy-disc subsystem compatible with Digital Research's CP/M soft-

FREE

You'll save money, have fun, and learn by building it yourself — with easy-to-assemble Heathkit Computers.

See all the newest in home computers, video terminals, floppy disk systems, printers and innovative software.

Send today for your **FREE Heathkit Catalog**



If coupon is missing, write Heath Co., Dept. 020-652, Benton Harbor, MI 49022

Send to: Heath Co., Dept. 020-652, Benton Harbor, MI 49022.

Send my free Heathkit Catalog now: I am not currently receiving your catalog.

Name _____

Address _____

City _____ State _____

CL-728 Zip _____

CIRCLE 35 ON FREE INFORMATION CARD

COMPUTER PRODUCTS
continued from page 101

ware, and an S-100 bus adapter. Single unit prices: for the *Work Station* with 90MPS with 4K bytes dynamic RAM, \$1050; with 90F/MPS with 16K bytes RAM and floppy-disc interface, \$1675.—Quay Corp., P.O. Box 386, Freehold, NJ 07728.

PERSONAL COMPUTERS, Atari 400, Atari 800, for educational, recreational, and home or small business applications. The *Atari 400* (shown) features a 6502 CPU, 8K of RAM, 8K of ROM expandable to 16K, 57-key alphanumeric keyboard with graphic and edit capabilities and 4 function keys, a TV channel 2-3 selector, user-definable graphics modes, a single solid-state cartridge slot, built-in speaker, and a serial I/O port. It also provides a cassette tape drive with 300-600 baud rate, automatic tone and volume

controls, and 2 audio/digital data channels; and is user-programmable in BASIC. The optional tape drive also provides 2 audio/digital channels, a 3-digit tape counter, pushbutton controls, a cable, and a 400K-byte data-storage capability per 120-minute cassette.

The *Atari 800* is the top-of-the-line home computer system. It contains a keyboard console (with processor and memory) that features a 57-key alphanumeric keyboard with built-in RF modulator, power indicator/low line voltage indicator, 4 controller ports, on/off switch, TV Channel 2-3 selector, built-in speaker, 2 external and 4 internal cartridge slots, and a video display controller IC. The cassette features 2 audio/digital channels, 3-digit tape counter, pushbutton controls, cable, and a 400K-byte data-storage capability per cassette. Other optional system elements include a dot matrix high-impact printer and a disc memory. The *Atari 800* system has a total memory content of 8K bytes of RAM expandable



CIRCLE 125 ON FREE INFORMATION CARD

to 48K bytes; 8K bytes of internal ROM and 8K bytes of ROM in cartridge form (BASIC), 2 ROM cartridge slots, 400K bytes of cassette memory. Software includes two program cartridges, user-programmable in Atari BASIC, Atari Disc BASIC and alternate languages. Suggested retail prices: *Atari 400*, \$529; *Atari 800*, \$949.—Atari Inc., Div. Warner Communications Inc., 1265 Borregas Ave., Sunnyvale, CA 94086.

MINI-DISC DRIVE SYSTEMS are add-on data storage systems for the TRS-80 computer and include both 40-track and 77-track drives. Single, dual or three-drive TRS-80 systems can be fitted with 40-track *TFD-100* drives or 77-track *TFD-200* drives. The *TFD-100* units increase disc storage capacity to about 250K bytes. Disc drive



CIRCLE 126 ON FREE INFORMATION CARD

interfacing to the TRS-80 is accomplished via TRS-80 expansion interface. Both the *TFD-100* and *TFD-200* include the drive, power supply and enclosure. Each system comes with a *Patch Pak No. 1* mini-disc containing patch programs for TRSDOS for both 44- and 77-track configurations. Prices: *TFD-100*: single drive, \$399; dual-drive, \$795; three-drive, \$1195; *TFD-200*: single drive, \$675; dual drive, \$1350; three-drive, \$2025.—Percom Data Co., 211 N. Kirby, Garland, TX 75042.

PRINTER, Quick Printer II, is a 5 X 7 dot matrix printer designed for use with Level II TRS-80 systems and other computers. It makes hard copies on 2 1/4-inch-wide aluminum-coated paper, is software-selectable for 16 or 32 characters-per-line and produces 120 lines-per-minute at a 64-character-per-second speed. Provides 96 modified ASCII characters with upper and lower case and 6 lines-per-inch vertical spacing, plus all 32 ASCII codes. TRS-80, RS-232C and 8-bit parallel interfaces are featured, and the printer can be connected to the TRS-80 CPU directly or via cable to TRS-80 expansion interface. The unit measures 3 1/2 X 6 X 9 1/4 inches, and sells for \$219.—

**For
The Man
Who Needs
Tools That Don't
Take Early Retirement**

... tools that stay on the job, year after year. That feel right in your hand, that ease the job. Tools precision made of drop forged, beautifully polished, high grade steel. Tools that give you quality in every detail (at no premium in price). Tools by CHANNELLOCK. Be sure that name is on the tools YOU buy.

CHAN NEL LOCK

CHANNELLOCK, INC. • Meadville, Pennsylvania 16335

Meet The Rest of The Family: Send For Free Catalog.

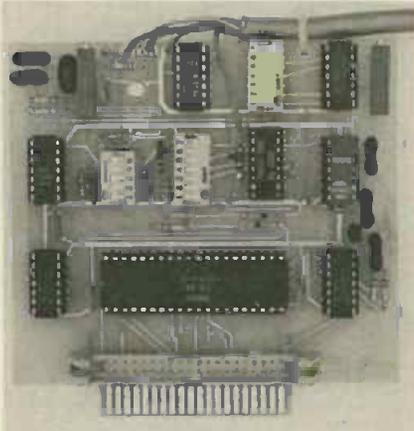
CIRCLE 42 ON FREE INFORMATION CARD



CIRCLE 127 ON FREE INFORMATION CARD

Radio Shack, 1300 One Tandy Center, IFort Worth, TX 76102.

SERIAL INPUT/OUTPUT BOARD, kit or assembled, is designed for the TRS-80 and is RS-232 compatible; board can be used with or without expansion bus. Board provides switch-selectable baud rates of 110, 150, 300, 600, 1200, and 2400; parity-odd or parity-even, or nonparity bits; from 5 to 8 data bits; and either 1 or 2 stop bits. Prices:



CIRCLE 128 ON FREE INFORMATION CARD

board only (Part No. 8010) \$19.95; kit with components, (Part No. 8010A) \$59.95; assembled (Part No. 8010C) \$79.95.—**Electronic Systems**, P.O. Box 21638, San Jose, CA 95151.

TRANSCIVER BOARD, the *MK-II*, interfaces *Touch-Tone* telephones and S-100-bus computers. The 5 X 10-inch board converts Bell System's Dual-Tone Multi-Frequency (DTMF) into binary format and binary into DTMF format. On incoming calls, vectored interrupts detect ring



CIRCLE 129 ON FREE INFORMATION CARD

signals and DTMF signals, thus permitting phoning into the computer and executing programs by punching correct tone-pad sequence on the remote phone. Additional features include single-tone generation, memory-mapped or isolated I/O addressing, 4-bit I/O ports, status flags for ring detection and valid DTMF detection, FIFO buffered output, and automatic gain control on input. Suggested applications for the *MK-II* include monitoring and tabulating outgoing calls, home-security "dialing," and PABX systems. The unit comes fully assembled, includes applications data and manual, and sells for \$425.—**MK Enterprises**, 8911 Norwick Rd., Richmond, VA 23229.



Expand
your knowledge

Subscribe to BYTE

The 1980's are here! The decade of the personal computer has arrived, and BYTE has made it happen! BYTE — the small systems journal devoted to personal computers — has helped usher in the new era. Leading the personal computer revolution, which is already transforming home and personal life, are BYTE's 160,000 enthusiastic readers. Their enthusiasm has made BYTE the largest computer magazine in the world!

To be knowledgeable in the 1980's you need to know how to use personal computers. BYTE is your personal guide to the new era. BYTE tells you how to build, buy, and use computers for fun, practical purposes, and profit. With help from BYTE, you can experiment right in your own home with graphics, word processing, computer music, speech synthesizers, simulations, robotics, personal data base management, business computing — and hundreds of other fascinating hardware and software applications:

Resolve now to expand your computer knowledge.
Subscribe to BYTE!

BYTE® the small systems journal
A MCGRAW-HILL PUBLICATION

Fill in and mail the coupon today. Read your first copy of BYTE. If it is everything you expected, honor our invoice. If it isn't, just write "Cancel" on the invoice and mail it back. You won't be billed and the first issue is yours at no charge.

Call us toll-free
800-258-5485

BYTE Subscription Dept. P.O. Box 590 Martinsville, NJ 08836

Please enter my subscription for:

- One year \$18 (12 issues) Two years \$32 Three years \$46
- Check enclosed entitles me to 13 issues for price of 12 (North America only)
- Bill Visa Bill Master Charge Bill me (North America only)

Card Number _____ Expiration _____

Signature _____ Name (please print) _____

Address _____

City _____ State/Province/Country Code _____

Foreign Rates (To expedite service, please remit in U.S. Funds)

- Canada or Mexico One year \$20 Two years \$36 Three years \$52
- Europe, one year (air delivered) \$32
- All other countries, one year (surface delivered) \$32 Air delivery available on request.

7880

Please allow 6-8 weeks for processing.

CIRCLE 8 ON FREE INFORMATION CARD

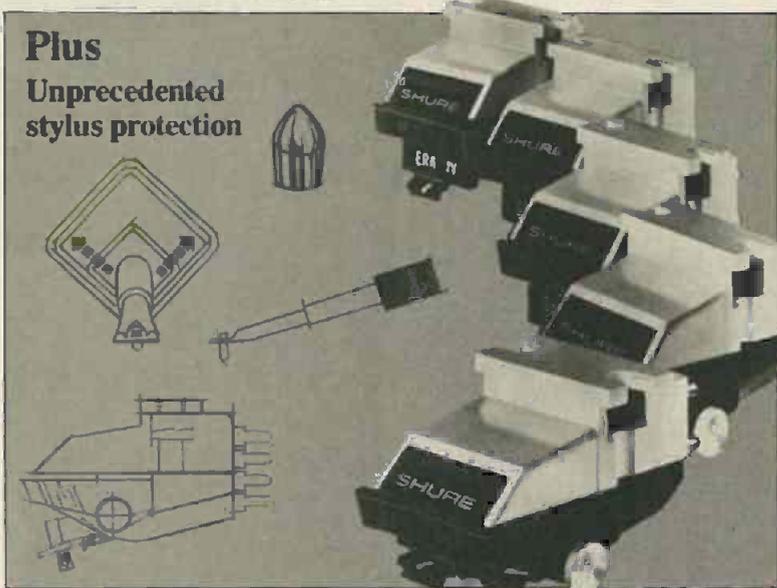
© BYTE Publications, Inc. 1980

MAY 1980

103

fact: five new Shure Cartridges feature the technological breakthroughs of the V15 Type IV

Plus
Unprecedented
stylus protection



the M97 Era IV Series phono cartridges

Shure has written a new chapter in the history of affordable hi-fi by making the space-age technological breakthroughs of the incomparable V15 Type IV available in a complete line of high-performance, moderately-priced cartridges: the M97 Era IV Series Phono Cartridges, available with five different interchangeable stylus configurations to fit every system and every budget.

The critically acclaimed V15 Type IV is the cartridge that astonished audiophiles with such vanguard features as the Dynamic Stabilizer—which simultaneously overcomes record-warp caused problems, provides electrostatic neutralization of the record surface, and effectively removes dust and lint from the record—and, the unique telescoped stylus assembly which results in lower effective stylus mass and dramatically improved trackability.

Each of these features... and more... has been incorporated in the five cartridges in the M97 Series—there is even an M97 cartridge that offers the low distortion Hyperelliptical stylus! What's more, every M97 cartridge features a unique lateral deflection assembly, called the SIDE-GUARD, which responds to side thrusts on the stylus by withdrawing the entire stylus shank and tip safely into the stylus housing before it can bend.

NEW! M97 Series Era IV Phono Cartridges... Five new invitations to the new era in hi-fi.

Model	Stylus Configuration	Tip Tracking Force	Applications
M97HE	Nude Hyperelliptical	3/4 to 1 1/2 grams	Highest fidelity where light tracking forces are essential.
M97ED	Nude Biradial (Elliptical)	3/4 to 1 1/2 grams	
M97GD	Nude Spherical	3/4 to 1 1/2 grams	
M97EJ	Biradial (Elliptical)	1 1/2 to 3 grams	Where slightly heavier tracking forces are required.
M97B	Spherical	1 1/2 to 3 grams	
78 rpm Stylus for all M97's	Biradial (Elliptical)	1 1/2 to 3 grams	For 78 rpm records.



Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204

In Canada: A. C. Simmonds & Sons Limited

Outside the U.S. or Canada write to

Shure Brothers Inc., Attn: Dept. J6 for information on your local Shure distributor.

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

CIRCLE 72 ON FREE INFORMATION CARD

books

BIOMUSIC SYNTHESIS, by David B. Bihary, P.O. Box 1013, Fairport Harbor, OH 44077. 16 pp. 5 1/2 X 8 1/2 in. Softcover \$3.

This little booklet takes a look at an interesting phenomenon: biomusic. What is it? A combination of sounds, natural resonances and vibratory energies associated with life and consciousness. Logic and empirical evidence are given to show how synthesized biomusic can help mental and physical efficiency.

HOME AUDIO SYSTEMS SCHEMATIC SERVICING MANUAL, VOLUME 1: CAPEHART, ZENITH, edited by TAB Editorial Staff. TAB Books, Blue Ridge Summit, PA 17214. 200 pp. 7 X 10 in. Softcover \$5.95; hardcover \$8.95.

HOME AUDIO SYSTEMS SCHEMATIC SERVICING MANUAL, VOLUME 2: CORONADO, CHANNEL MASTER, HITACHI, edited by TAB Editorial Staff. TAB Books, Blue Ridge Summit, PA 17214. 200 pp. 7 X 10 in. Softcover \$5.95; hardcover \$8.95.

HOME AUDIO SYSTEMS SCHEMATIC SERVICING MANUAL, VOLUME 3: ADMIRAL, AUTOMATIC RADIO, MIDLAND, SHARP, edited by TAB Editorial Staff. TAB Books, Blue Ridge Summit, PA 17214. 200 pp. 7 X 10 in. Softcover \$5.95; hardcover \$8.95.

These three volumes contain a compilation of data from nine separate service/repair manuals for more than 400 stereo sound systems. Some of the equipment covered includes AM/FM multiplex radios, cassette and 8-track tape recorders, add-on cassette decks, etc.

Each chapter covers in detail all the models for a single manufacturer and gives electrical specs; large-size schematics (with factory revisions); replacement parts lists complete with factory numbers; alignment and mechanical-adjustment procedures; drawings; manufacturer's addresses; and exploded views of critical components.

THE HOME VIDEO HANDBOOK, by Charles Bensinger. Comprehensive Video Supply Corp., 148 Veterans Drive, Northvale, NJ 07647. 206 pp. 5 1/2 X 8 1/2 in. Softcover \$8.95.

This book was written for both consumer VCR dealers and their customers in response to the need for clear, easily understood reference material on home VCR's. It concerns itself with such areas as VCR compatibility, differences in playing time and the purchase of video cameras. The book tells you how to use your VCR in the most effective way, and includes chapters on advanced video systems; video projectors; basic sound, lighting and graphics techniques; and where to purchase prerecorded video programs.

HOME RECORDING FOR MUSICIANS, by Craig Anderton. Guitar Player Books, P.O. Box 615, Saratoga, CA 95070. 182 pp. 8 1/2 X 11 in. Softcover \$9.95.

This book is designed for all those professional and amateur musicians who are interested in "rolling their own" in home sound recording. Topics covered are taped decks, multichannel recorders, mikes, studio setups, tapes, mixing, etc. The clear, easily understood text is accompanied by many illustrations; there are several appendixes in the back; and a free demo record is included that lets you hear the sorts of sounds heard in a home studio.

GETTING STARTED WITH YOUR PET. Total Information Services, P.O. Box 921, Los Alamos, NM 87544. 42 pp. \$4.00.

PET STRING AND ARRAY HANDLING. Total

Information Services, P.O. Box 921, Los Alamos, NM 87544. 28 pp. \$3.95.

PET CASSETTE. Total Information Services, P.O. Box 921, Los Alamos, NM 87544. 49 pp. \$4.95.

This series of beginner's workbooks is aimed at filling the information gap on using Commodore PET 2001 computers. The first workbook is a primer that explains PET BASIC—its characteristics, limitations and features. The second book describes string and substring search, concatenation, replacement and manipulation. The limitations and features of arrays are discussed; and you learn how to use subscripted variables in programs. The PET cassette workbook covers OPEN, CLOSE, string and numeric data files. Step-by-step exercises are interspersed with the text in all books.

THE BEST OF CREATIVE COMPUTING, Volume 1, edited by David H. Ahl. Creative Computing Press, P.O. Box 789-M, Morristown, NJ 07960. 326 pp. 8 1/2 X 11 in. Softcover \$8.95.

THE BEST OF CREATIVE COMPUTING, Volume 2, edited by David H. Ahl. Creative Computing Press, P.O. Box 789-M, Morristown, NJ 07960. 326 pp. 8 1/2 X 11 in. Softcover \$8.95.

Both volumes contain hundreds of articles, stories and features culled from *Creative Computing* magazine and reflect a hands-on approach to computer usage. Volume 1 focuses on the educational computer applications and the impact of computers on modern society. Volume 2 reflects the increasing trend away from purely educational aspects toward microcomputer kits, microprocessors and home applications; there's a section on how to build MITS Altair 8800. Both books contain myriads of learning activities, programs, computer games, book reviews, puzzles, poetry, and computer art.

6800 ASSEMBLY LANGUAGE PROGRAMMING, by Lance A. Leventhal. Osborne & Associates, Box 2038, Berkeley, CA 94702. 454 pp. 5 1/2 X 8 in. Softcover \$8.50.

This book is an assembly-language primer for those who have little or no background in the field; it does however require a familiarity with computers, addressing methods and instruction sets. Chapters covered include such topics as basic instructions, assemblers, and their functions, 6800 instruction set, simple programs, program loops, code conversion, interrupts and debugging.

HOW TO BUY, INSTALL AND MAINTAIN YOUR OWN TELEPHONE EQUIPMENT, by Joseph La Carruba and Louis Zimmer. Almar Press, 4105 Marietta Dr., Binghamton, NY 13903. 50 pp. 5 1/2 X 8 1/2 in. Softcover \$3.00.

You do not have to have any prior knowledge of telephone installation work to use this planning guide and reference to the installation of phone equipment in home, apartment or business—just a familiarity with the FCC regulations governing such installation. The text provides a step-by-step description of the installation procedure involved with each piece of equipment, each item is defined as it is used and wire connections are described carefully. There are chapters dealing with both servicing and troubleshooting telephone equipment, and the text is accompanied by illustrations.

BASEX, A SIMPLE LANGUAGE AND COMPILER FOR 8080 SYSTEMS, by Paul Warne. Byte Books, Div. of Byte Publications, Inc., 70 Main St., Peterborough, NH 03458. 97 pp. 8 1/2 X 11 in. Softcover \$8.00.

BASEX is a new compiled language that can be run on 8080, Z80 or 8085 microcomputers. The general operation is described, and a comparison is shown of BASEX, BASIC and assembly languages. The book also includes a description of commands, suggestions for user modifications and directions on how to use the loader to relocate and compress programs. Appendices include error messages, a sample program, plus Paperbyte Bar-Code Formats of object codes for the BASEX compiler and loader. R-E

I they look expensive.
They sound expensive.
But they're not because you
build them yourself.



The Magnificent Schober Electronic Organs.

Imagine the pride and joy of owning one of the world's great organs. And for up to 50% less than an instrument of comparable sound and quality. Schober organ kits come in 5 different styles and sizes to fit your musical taste and budget.

Mail this coupon today for free information.

The Schober Organ Corp., Dept. RE-91
43 West 61st Street, New York, N.Y. 10023
 Send me free catalog.

Name _____

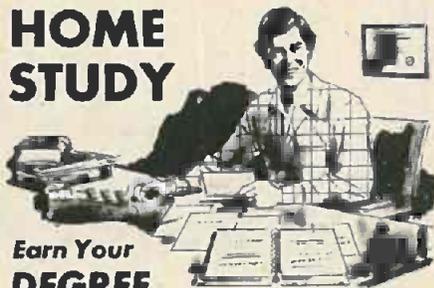
Address _____

City _____ State _____ Zip _____

CIRCLE 45 ON FREE INFORMATION CARD

Put Professional Knowledge and a
COLLEGE DEGREE
in your Electronics Career through

**HOME
STUDY**



**Earn Your
DEGREE**

by correspondence, while continuing your present job. No commuting to class. Study at your own pace. Learn from complete and explicit lesson materials, with additional assistance from our home-study instructors. Advance as fast as you wish, but take all the time you need to master each topic.

The Grantham electronics degree program begins with basics, leads first to the A.S.E.T. degree, and then to the B.S.E.T. degree. Our free bulletin gives complete details of the program itself, the degrees awarded, the requirements for each degree, and how to enroll. (We are located at 2500 S. LaCienega Bl., Los Angeles, Calif.) Write to our mailing address shown below for *Bulletin R-80*

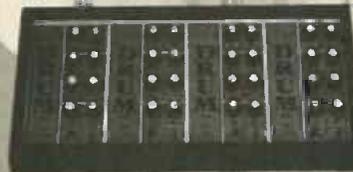
Grantham College of Engineering
P. O. Box 35499
Los Angeles, California 90035

Worldwide Career Training thru Home Study

the **DRUM** T.M. by PAVA

PERCUSSION SYNTHESIZER

- * Modular design provides flexibility to realize as large or small a system as you need.
- * Continuously variable controls rather than switches allow true synthesizer versatility.
- * Numerous rear panel interfacing and control options permit multi-voice patches.
- * Variety of sensor mounting options, permanent or temporary on your own drum set or our practice pads.
- * Available as quick and easy to assemble kit \$269.75 or factory wired and tested — \$399.95.



- () I'm Sold, Send the 5700P The Drum package kit \$269.75 enclosed
- () Send the 5700P-A The Drum assembled \$399.95 enclosed
- () Send Assembly & Using Manual for The Drum, \$5.00 enclosed (refundable upon purchase)
- () **SEND FREE CATALOG**

Name _____

Address _____

City _____ State _____ Zip _____

PAVA ELECTRONICS, Dept. R-8, 1070 E. Windsor, Brea, CA 92718

CIRCLE 25 ON FREE INFORMATION CARD

Test computer terminal CRTs

with a
B&K-PRECISION
portable
CRT analyzer



Model 467
\$360

Now you can save time and reduce call-backs by field testing most any monitor or computer-terminal CRT. The B&K-PRECISION 467 CRT restorer/ analyzer provide a definite "yes or no" answer to tube condition on an easy-to-read meter. It offers fast set-up and testing and measures true dynamic beam current. All CRTs are checked identically—including all color "in-line" and "one-gun" types. Checks virtually all types of terminal CRTs.

In addition, the 467 offers a powerful digitally controlled CRT restoration method so that you'll be able to extend the life of many "bad" CRTs and guarantee results.

- Exclusive multiplex technique tests all three guns of a color CRT simultaneously
- Exclusive circuit tests focus-electrode lead continuity
- Obsolescence proof: perpetual set-up charts available
- Improves profitability by reducing call-backs—repair a terminal in one trip instead of two!
- Entirely self contained; weighs only 10 pounds

Available for immediate delivery at your local B&K-PRECISION distributor.

BK PRECISION

DYNASCAN CORPORATION

6460 West Cortland Street
Chicago, Illinois 60635 • 312/889-9087

Int'l. Sls., 6460 W. Cortland St., Chicago, IL 60635
Canadian Sales: Atlas Electronics, Ontario

CIRCLE 48 ON FREE INFORMATION CARD

new lit

More information on new lit is available. Use the Free Information Card inside the back cover

INSTRUMENTS, Catalog 4900, is a 60 page, four-color catalog covering a complete line of stock analog and digital panel meters, meter relays, controllers and test instruments. New products include a compact liquid crystal digital multimeter and a universal temperature adapter probe.—**Simpson Electric Co.**, 853 Dundee Ave., Elgin, IL 60120

CIRCLE 141 ON FREE INFORMATION CARD

OUTDOOR TV ANTENNAS, a series of 3 full-color wall charts outline the features of RCA's full line of Permacolor TV Antennas. One covers the complete line of UHF-VHF/FM, VHF-FM, UHF, and FM antennas. The second covers UHF-VHF/FM combination and FM antennas, and the third covers VHF/FM and FM antennas.—**RCA Distributor and Special Products Div.**, Sales Promotion Services, Deptford, NJ 08096.

CIRCLE 142 ON FREE INFORMATION CARD

TEST INSTRUMENTS CATALOG, contains 60 pages of complete features, specs and applications for more than 50 instruments, in addition to probes and other accessories. Described are oscilloscopes, digital frequency counters, audio

test instruments, meters and bridges, video generators and a series of instruments designed for special applications.—**Leader Instrument Corp.**, 151 Dupont St., Plainview, NY 11803.

CIRCLE 143 ON FREE INFORMATION CARD

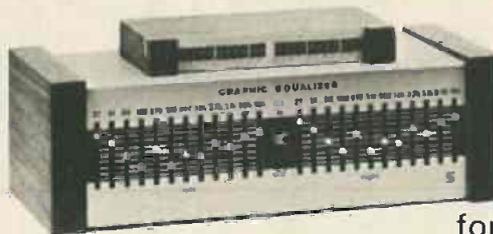
STUDIO SOUND EQUIPMENT, Sound Studio Series, contains 6 pages covering control units such as studio mixers, a frequency equalizer, a sound control fader, and a combination mixer and equalizer. Also included are dynamic mikes and a broadcast monitor headphone and dynamic mike combo. Features are described and technical specifications are given.—**Numark Electronics Corp.**, 503 Raritan Center, Edison, NJ 08817.

CIRCLE 144 ON FREE INFORMATION CARD

SEMICONDUCTOR MASTER REPLACEMENT GUIDE, No. ECG212J, provides 350 pages of ECG replacement devices and provides cross-references for other manufacturers' part numbers. The contents also include an introductory section that explains semiconductors, how to mount them and how to select the proper transistor; as well as a section that deals with test proce-

Cover Story Kits

"Build this Audio Power Level Meter"
from 2/80 Radio
Electronics for
\$42



"Graphic Equalizer
for your stereo system"
from 5/78 Radio Electronics for
\$100/kit

(12 band/channel)

\$165 custom assembled, allow 60 days delivery.

Clever design and efficient packaging allow us to offer these attractive (SOLID unfinished walnut and brushed aluminum) high performance kits at unbeatable prices. Len Feldman reported on our equalizer's performance in the May 1978 issue: "excellent signal-to-hum-and-noise readings . . . THD measured .005% with a 1kHz input signal . . . Intermodulation distortion measured .009% . . . response was flat from 20Hz to 20kHz, within .5dB . . . offers graphic equalization capabilities of more expensive commercially built units at just a fraction of the cost."



**SYMMETRIC
SOUND
SYSTEMS**

DEPT. R, 912 KNOBCONE PLACE
LOVELAND, CO 80537

Phone Orders: (303) 669-1567



CIRCLE 41 ON FREE INFORMATION CARD

dures of solid-state devices. An index/product list is given together with detailed descriptions of transistors, diodes, rectifiers, etc., all accompanied by schematic diagrams. Price: \$2.95.—GTE Sylvania Inc. Distributor & Special Markets Div., 1025 Westminster Drive, Williamsport, PA 17701.

ANTENNA ACCESSORIES, *Catalog PC-80*, contains 19 pages covering 72 antenna accessories for ham, CB, and home TV innovators. Included are baluns, traps, insulators, CB invisible antennas, filters and home TV hook-up accessories. Price list and order form are enclosed.—Unadilla/Reyco Div., Microwave Filter Co., Inc., 6743 Kinne St., East Syracuse, NY 13057.

CIRCLE 145 ON FREE INFORMATION CARD

KITS CATALOG, *Catalog No. 791*, contains 8 pages of kits for scanner accessories, such as unscramblers, a 2 watt audio amplifier, VOX switch, a recording coupler that is used with tape recorder to record scanner traffic. Other kits described are an SCA decoder, VHF pre-amplifier and a regulated power supply. Order form is included.—Capri Electronics, Rt. 1, Box 91-1J, Canon, GA 30520.

CIRCLE 146 ON FREE INFORMATION CARD

COILS AND CHOKES, *General Catalog 79*, contains 96 pages covering a large selection of coils, along with frequency listings, specifications, illustrations of coil types and schematics. Other products include transformers, audio filters, interference filters and bandpass filters. An index and a price list are included.—Bell Industries, J.W. Miller Div., 19070 Reyes Ave., P.O. Box 5825, Compton, CA 90224.

CIRCLE 147 ON FREE INFORMATION CARD

SPEAKER KITS, catalog contains 48 four-color pages describing 10 stereo speaker kits along with photos, specs, and price information. Also covered are woofers, tweeters, midranges and fullrange drivers, crossovers, speaker enclosures, accessories, complete stereo systems, and new publications. New products include an active subwoofer system and midrange and tweeter horns using the Wave Aperture principle.—Speakerlab, 735 N. Northlake Way, Seattle, WA 98103.

CIRCLE 148 ON FREE INFORMATION CARD

REPLACEMENT SEMICONDUCTORS, *Catalog X79*, 217 pages, is an updated manual (80 new types) that now contains over 150,000 listings of replacement semiconductors and IC's. This comprehensive catalog provides quick and easy selection plus accurate cross referencing. Included is a guide to usage of semiconductors, symbols and terminology used, specifications, product descriptions and index, and diagrams of case styles and accessories. Available for \$2.00 prepaid.—Workman Electronic Products, Inc., P.O. Box 3828, Sarasota, FL 33578.

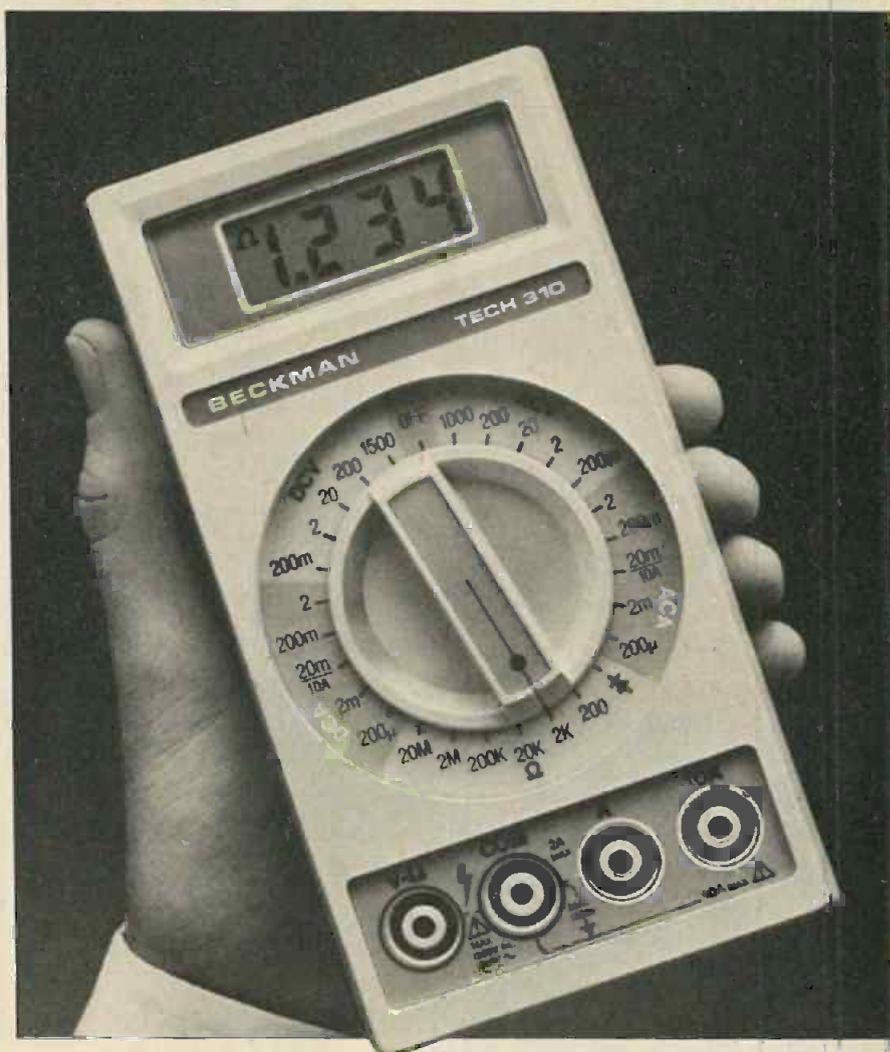
CASSETTE TAPES, is a 6-page color brochure featuring the FX-I ferric oxide tape with normal bias and 120 μ s equalization, and the FX-II Berridox with high bias and 70 μ s equalization. It includes detailed descriptions of the tapes, specifications, test conditions, and graphs showing frequency response and distortion characteristics.—Fuji Photo Film U.S.A., Inc., Magnetic Tape Div., 350 5th Ave., New York, NY 10001.

CIRCLE 149 ON FREE INFORMATION CARD

SOFTWARE CATALOG, 32 pages, lists over 300 programs for the PET, Apple, and TRS-80 micro-computers, covering a wide range of applications from science, education, and business, to entertainment and use in the home. Included for each program listed is a description of its contents, a photo of the computer screen during operation, and specs for system and memory. Also provided is a cross-reference of contents by use and an index of software for each system.—Instant Software, Inc., Catalog Dept., Peterborough, NH 03458.

CIRCLE 150 ON FREE INFORMATION CARD

\$140 Gets It All.



We just knocked down the last reasons for not going digital in a multimeter. Fast continuity measurement. And price.

Beckman's exclusive Insta-Ohms™ feature lets you do continuity checks as fast as the analogs. And Beckman's superior technology and experience let you own this beauty for such a reasonable price.

Of course you get a lot more. Like 7 functions and 29 ranges including 10 amp ac/dc current capability. 0.25% Vdc accuracy. In-circuit resistance measurements and diode/transistor test function. Two years' typical operation from a common 9-volt battery. In other words, all the features you want in one hand-held unit of exceptional good looks and design.

With 1500 Vdc overload protection, 100% instrument burn-in, plus rugged, impact-resistant case, you're assured of the utmost in dependability and long-term accuracy. You get a tough meter that keeps on going, no matter how tough the going gets.

So visit your dealer today and get your hands on the DMM that does it all. Or call (714) 871-4848, ext. 3651 for your nearest distributor.

BECKMAN

CIRCLE 37 ON FREE INFORMATION CARD

NETWORKS

continued from page 71

a feature called CHAT. The CHAT program allows one user to communicate directly with another. To use it, the word CHAT is typed followed by the account number of the party being called. Anything typed after that appears on the called party's screen and if he wishes to talk to you all *he has to do* is type CHAT and the conversation can begin.

Other information services offered by The Source include directories of emergency telephone number and toll-free "800" numbers, a discount shopping service, a guide to restaurants (with ratings) and wines.

The Source also offers subscribers free membership in the Travel Club, which allows the user to make airline, hotel and car rental reservations from his own home, with all transactions automatically billed to his credit card.

CCBB's are very popular

While The Source and MicroNET are growing in popularity because of all the services they offer—with more appearing every day—many hobbyists are finding that they would rather communicate with other computer users simply by means of Computer Community Bulletin Boards (CCBB's). Currently there are well over 100 computer bulletin boards set up throughout the country. These are operated by a variety of people ranging from individuals to computer stores, computer clubs and even manufacturers. There is no fee for the use of these bulletin boards and anyone may post or read messages. The limitations of these bulletin boards, however, is that they are *just that*, bulletin boards, and no two-way chatting nor can CB-like communications be

FOR MORE INFORMATION

You can obtain further information about getting your computer "on-line" to these information utilities by writing or circling the corresponding numbers on the Free Information Card inside the back cover.

The Source
Telecomputing Corporation
of America
1616 Anderson Road
McLean, VA 22102

**CIRCLE 99 ON FREE
INFORMATION CARD**

CompuServe (MicroNET)
Personal Computing Division,
Dept. B
5000 Arlington Centre Blvd.
Columbus, OH 43220
**CIRCLE 98 ON FREE
INFORMATION CARD**

rently there are well over 100 computer bulletin boards set up throughout the country. These are operated by a variety of people ranging from individuals to computer stores, computer clubs and even manufacturers. There is no fee for the use of these bulletin boards and anyone may post or read messages. The limitations of these bulletin boards, however, is that they are *just that*, bulletin boards, and no two-way chatting nor can CB-like communications be

established. Another big disadvantage is that if the bulletin board is not local, you have to pay for the long distance call, something which is not necessary on the information utility networks since they have exchanges in most major cities. Still, computer bulletin boards are growing in popularity very rapidly.

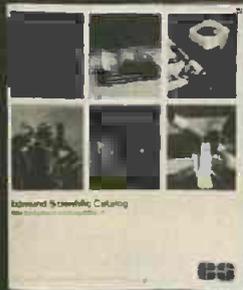
These bulletin boards are not an expensive proposition to get started. All it takes is a home computer, a modem and some software. One company offers bulletin board software for the Apple computer for only \$65. This will perform all the tasks necessary to convert an Apple into a community bulletin board. Programs for other computers are comparably priced.

A special consideration

If you are going to be using the information utilities regularly, or setting up your own computer community bulletin board, you might want to consider having another telephone line installed. The reason for this is that once you start, you will be surprised at how much time you spend on these various systems and pretty soon your friends will be telling you that it's impossible to get you because the phone is always busy. Also, your family may object to not being able to use the telephone. RE

Free!

Edmund Scientific Catalog



Explore Astronomy, Biofeedback, Optics, Lasers, Magnets, Weather, Magnifiers, Microscopes, Photography... Over 4,000 Fascinating Products in Our FREE 100 page color Catalog! Send for your FREE Edmund Scientific Catalog, Today! 38 Years Of Service!

Yes! Rush me your FREE catalog!

Name _____

Address _____

City _____

State _____ Zip _____

Clip and Mail Coupon Today to:

Edmund Scientific Co., Dept. 2020, EH10

Edscorp Bldg., Barrington, N.J. 08007

No. 156 ©1980 Edmund Scientific Co.

ATTENTION TECHNICIANS

ARE YOU TIRED

of being

"only a serviceman"

or

"just a technician"?

THE LETTERS "CET
AFTER YOUR NAME SPELLS

"PRIDE"

TRY IT.

Take pride in
your profession—
Decide to be a CET



For information about: _____ exam dates;
_____ requirements; _____ study guides;
other _____

Send to: NESDA/ISCET
2708 W. Berry St.
Fort Worth, TX 76109
(817) 921-9101

Name _____

Address _____

City _____ St. _____ Zip _____

CIRCLE 22 ON FREE INFORMATION CARD

Quietrolle

The Original...

A First In the industry, with over thirty years of use by satisfied customers.



Spray Pack Mark II gets into places of close tolerance and washes out the dirt, leaving a thin film of lubricant which lasts indefinitely, with zero effect upon current capacity and resistance.

Spray Pack Mark II has been tested and proven in the Space Age and is still the finest lubri-cleaner available. It is quick, safe, effective - a MUST for every tool caddy.

Spray Pack Mark II is the best-priced lubri-cleaner.

Available at Leading Distributors

Product of

QUIETROLLE

COMPANY

455 Montgomery Building
Spartanburg, SC 29301
803-582-4837

CIRCLE 74 ON FREE INFORMATION CARD

in the amateur 40-meter band. For example, a European broadcaster wishing to use a frequency in that band to broadcast to the Americans, could schedule a transmission during prime time in the Americas in a westward direction. In registering the frequency, the broadcaster could show its target area as Australia, and transmit in English. If the signal just happened to cross the Americas—why, that would simply be a coincidence. The amateurs, in light of the "contrants" footnote, would have little recourse.

As a result of the above, it is feared that some degradation of the 40-meter band is inevitable when the Final Acts come into force.

AM broadcasting

In the western hemisphere the AM band was expanded from the present 1605- to 1705-kHz. The band from 1605- to 1625-kHz will be allocated exclusively to broadcasting, and remainder to be shared with LORAN services. The additional frequency space is to become available after a western-hemisphere regional AM Broadcasting conference to be held by 1985 which will plan the use of the band.

The extension of the AM bands from 1605- to 1705-kHz was consistent with United States policy to increase the number of stations operating on medium wave. In particular, it is expected that one result of that expansion will be a significant increase in the number of minority owners operating AM stations. Specific frequency assignments will be made at the planning conference.

Space services

WARC-79 recommended the convening of a Conference to plan the use of various space services, and for the use of geostationary satellites. The developing countries are in favor of planning that would guarantee all countries orbital slots and the necessary frequencies to go with them. Some developing countries fear that unless such planning takes place they will be frozen out of orbital slots and spectrum space permanently. It has been the position of the United States that such planning is wasteful because it would, in effect, permit both orbital slots and frequencies to lie fallow while countries to whom these had been assigned developed the technology and economic wherewithal to initiate space services. The United States supported the concept of equal access by all countries, and the issue will be discussed further at the upcoming space conference.

WARC-79 also approved a more than threefold increase in the number of

continued on page 110



Featuring
RCA 1802 COSMAC CPU
Own a powerful home computer system, starting for just \$99.95—a price that gets you up and running the very first night... with your own TV for a video display, \$99.95 ELF II includes RCA 1802 8-bit microprocessor addressable to 64k bytes with DMA interrupt, 16 registers, ALU, 256 byte RAM, full hex keyboard, two digit hex output display, stable crystal clock for timing purposes, RCA 1501 video IC to display your programs on any video monitor or TV screen and 5 slot plug-in expansion bus (uses connectors) to expand ELF II into a giant!

ELF II Explodes into A Giant!
Master ELF II's \$99.95 capabilities, then expand with GIANT BOARD, KLUDGE BOARD, 4k RAM BOARDS, TINY BASIC, ASCII KEYBOARD, LIGHT PEN, ELF BUG MONITOR, COLOR GRAPHICS & MUSIC SYSTEM, TEXT EDITOR, ASSEMBLER, DISASSEMBLER, VIDEO DISPLAY BOARD... and, another great reason for getting your ELF now—

BREAKTHROUGH!

Netronics proudly announced the release of the first 1802 FULL BASIC, written by L. Sandlin, with a hardware floating point RPN math package (requires 8k RAM plus ASCII and video display boards), \$79.95 plus \$2 p&h. Also available for RCA VIP and other 1802 systems (send for details!)

Master This Computer in A Flash!

Regardless of how minimal your computer background is now, you can learn to program an ELF II in almost no time at all. Our Short Course On Microprocessor & Computer Programming—written in non-technical language—guides you through each of the RCA COSMAC 1802's capabilities, so you'll understand everything ELF II can do... and how to get ELF II to do it! Don't worry if you've been stumped by computer books before. The Short Course represents a major advance in literary clarity in the computer field. You don't have to be a computer engineer in order to understand it. Keyed to ELF II, it's loaded with "hands on" illustrations. When you're finished with the Short Course, neither ELF II nor the RCA 1802 will hold any mysteries for you.

In fact, not only will you now be able to use a personal computer creatively, you'll also be able to read magazines such as BYTE, INTERFACE AGE, POPULAR ELECTRONICS and PERSONAL COMPUTING and fully understand the articles. And, you'll understand how to expand ELF II to give you the exact capabilities you need!

If you work with large computers, ELF II and the Short Course will help you understand what they're doing.

Get Started For Just \$99.95, Complete!

\$99.95 ELF II includes all the hardware and software you need to start writing and running programs at home, displaying video graphics on your TV screen and designing circuits using a microprocessor—the very first night—even if you've never used a computer before.

ELF II connects directly to the video input of your TV set, without any additional hardware, or, with an \$8.95 RF modulator (see coupon below), you can connect ELF II to your TV's antenna terminals instead.

ELF II has been designed to play all the video games you want, including a fascinating new target-missile gun game that was developed specifically for ELF II. But games are only the icing on the cake. The real value of ELF II is that it gives you a chance to write machine language programs—and machine language is the fundamental language of all computers. Of course, machine language is only a starting point. You can also program ELF II with assembly language and tiny BASIC. But ELF II's machine language capability gives you a chance to develop a working knowledge of computers that you can't get from running only

Write and run programs—the very first night—even if you've never used a computer before!

You're up and running with video graphics for just \$99.95 — then use low cost add-ons to create your own personal system that rivals home computers sold for 5-times ELF II's low price!

pre-recorded tape cassettes.

ELF II Gives You The Power To Make Things Happen!
Expanded, ELF II can give you more power to make things happen in the real world than heavily advertised home computers that sell for a lot more money. Thanks to an ongoing commitment to develop the RCA 1802 for home computer use, the ELF II products—being introduced by Netronics—keep you right on the outer fringes of today's small computer technology. It's a perfect computer for engineering, business, industrial, scientific and personal applications.

Plug in the GIANT BOARD to record and play back programs, edit and debug programs, communicate with remote devices and make things happen in the outside world. Add Kluge (prototype) Board and you can use ELF II to solve special problems such as operating a complex alarm system or controlling a printing press. Add 4k RAM Boards to write longer programs, store more information and solve more sophisticated problems.

ELF II add-ons already include the ELF II Light Pen and the amazing ELF BUG Monitor—two extremely recent breakthroughs that have not yet been duplicated by any other manufacturer.

The ELF BUG Monitor lets you debug programs with lightning speed because the key to debugging is to know what's inside the registers of the microprocessor. And, with the ELF BUG Monitor, instead of single stepping through your programs, you can now display the entire contents of the registers on your TV screen. You find out immediately what's going on and can make any necessary changes.

The incredible ELF II Light Pen lets you write or draw anything you want on a TV screen with just a wave of the "magic wand." Netronics has also introduced the ELF II Color Graphics & Music System—more breakthroughs that ELF II owners were the first to enjoy!

ELF II Tiny BASIC

Ultimately, ELF II understands only machine language—the fundamental coding required by all computers. But, to simplify your relationship with ELF II, we've introduced an ELF II Tiny BASIC that makes communicating with ELF II a breeze.

Now Available! Text Editor, Assembler, Disassembler And A New Video Display Board!

The Text Editor gives you word processing ability and the ability to edit programs or text while it is displayed on your video monitor. Lines and characters may be quickly inserted, deleted or changed. Add a printer and ELF II can type letters for you—error free—plus print names and addresses from your mailing list!

ELF II's Assembler translates assembly language programs into hexadecimal machine code for ELF II use. The Assembler features mnemonic abbreviations rather than numerics so that the instructions on your programs are easier to read—this is a big help in catching errors.

ELF II's Disassembler takes machine code programs and produces assembly language source listings. This helps you understand the programs you are working with... and improve them when required.

The new ELF II Video Display Board lets you generate a sharp, professional 32 or 64 character by 16 line upper and lower case display on your TV screen or video monitor—dramatically improving your unexpanded \$99.95 ELF II. When you get into longer programs, the Video Display Board is a real blessing!

Now Available!

- A-D/D-A Board Kit Includes 1 channel (expandable to 4) D-A, A-D converters, \$39.95 plus \$2 postage & handling.
- PILOT Language—A new text-oriented language that allows you to write educational programs on ELF II with speed and ease! Write programs for games... unscrambling sentences... spelling drills... "fill in the missing word" tests, etc. PILOT is a must for any ELF II owner with children. PILOT Language on cassette tape, only \$19.95 postpaid!
- Game Package on cassette tape (requires 4k RAM), \$9.95 plus \$2 postage & handling.

Clip Here and Attach to Your Order Below!

Netronics R&D Ltd., Dept RE-5
333 Litchfield Road, New Milford, CT 06776

Yes! I want my own computer! Please rush me—

- RCA COSMAC ELF II kit at \$99.95 plus \$2 postage and handling (requires 6.3 to 8 volt AC power supply)
- Power Supply (required) \$4.95 postpaid
- RCA 1802 User's Manual \$5 postpaid
- Tom Pitman's Short Course On Microprocessor & Computer Programming teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language, it's a learning breakthrough for engineers and laymen. \$19.95 plus \$2 postage and handling.
- Deluxe Metal Cabinet with Plexiglas dust cover for ELF II \$29.95 plus \$2.50 p&h
- I am also enclosing payment (including postage & handling) for the items checked below.
- I want my ELF II wired and tested with power supply. RCA 1802 User's Manual and Short Course—all for just \$149.95 plus \$3 p&h.

ALSO AVAILABLE FOR ELF II

- GIANT BOARD™ add with cassette I/O RS 232 C/TTY I/O 8 bit P+D documented for 14 separate I/O instructions and a system monitor/editor. \$39.95 plus \$2 p&h
- Kluge (Prototype) Board accepts up to .36 IC's \$17.00 plus \$1 p&h
- 4k Static RAM kit. Addressable to any 4k page to 64k. \$89.95 plus \$3 p&h
- Gold plated 88-pin connectors (one required for each plug-in board). \$5.70 ea. postpaid
- Expansion Power Supply (required when adding 4k RAM) \$34.95 plus \$2 p&h
- Professional ASCII Keyboard kit with 128 ASCII upper/lower case set, 96 printable characters, onboard regulator, parity logic selection and choice of 4 hand shaking signals to mate with almost any computer. \$64.95 plus \$2 p&h
- Deluxe metal cabinet for ASCII Keyboard. \$19.95 plus \$2.50 p&h
- Video Display Board kit lets you generate a sharp professional 32 or 64 character by 16 line upper and lower case display on your TV screen or video monitor—dramatically improving your unexpanded \$99.95 ELF II. Fits inside ASCII Keyboard cabinet. \$89.95 plus \$2 p&h
- ELF II Tiny BASIC on cassette tape. Commands include SAVE, LOAD, & X. \$19.95 plus \$2 p&h
- 26 variables A-Z, LET, IF, THEN, INPUT, PRINT, GO TO, GO SUB, RETURN, END, REM, CLEAR, LIST, RUN, PLOT, PEER, POKE. Comes fully documented and includes alphanumeric generator required to display alphanumeric characters directly on your TV screen with out additional hardware. Also plays hex lock (plus a drawing game that uses ELF II's hex keyboard as a play and 4k memory required). \$14.95 postpaid
- Tom Pitman's Short Course on Tiny Basic for ELF II \$5 postpaid
- ELF-BUG™ Deluxe System Monitor on cassette tape. Always displaying the contents of all registers on your TV at any point in your program. Also displays 24 bytes of memory that uses ELF II's hex keyboard as a play and hex scrolling. A must for the serious programmer. \$14.95 postpaid
- Text Editor on cassette tape gives you the ability to insert, delete or edit lines and words from your programs while they are displayed on your video monitor. (Add printer and you can use ELF II to type error free letters plus insert names and addresses from your mailing list.) \$19.95 postpaid
- Assembler on cassette tape translates assembly language programs into hexadecimal machine code for ELF II use. Mnemonic abbreviations for instructions (rather than numerics) make programs easier to read and help prevent errors. \$19.95 postpaid
- Disassembler on cassette tape takes machine code

PHONE ORDERS ACCEPTED!
Call (203) 354-9375

Total Enclosed \$ _____
(Conn. res. add tax)

CHARGE IT? Exp. Date _____
 Visa Master Charge
(Bank # _____)

Account # _____

Print Name _____
Address _____
City _____
State _____ Zip _____

DEALER INQUIRIES INVITED

BUILD A MASTERPIECE OF SOUND



Wersl has combined select features of the electronic music field, added its own creations and years of research by top engineers and musicians, to produce an incomparable line of organs.

Space-age technology. True-to-life voicing with full drawbar system. Polyphonic

percussion and sustain. Wersl's famous string orchestra and bass guitar. Exclusive Sound Computer for 32-128 "One Stop Sounds" (total organ presets). Transposer. And lots more.

Build your own masterpiece of sound. No technical knowledge required. Just follow the clearly illustrated, easy to understand instructions. Step by step. Choose from at least 10 models. (Also factory assembled.)

Send \$6.00 with coupon for your Wersl Demo-Package (LP with 104-page color catalog).

WERSL

Wersl Electronics, Inc. Dept. 21
1720 Hempstead Road
Lancaster, PA 17601

Wersl Organs & Kits Dept. 21
14104 E. Firestone Blvd.
Santa Fe Springs, CA 90670

Enclosed is \$6.00 for my Demo-Package (LP with 104-page color catalog.)

Name _____
Address _____
City _____ State _____ Zip _____

CIRCLE 10 ON FREE INFORMATION CARD

WARC-79

continued from page 409

fixed and broadcast satellites that will be able to operate in the 12 GHz portion of the spectrum in the western hemisphere.

The 11.7- to 12.1-GHz band will be allocated to the Fixed Satellite Service (space-to-earth) shared with other services; the 12.0- to 12.7-GHz band will be allocated to broadcasting and broadcasting satellites, shared with other services. The specific frequencies to be assigned to the broadcasting satellite service will be allocated at a Conference scheduled to be held in 1983. That will be followed by a general satellite conference as mentioned above.

The overriding issue of the 80's will be the movement on the part of developing countries to plan the assignment and use of orbital slots and frequencies in such a way as to assure all countries an equal "slice of the pie." WARC-79 did not address that issue completely, but only deferred it to subsequent space conferences which will be held in this decade. Major battles on the issue of equal rights may loom ahead.

R-E

OSCILLOSCOPE

continued from page 56

uator switch S403 at 0.4 V/div, connect a 20-kHz squarewave to the external horizontal input and adjust R230 so the display consists of two dots on the screen. Misadjustment will cause "tails" at the outside or inside of the dots indicating overshoot or rounding. Now apply a 1.41-volt RMS (4.0 V P-P) 100-Hz sinewave and adjust R226 for a ten-division horizontal line. Change S403 to 2 V/div and apply a 1-kHz squarewave, adjusting C403 for two dots with no tails as above.

Sweep: First set SWEEP LENGTH control R325 for an 11-division horizontal line. Then, with variable SWEEP TIME control R317 at minimum resistance and a 60-Hz line display, set SWEEP RANGE switch S304 to 4 ms/div and adjust SWEEP CALIBRATE control R319 so two complete cycles occupy 8.33 divisions. Now display a 100-kHz squarewave, set S304 to 1µs/div, and adjust C314 for one full cycle over ten divisions. Finally, vary the generator frequency slowly. If double traces appear at the right of the screen it will be necessary to lower the value of R327 to hold off trigger during retrace. If R327 is too low, the 555 will not trigger at all.

Now that the scope is calibrated, it's ready to be put into active duty on your workbench. You should recalibrate the scope periodically to be sure of optimum performance, but the scope should provide years of trouble free service. R-E

ANTENNA PROBLEM?



DYMEK HAS THE SOLUTION WITH THE DA100D.

Need Full Frequency Coverage? The DA100D covers the entire frequency range of 50kHz - 30MHz.

Looking For Better Performance? Dymek users worldwide praise the DA100 and its ability to out-perform long wire antenna systems.

Worried About Impedance Problems? An output impedance attenuator switch prevents RF overload and matches varying receiver input requirements.

Want To Go Portable or Mobile? Selectable operation from either 115-230VAC or 12VDC allows both fixed and mobile or marine operation (DA100DM available for use on or near saltwater).

Money Back Guarantee.
Rent/Own Plan Available (U.S. Only). Specs and Details on Request. CALL TOLL FREE NOW.

800/854-7769
Calif 800/472-1783
Local 714-621-6711 ■ TWX 910-581-4990



McKAY DYMEK COMPANY
111 S. College Ave., P.O. Box 5000
Claremont, CA 91711

CIRCLE 70 ON FREE INFORMATION CARD

Discone™ Model DCX

MAKE YOUR SCANNER REALLY PERFORM!

...with Hustler multi-band monitor antennas.

Whether it's mobile or base, Hustler has the antenna that provides exceptional scanner performance, resulting from advanced engineering and use of quality materials.

If you want real performance... get Hustler!

See your dealer or write:

HUSTLER INC.

3275 North B. Ave., Kissimmee, Florida 32741

Clearly the choice of those who know quality.

MOM
Magnetic
Mount

CIRCLE 26 ON FREE INFORMATION CARD

THE RADAR DETECTOR

I should like to comment on the letter, "Radar Detector," by John W. Ecklin, which appeared in your June 1979 issue.

When Mr. Eckland stated that we have the "erroneous idea that not even light can travel faster than 186,000 miles-per-second or c," he said a mouthful. Scientists across the country are in hot debate, and are doing intense research, on the possibilities of mass and/or energy moving at a speed greater than that of light, or any known electromagnetic energy for that matter.

In his theory of relativity, Albert Einstein stated that no object can exceed the speed of light. And since energy is directly related to an object (mass) by the equation $E=mc^2$ we can see that energy in the form of electromagnetic radiation would also be subject to the limit of the speed of light.

Mr. Eckland mentioned that the electromagnetic radiation would pick up the speed of its source, and thus gain additional velocity. He also asked how the Doppler effect could occur unless the speed of the electromagnetic radiation—in this case radar waves—picked up or lost some speed because of its source's velocity.

The Doppler effect is directly related to time, and not the velocity of the radiation but the velocity of the source. Suppose that a radiation source were moving a hundred miles-per-second forward and the radiation were moving c (the speed of light) in the opposite direction. When the radiation was picked up by a detector, the detector would register a frequency change—thus the Doppler effect. But in no way was the radiation's velocity increased or decreased; it merely arrived later than it would have if it had been moving toward the detector. And since time is directly related to frequency in this case, the Doppler effect can occur without an increase in the velocity of the radiation.

To put it simply: An electromagnetic wave leaving its source does not gain additional speed, no matter how fast its source is moving forward. The velocity of the source only determines *when* the wave will arrive with reference to the source's velocity. A star is a moving electromagnetic source. When it emits electromagnetic radiation, that radiation leaves the star at c, no matter what the velocity of the star itself may be—even if it were a million miles a second, the wave remains constant at c.

By the way, there is one thing that can exceed the speed of light—or possibly is not governed by any laws of motion, energy, mass, etc., and that is—Time. Figure that one out.

As the saying goes: "It's all in your relative position-Relativity."

MICHAEL A. ALVARADO II,
Norwalk, CT.

THERMO-ACTIVE DRUGS

In reference to "The Fight Against Cancer:" (September 1979) *RF hyperthermia* is also used in conjunction with *thermo-active drugs*. Thermo-active drugs become activated at slightly higher-than-normal body temperatures. The drugs are injected into the bloodstream; then the cancerous area is heated via RF-hyperthermia methods.

Note that the drugs are only activated in the heated cancerous area.

Indeed, as you say, it is experimental—but it shows great promise! I read your editorial every month.

ROBBIE CAVE
Princeton, Texas

OOOOOOOOPS!

Sharp-eyed Eloy Marez, of *Radio Control Modeler Magazine* spotted two errors in digital clock article in the February 1980 issue. In Fig. 1, the emitter of transistor Q1 should connect to the line common to the cathodes of all the LED's; not to the emitter of Q8. In the component placement layout, Fig. 3, add a jumper from the open pad at the emitter of Q1 across to the pad on the

line connecting the cathodes of all the LED's. Thanks Eloy.

CLOCK IC's

Earl Savage's article on the use of clock IC's for long-term alarm and other specialized purposes was very good. It should be noted, however, that the outputs cannot be decoded by the methods shown in the August issue if the displays are multiplexed. Most of the clock IC's—especially the cheaper units—are multiplexed. Decoding those outputs is extremely complicated, if not impossible.

Some of the newer IC's are direct drive and can be used as he describes.

WARREN H. CLARK
Balboa, CA

R-E

You'll find **MORE** of what you want in Sprague Q-LINE™ capacitors

MORE Types • **MORE** Ratings
MORE Quality • **MORE** Value



Sprague Q-LINE Capacitors are on display for self-service purchasing at leading electronic distributors. The buying is easy because you can see what's available . . . without waiting, without asking, without searching . . . all pertinent information is clearly spelled out on attractive, color-keyed Blister-Pak packaging, which keeps capacitors visible while protecting them from moisture and dirt. Q-LINE Capacitors give you a broad choice of popular, frequently-needed types and ratings:

Capacitor Type	Number of Ratings	Capacitance Values	Working Voltage Range
 Axial-Lead Electrolytic	62	.47 to 15000 μ F	0-6.3 to 0-450 V
 Vertical-Mounting Electrolytic	33	.47 to 4700 μ F	0-16 to 0-630 V
 Vertical-Mounting Film	63	.0010 to .47 μ F	0-100 to 0-1600 V
 Resin-Coated Solid Tantalum	31	.1 to 680 μ F	0-3 to 0-50 V
 General-Application Ceramic	65	5 pF to 3.3 μ F	0-25 to 0-1000 V
 Epoxy-Dipped Mica	17	10 to 1000 pF	0-500 V

For detailed definition of types and ratings available, write for a copy of Q-LINE Capacitor Listings to Sprague Products Co., Distributors' Division of the Sprague Electric Co., 81 Marshall St., North Adams, Mass. 01247.



Where **MORE** is more than a promise.

CIRCLE 65 ON FREE INFORMATION CARD

MAY 1980

CLASSIFIED COMMERCIAL RATE (for firms or individuals offering commercial products or services). \$1.50 per word prepaid (no charge for zip code) . . . **MINIMUM 15 WORDS**. 5% discount for 6 issues, 10% for 12 issues within one year, if prepaid.

NON-COMMERCIAL RATE (for individuals who want to buy or sell personal items) 85¢ per word prepaid . . . no minimum.

ONLY FIRST WORD AND NAME set in bold caps. Additional bold face (not available as all caps) at 10¢ per word. All copy subject to publisher's approval. **ADVERTISEMENTS USING P.O. BOX ADDRESS WILL NOT BE ACCEPTED UNTIL ADVERTISER SUPPLIES PUBLISHER WITH PERMANENT ADDRESS AND PHONE NUMBER.** Copy to be in our hands on the 26th of the third month preceding the date of the issue (i.e., August issue closes May 26). When normal closing date falls on Saturday, Sunday, or a holiday, issue closes on preceding working day.

PASS FCC EXAMS

The Original FCC Tests-Answers exam manual that prepares you at home for FCC First and Second class Radio-telephone licenses. Newly revised multiple-choice exams cover all areas tested on the actual FCC exam. Plus "Self-Study" Ability Test. Prepaid \$9.95 postpaid. Moneyback Guarantee.



COMMAND PRODUCTIONS Radio Engineering Division P.O. Box 26348 E San Francisco, CA 94126

BUSINESS OPPORTUNITIES

MECHANICALLY inclined individuals desiring ownership of Small Electronics Manufacturing Business—without investment. Write: **BUSINESS-ES**, 92-R, Brighton 11th, Brooklyn, NY 11235

RADIO installation: Learn to install car stereos. Work for yourself or dealers. For information send \$1.00 to **ELECTRONICS ON WHEELS**, 3319 1 Ridge Manor Drive, Birmingham, AL 35216

WHOLESALE TO DEALERS

DEALERS: send letterhead for free wholesale pricelist of CB radio and scanner equipment. **FOUR WHEELER COMMUNICATIONS**, 10-R New Scotland Ave., Albany, N.Y. 12208 (518) 465-4711

TRS-80

TS-80 parallel I/O. PPI-80 contains three 8-bit programmable ports with switch selectable address decoding, plugs into keyboard or E/I. PCB and manual \$25.95. **QUANT SYSTEMS**, Dept RE, Box 628, Charleston, SC 29402

To run your own classified ad, put one word on each of the lines below and send this form along with your check for \$1.50 per word (minimum 15 words) to:

Radio-Electronics, 200 Park Avenue South, N.Y., N.Y. 10003

ORDER FORM

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of \$10.

() Plans/Kits () Business Opportunities () For Sale
() Education/Instruction () Wanted ()

Special Category: \$10

(PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.)

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

PLEASE INCLUDE FOR OUR FILES YOUR PERMANENT ADDRESS AND PHONE NUMBER.

SATELLITE TV FOR THE HOME

Our receiver lets you get over 75 channels of television directly from earth-orbiting cable TV satellites! HBO, Showtime, super stations, sports and movies from around the world.



Sick of Network TV?

Buy Complete or Build our kit and save!

Our 24-channel receiver provides "studio quality" TV reception. Easy to install! Ultra low power consumption! Brilliant color! Works anywhere! FCC licensing no longer required. Order today!

Complete details covered in our Home Earth Station manual. Send \$7.95 today (refundable against any purchase), or call:

24-hour C.O.D. Hotline
(305) 869-4283

SPACECOAST RESEARCH

Dept. T, P.O. Box 442, Altamonte Springs, FL 32701

SATELLITE TELEVISION

GEOSTATIONARY satellites, present and future, found for your location. \$2.00 with longitude-latitude, \$3.00 without. For free sample, send self-addressed stamped envelope. **SAT-FIND**, Box 524, North Amherst, MA 01059

SATELLITE TV mixer 3.7-4.2 GHz In, 70 MHz out, 20 dB gain. PCB with parts \$50.00 Birkitt LNA PCB GaAs-FET or bipolar \$15.00, both \$25.00. **NORMAN GILLASPIE**, 2225 Sharon Rd., #224, Menlo Park, CA 94025

ATV Research

...specialists in CCTV and computer monitors!

Video monitors - color & B/W * TV Cameras, kits, parts & plans * Video-to-RF modulators * Free catalog. Phone or write. (402) 987-3771

13-RE Broadway Dakota City, NE. 68731

ELECTRONIC MUSIC

ELECTRONIC music and home recording in Polyphony magazine. Advanced applications, interviews, projects, computer music. Sample, \$1.50. Subscription (6 issues), \$8 US/\$10 foreign. **POLYPHONY**, Box R20305, Okla. City, OK 73156.

Govt. SURPLUS ELECTRONIC EQUIPMENT CATALOG

New ITEMS . . . New BARGAINS!

FREE UPON REQUEST!

Send today for FREE copy of NEW CATALOG WS-80 Address: Dept. RE

FAIR RADIO SALES

1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

Special

**2SC1308K Sanyo
Horizontal Output Transistor
Equivalent to ECG 238**

2.45

Minimum order of 10.

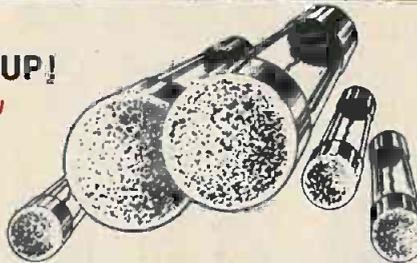
Sanyo Number	Specifications	Equivalent To	Replaces	Price
→ C1025	VcBo 200V Ic 3A, Pc25W	ECG 175 TO-66	Most H, V DEF. out- put transistors and more. Includes C160, C1161, D130, D291.	.95
★ D386A	VcBo 200V Ic 2A, Pc25W	ECG 375	Most vert. output transistors included.	1.40
→ C1308K	VcBo 1500V Ic 7A, Pc50W	ECG 238 TO-3 case	Most horizontal out- put transistors including C1358, C1172, C1172B, D350.	2.90
A1011	VcBo 180V Ic 1.5A, Pc25W	TO-220 case	B536, B537, A913. Used for AF driven PNP.	.75
G2344	VcBo 180V Ic 1.5A, Pc25W	TO-220 case	D381, D382, C1447. Used for AF driven NPN.	.75
B507	VcBo 60V Ic 3A, Pc30W	ECG 153 TO-220 case	B511, B512, B513, B514, B515, AF output.	.70

Sanyo Number	Specifications	Equivalent To	Replaces	Price
D313	VcBo 60V Ic 3A, Pc30W	ECG 152 TO-220 case	D234, D235, D314, D325, D330, D331, D317, D318.	.55
B633	VcBo 100V Ic 6A, Pc40W	ECG 197 TO-220 case	Most of TO-220 case PNP Audio output transistors.	.90
D613	VcBo 100V Ic 6A, Pc40W	ECG 196 TO-220 case	Most of TO-220 case NPN Audio outputs.	.80
B697K	VcBo 180V Ic 12A, Pc100W	ECG 281 TO-3 case	Most of TO-3 case PNP Audio outputs. STRONGI	2.50
D733	VcBo 180V Ic 12A, Pc100W	ECG 280 TO-3 case	Most of TO-3 case NPN Audio outputs. Includes C1079, C1080, D116, D425, D426, D371, D217	2.45
D24Y	VcBo 300V Ic150MA, Pc65W	ECG 124 TO-66	C615A, C685A. HV Audio power output for TV.	.75

**Our huge buy of popular
fuses makes the prices too good for you to PASS UP!**

ACG Style Amps: .5/1/1.5/2/3/4/5/6/7/1
(10 to 100) 12¢ each (100 up) 8¢ each

GMA (F Type) Amps: .1/1.5/1/1.5/2/2.5/3/4/5/6/7/1
(10 to 100) 18¢ each (100 up) 14¢ each
Minimum order of 100 of each



Special prices available for OEM and distributors. Call Toll Free number for information.

ECG Equivalents at Huge Savings!

Here is a list of in-stock ECG equivalents. We also have hundreds of semiconductors not listed here. Write for free 20-page catalog or receive it free with each order.

Eqn. To	Price																
102	.40	163	4.80	237	2.40	323	2.20	737	3.60	941	.75	1035	4.70	1081A	2.30	1129	7.40
103	.70	164	3.35	238	3.35	324	2.50	738	4.80	966	2.80	1036	5.60	1082	1.30	1130	4.20
104	1.35	165	3.35	276	7.90	376	2.25	739	3.20	973	1.80	1037	3.00	1085	1.30	1131	4.40
105	3.90	171	1.80	277	5.80	500A	12.40	740	2.80	973D	2.00	1038	4.70	1087	1.30	1132	4.20
106	.40	175	2.90	279	7.40	506	1.50	742	4.20	975	1.60	1040	1.40	1089	6.40	1133	3.80
107	.80	177	.25	280	2.70	526	18.80	743	1.50	976	1.80	1041	1.20	1090	9.80	1134	4.40
108	1.20	180	2.80	281	2.80	551	2.00	744	5.20	978	1.80	1042	2.40	1091	3.80	1135	1.80
109	.20	181	2.70	282	2.00	601	.30	748	3.80	987	1.40	1043	4.40	1092	1.50	1137	1.80
110	.40	182	3.20	283	4.80	605	1.65	748	2.80	1002	1.30	1045	2.80	1093	2.40	1140	1.80
116	.20	183	3.75	284	4.30	612	.35	749	2.90	1003	1.30	1046	3.20	1096	3.85	1142	1.40
117	.20	184	1.00	285	6.20	613	.40	778	1.80	1004	2.20	1049	3.90	1097	6.80	1148	14.80
121	2.75	185	1.00	287	.70	703A	1.50	780	3.20	1005	2.20	1052	1.50	1098	7.85	1149	3.90
123A	.35	186A	.80	288	.55	708	1.50	783	3.20	1006	2.20	1053	2.40	1100	1.40	1150	2.20
124	1.95	187A	.80	290	.40	709	1.50	788	1.90	1009	2.20	1054	1.70	1101	1.90	1153	2.50
125	.20	190	1.00	291	1.30	710	3.00	790	2.80	1010	2.20	1055	2.70	1102	1.40	1154	2.80
128	.80	192	.45	292	1.50	711	3.95	791	2.80	1011	2.20	1058	2.80	1103	1.20	1155	2.10
127	2.95	193	.55	293	.45	712	1.50	793	3.20	1012	.95	1057	3.15	1104	1.20	1158	3.40
128	2.50	196	1.30	294	.40	713	1.50	801	1.50	1013	1.30	1058	1.95	1105	3.90	1159	3.40
129	2.20	197	1.50	295	.60	714	1.50	802	8.80	1014	1.90	1060	1.30	1106	2.70	1160	2.30
130	1.00	198	1.50	297	.55	715	3.20	803	4.80	1016	2.20	1061	3.95	1108	2.80	1161	6.80
131	1.00	199	.30	298	.70	718	1.50	804	4.20	1019	1.30	1062	4.20	1109	3.90	1162	2.40
132	.60	220	1.60	299	.75	719	1.50	805	3.20	1020	2.20	1063	4.90	1110	7.80	1163	3.90
133	.60	221	1.40	300	.70	720	1.50	808	3.80	1021	2.20	1067	5.70	1115	2.40	1164	5.40
152	.80	222	1.60	302	1.00	721	3.80	807	3.20	1024	4.20	1069	9.30	1115A	2.40	1165	2.20
153	.95	226	1.00	306	1.30	722	1.50	812	4.00	1025	5.90	1070	3.80	1116	2.60	1166	2.30
155	2.90	229	.80	307	.50	723	1.50	814	4.20	1028	1.20	1071	4.80	1117	2.80	1167	5.60
157	2.25	230	4.60	308	7.40	724	2.80	818	3.80	1027	4.90	1072	2.90	1122	4.40	1168	5.40
158	.40	231	4.90	310	7.40	725	1.50	824	2.50	1028	9.20	1073	1.60	1123	6.10	1169	3.00
159	.80	233	.80	312	.80	726	3.50	912	2.40	1029	2.80	1074	2.80	1124	2.90	1170	2.90
160	1.80	234	.40	315	1.00	729	4.20	917	3.20	1030	5.40	1075A	2.80	1126	4.20	1171	4.40
161	1.20	235	1.60	320	10.60	731	1.50	923	1.00	1032	2.80	1078	7.40	1127	2.30	1172	4.60
162	4.60	236	2.30	321	3.80	733	2.80	925	6.00	1034	4.70	1080	3.20	1128	1.75	1173	2.90

ECG is a registered trademark of the Sylvania Corporation.

Call These Toll-Free 24 Hour Hot Lines
1-800-543-3538 or 1-800-543-3528
(In Ohio call 513-254-6283) TL X 288349

mem audio, inc.
Your original Japanese semiconductor supplier
639 Water-Hol Avenue, Dayton, Ohio 45420

KITS—COMPONENTS

KITS—components, retail, wholesale, LED's, IC's, sockets, etc. Free catalog. WIZARD ELECTRONICS, 24 E. Central, Toledo, OH 43608

HIGHLY PROFITABLE ONE-MAN ELECTRONIC FACTORY

Investment unnecessary. Knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! Postcard will do. Barta-RE-C, Box 248, Walnut Creek, CA 94597.

FOR SALE

RADIO & TV tubes 49¢ each. One year guaranteed. Plus many unusual electronic bargains. Free catalog. CORNELL, 4217-E University, San Diego, Calif. 92105

PRINTED circuit boards: Your artwork, quick delivery, reasonable. Quantity discounts. ATLAS CIRCUITS, Box 974, Waynesville, NC 28786 (704) 456-3739

RAW speakers and finished systems for HI-FI and Sound Reinforcement. Also cabinet plans, hardware, grille cloth, crossovers, microphones, accessories, much more. Information-packed catalog, \$1.00. UNIVERSAL DISCOUNT SOUND, Dept. RE, 2243 Ringling Blvd, Sarasota, FL 33577

ALARM systems! Burglar, fire, car. Finest equipment! Save! Catalog, decal; 50¢, refundable! AAS, 186H Oxmoor Road, B'ham, AL 35209

VARIABLE television tuners. These are small high performance units with separate VHF and UHF tuners. With data, new \$19.75 ppd. USA. L.R. DESIGN, Box 41, McMinnville, OR 97128

RESISTORS 1/4W, 1/2W 5% carbon film. All values 2.2 ohms through 4.7 megohms 3¢ each plus \$1.00 shipping. JR INDUSTRIES, 5834-C Swancreek, Toledo, Ohio 43614

PICTURE TUBE MACHINE

We buy and sell NEW and USED CRT rebuilding machinery. COMPLETE TRAINING. Buy with CONFIDENCE from the ORIGINAL MFR.

For complete details send name, address zip to:

LAKESIDE INDUSTRIES
4071 N. Elston Avenue
Chicago, Ill. 60618
Phone: 312-583-9585



SCANNER/monitor accessories—kits and factory assembled. Free catalog. CAPRI ELECTRONICS, Route 1R, Canon, GA 30520

FREE catalog, IC's, LED's, semi's, parts. CORONET ELECTRONICS, 649A Notre Dame W., Montreal, Que., Canada H3C 1H8. U.S. Inquiries.

RECONDITIONED test equipment. \$1.00 for catalog. JAMES WALTER TEST EQUIPMENT, 2687 Nickel, San Pablo, CA 94806

HAMS, CBers, SWLs—eight character morse-A-word morse code reader; RTTY reader. Decodes signals off the air. Send for details. MICROCRAFT CORPORATION, Box 513R, Thiensville, WI 53092 1-414-241-8144.

"SECRET Registry of U.S. Government Radio Frequencies (25 to 470 MHz)." Book shows 3,800+ frequencies: FBI, FCC, Treasury, Border, Immigration, Secret Service, Customs, NASA, military, more. \$4.95 ppd., CRB RESEARCH, Box 56-RE, Commack, NY 11725

SAVE up to 50% on name brand test equipment. Free catalog and price list. SALEN ELECTRONICS, Box 82-M, Skokie, IL 60077

FUZZ BUSTER II Multiband \$79.99. Range Booster \$10.00. Bearfinder \$69.99. Catalogue 2.00 refundable. MSE, Box 936EL, Woodside, NY 11377

TEST equipment, new and used. Catalog \$1.00. PTI, Box 8756, White Bear Lake, MN 55110

PHONE-GUARD alerts you to taps, bugs, eavesdroppers with a red light. Unscrew phone mouthpiece, screw Phone-Guard on. BENNIES, Dept. RE, 1423 E 36th, Houston, TX 77022.

GOVERNMENT surplus receivers, transmitters, snooper scopes, parts, fantastic 72 page catalog 25¢. MESHNA, Nahant, Mass. 01908

TELEVISION downconverters, 1.6-2.7 GHz, \$99.95 assembled. Details for stamp. GW ELECTRONICS, POB 688, Greenwood, IN 46142

OSCILLOSCOPE, DC to 22 MHz, Dual Trace, Navy equivalent to HP170, \$199. HAMMOND, 1013 Lafayette Ave, Colonial Heights, VA 23834

4 in CAPACITANCE METER 1pF to 999KpF
FREQUENCY COUNTER 35MHz
SQUARE WAVE GEN. 1Hz to 99KHz-
OHMMETER - 3.58MHz Xtal - Regulated PS - Five 8" Readouts - Low cost TTL Circuits - Automatic Decimal Placement - Be AMAZED - Satisfaction Guaranteed. I purchase the plans, etched P.C. board 4-3/4" by 6-3/4" and front panel decal for \$15.29! BAGNALL ELECTRONICS, 179 May Street, Fairfield, Conn. 06430

PLANS & KITS

ELECTRONIC organ kits. The ultimate design. Sounds like a pipe organ. Build it to sell or build it to keep. Models for churches, homes, clubs, pizza parlors. Send \$2.00 for demo record and catalog. DEVTRONIX, Dept. 70, 6101 Warehouse Way, Sacramento, CA 95826

PRINTED circuit boards from sketch or artwork. Kit projects. Free details. DANOCINTHS INC., Box 261, Westland, MI 48185

SPEAKERS. Save 50%. Build your own speaker system. "Free catalog" write: MC GEE RADIO, RE 1901, McGee Street, Kansas City, MO 64108

NEGATIVE ion generator plans, \$4.00. Kits, other plans available, free list. STARWIND, Box 712, Goleta, CA 93017.

INSTRUCTIONS and PC negatives, frequency counter 30MHz \$5.00, clock 4 digit \$2.50. RCS ENTERPRISES, Box 488, Sierra Vista, AZ 85635

SATELLITE TV antenna build for \$300. Detailed plans \$30. NUMAN ENTERPRISES, Rt. 1, Box 357, Jonesboro, TE 37659

OPTOAUDIO entertainment systems! And other construction guides. Also join our newsletter. SASE for free information. GEORGE QUIROGA, 1515 Farmstead, Hacienda Heights, CA 91745

Convert Your Car Into A Concert Hall!



AUTOMATIC RADIO

MADE BY THE AUTO RADIO SPECIALISTS!!

Models May Vary
PUSH BUTTONS

AM-FM

19⁹⁵
\$3.00 Shpg.
Delta No. 5785R

\$100 AM-FM AUTO RADIO

FACTORY CLOSEOUT! One of America's largest manufacturers of auto radios has given up. We've been fortunate in acquiring the last auto radios in production. These are AM-FM sets...designed for new cars. All are tested 100% operational and come with knobs and push buttons. Ideal for installing in your auto, van, camper, boat.

NEWS ITEM! Auto hi-fi has become as sophisticated as home hi-fi — and nearly as expensive. You can spend \$200 for simple components—which means hi-fi can be out of reach for many folks and 2nd cars. If you want hi-fi FM, you can start with the purchase of a \$100 radio for a mere \$19.95.... This price will not last long—order today!



Quality Speakers For Above Radios

Delta No.	Size	Type	Ohms	Watts	Magnet	Mic. Ctrs.	Each
60010R	6x9	Oval	8	10	2-3/4" R.d.	6 1/2 x 4 1/4"	\$7.95
5730R	6	Round	8	3	2-3/8" "	5-5/8"	5.95
60013R	5	Round	4 & 8	12	3" R.d.	3-7/8"	7.95
60014R	5	Round	4 & 8	12	3-1/4" R.d.	3-7/8"	9.95
60011R	4x6	Oval	8	10	2-5/8" Sq.	5 1/4 x 3"	5.95
60026R	4x6	Oval	8	10	2-3/8" R.d.	5 1/4 x 3"	5.95

•• High compliance stereo speakers

High Power TRANSFORMER

29⁹⁵ RARE FIND!

Delta No. G 996R

\$100 Value

Secondary

1 - 115V @ 5.5 Amps 3 - 15V @ 4.5 Amps 5 - 15V @ 5.0 Amps
2 - 32V @ 1.4 Amps 4 - 11V @ 1.75 Amps 6 - 15V @ 5.0 Amps

This transformer is one of the most versatile high power transformers we have ever sold. It has 6 heavy duty windings, and a dual tapped primary. It has isolation winding rated at over 630 VA, plus 5 other windings. Proper selection of the primary taps will allow the various secondary voltages to be varied by ± 15%. The transformer may be used on 115 or 230 volts, by putting the primaries in series or parallel. All output voltages may be reduced half if the primary windings are placed in series and operated on 115 volts. We provide a data sheet showing many of the voltage possibilities of this flexible transformer. Listed are the rated voltages. These currents are extremely conservative. We have drawn as much as 25% more, still keeping with our own ratings. Wt. 39 lbs. 6 1/2" x 5 1/2" x 7 1/2"

For computers, high power amps, lab supplies, bench supplies, etc.

Resistor Assortment Each 1/2¢

\$3 APPROX. 700 pcs.

We have several million resistors—all cut and formed for P.C. boards. They are 6 1/2-watt carbon film. Rather than count them, we are weighing 'em out by the 1/2-Lb....and, find that they average about 700 pieces to the 1/2-Lb....making the price per resistor less than 1/2 cent each. This is a great way to build up an inventory for your work bench. Has a large number of mixed values. No. 8926R

MAIL-ORDER ADDRESS:

Be sure to include postage

Video Cube TV Interface! \$12.95

The perfect interface between your computer and TV set. Allows you to use your set without any further outlay for a video terminal. Works on both b & w and color TV's. Comes with 300 film output & selector switch for switching from TV to computer. Traces about 10 mils at 5V to 15V. This meets all FCC requirements for this type of device. Includes complete instructions & reprint of the article "The Versatile Videocube" by Glen Dash No. 5499R 2 for \$24

FREE 120-PG. SURPLUS CATALOG

DELTA ELECTRONICS

176 SECOND AVE. WALTHAM, MASS. 02154
Minimum Order \$8.00
TEL. (617) 388-4705

Master Charge VISA

Low Cost...High Performance

DIGITAL MULTIMETER



\$99.95 WIRED

Low cost, high performance, that's the DM-700. Unlike some of the hobby grade DMMs available, the DM-700 offers professional quality performance and appearance at a hobbyist price. It features 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3 1/2 digit, 1/2 inch high LED display, with automatic decimal placement, automatic polarity, and overrange indication. You can depend upon the DM-700, state-of-the-art components such as a precision laser trimmed resistor array, semiconductor band gap reference, and reliable LSI circuitry insure lab quality performance for years to come. Basic DC volts and ohms accuracy is 0.1%, and you can measure voltage all the way from 100 μ V to 1000 volts, current from 0.1 μ A to 2.0 amps and resistance from 0.1 ohms to 20 megohms. Overload protection is inherent in the design of the DM-700, 1250 volts, AC or DC on all ranges, making it virtually goof proof. Power is supplied by four 'C' size cells, making the DM-700 portable, and, as options, a nicad battery pack and AC adapter are available. The DM-700 features a handsome, jet black, rugged ABS case with convenient retractable tilt ball. All factory wired units are covered by a one year limited warranty and kits have a 90 day parts warranty.

Order a DM-700, examine it for 10 days, and if you're not satisfied in every way, return it in original form for a prompt refund.

Specifications

DC and AC volts: 100 μ V to 1000 Volts, 5 ranges
 DC and AC current: 0.1 μ A to 2.0 Amps, 5 ranges
 Resistance: 0 Ω to 20 megohms, 6 ranges
 Input protection: 1250 volts AC/DC all ranges fuse protected for overcurrent
 Input impedance: 10 megohms, DC/AC volts
 Display: 3 1/2 digits, 0.5 inch LED
 Accuracy: 0.1% basic DC volts
 Power: 4 'C' cells, optional nicad pack, or AC adapter
 Size: 6"W x 3"H x 6"D
 Weight: 2 lbs with batteries

Prices

DM-700 wired + tested	\$99.95
DM-700 kit form	79.95
AC adapter/charger	4.95
Nicad battery pack	16.95
Probe kit	3.95

TERMS: Satisfaction guaranteed or money refunded. COD, add \$1.50. Minimum order \$6.00. Orders under \$10.00, add \$.75. Add 5% for postage, insurance, handling. Overseas, add 15%. NY residents, add 7% tax.



600 mHz COUNTER



\$99.95 WIRED

The CT-70 breaks the price barrier on lab quality frequency counters. No longer do you have to settle for a kit, half-kit or poor performance, the CT-70 is completely wired and tested, features professional quality construction and specifications, plus is covered by a one year warranty. Power for the CT-70 is provided by four 'AA' size batteries or 12 volts, AC or DC, available as options are a nicad battery pack, and AC adapter. Three selectable frequency ranges, each with its own pre-amp, enable you to make accurate measurements from less than 10 Hz to greater than 600 mHz. All switches are conveniently located on the front panel for ease of operation, and a single input jack eliminates the need to change cables as different ranges are selected. Accurate readings are insured by the use of a large 0.4 inch seven digit LED display, a 1.0 ppm TCXO time base and a handy LED gate light indicator.

The CT-70 is the answer to all your measurement needs. In the field, in the lab, or in the ham shack. Order yours today, examine it for 10 days, if you're not completely satisfied, return the unit for a prompt and courteous refund.

Specifications

Frequency range: 10 Hz to over 600 mHz
 Sensitivity: less than 25 mv to 150 mHz
 less than 150 mv to 600 mHz
 Stability: 1.0 ppm, 20-40°C; 0.05 ppm/°C TCXO crystal time base
 Display: 7 digits, LED, 0.4 inch height
 Input protection: 50 VAC to 60 mHz, 10 VAC to 600 mHz
 Input impedance: 1 megohm, 6 and 60 mHz ranges 50 ohms, 600 mHz range
 Power: 4 'AA' cells, 12 V AC/DC
 Gate: 0.1 sec and 1.0 sec LED gate light
 Decimal point: Automatic, all ranges
 Size: 5"W x 1 1/2"H x 5 1/2"D
 Weight: 1 lb with batteries

Prices

CT-70 wired + tested	\$99.95
AC adapter	4.95
Nicad pack with AC adapter/charger	9.95
Telescopic whip antenna, BNC plug	7.95
Tilt ball assembly	3.95
CT-70 Kit Form	75.95

ramsey electronics

BOX 4072, ROCHESTER, N.Y. 14610
 PHONE ORDERS CALL
 (716) 271-6487

MAY 1980



NEW PRODUCTS!

Super Color S-100 Video Kit \$99.95
Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, 280 etc.

Grenlin Color Video Kit \$59.95
32 x 16 alpha/numerals and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. Not expandable to high resolution Graphics.

Quest Super Basic

Quest, the leader in inexpensive 1802 systems announces another first. Quest is the first company worldwide to ship a full size Basic for 1802 systems. A complete function Super Basic by Ron Kantor including floating point capability with scientific notation (number range $\pm 17E^{23}$). 32 bit integer ± 2 billion; Multi dim arrays; String arrays; String manipulation; Cassette I/O. Save and load, Basic, Data and machine language programs; and over 75 Statements, Functions and Operators.

Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user

programs. Cassette version in stock now. ROM versions coming soon with exchange privilege allowing some credit for cassette version.

Super Basic on Cassette \$40.00

Tom Pittman's 1802 Tiny Basic Source listing now available. Find out how Tom Pittman wrote Tiny Basic and how to get the most out of it. Never offered before. \$19.00.

S-100 4-Slot Expansion \$9.95

Super Monitor V.I. Source Listing \$15.00

Coming Soon: Assembler, Editor, Disassembler, DA/AD, Super Sound/Music, EPROM programmer, Stringy floppy Disc System.



RCA Cosmac Super Elf Computer \$106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the Super Elf for so little money. The Super Elf is a small single board computer that does many big things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.

A 24 key HEX keyboard includes 16 HEX keys plus load, reset, run, wait, input, memory protect, monitor select and single step. Large, on board displays provide output and optional high and low address. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for all IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. Including a series of lessons to help get you started and a music program and graphics target game.

Before you buy another small computer, see if it includes the following features: ROM monitor, State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of In warranty repairs; Full documentation.

The Super Elf includes a ROM monitor for program loading, editing and execution with SINGLE STEP for program debugging which is not included in others at the same price. With SINGLE STEP you can see the microprocessor chip operating with the unique Quest address and data bus displays before, during and after executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

Remember, other computers only offer Super Elf features at additional cost or not at all. Compare before you buy. Super Elf Kit \$106.95, High address option \$8.95, Low address option \$9.95. Custom Cabinet with drilled and labeled plexiglass front panel \$24.95. Expansion Cabinet with room for 4 S-100 boards \$41.00. NiCad Battery Memory Saver Kit \$6.95. All lots and options also completely assembled and tested. Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for \$12.00 per year. Issues 1-12 bound \$16.50.

An RCA 1861 video graphics chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a speaker system included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

Tiny Basic Cassette \$10.00, on ROM \$38.00, original Elf kit board \$14.95, 1802 software; Moew's Video Graphics \$5.50, Games and Music \$3.00, Chip 8 Interpreter \$5.50.

Super Expansion Board with Cassette Interface \$89.95

This is truly an astounding value! This board has been designed to allow you to decide how you want it optioned. The Super Expansion Board comes with 4K of low power RAM fully addressable anywhere in 64K with built-in memory protect and a cassette interface. Provisions have been made for all other options on the same board and it fits neatly into the hardware cabinet alongside the Super Elf. The board includes slots for up to 6K of EPROM (2708, 2758, 2716 or TI 2716) and is fully socketed. EPROM can be used for the monitor and Tiny Basic or other purposes.

subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the Super Expansion Board and Super Monitor the monitor is up and running at the push of a button.

Other on board options include Parallel Input and Output Ports with full handshake. They allow easy connection of an ASCII keyboard to the input port. RS 232 and 20 ma Current Loop for teletype or other device are on board and if you need more memory there are two S-100 slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. Parallel I/O Ports \$9.85, RS 232 \$4.50, TTY 20 ma I/F \$1.95, S-100 \$4.50. A 50 pin connector set with ribbon cable is available at \$15.25 for easy connection between the Super Elf and the Super Expansion Board.

A 1K Super ROM Monitor \$19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette reader/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

Same day shipment. Firstline parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

74001	LM2236	5	85	CD4027	1.28
74002	LM2237	17	110	CD4027	1.10
74003	LM2238	15	150	CD4023	74
74004	LM2239	15	180	CD4024	73
74005	LM2240	15	180	CD4025	73
74006	LM2241	15	180	2111-1	3.70
74007	LM2242	15	180	2111-2	3.70
74008	LM2243	15	180	2111-3	3.70
74009	LM2244	15	180	2111-4	3.70
74010	LM2245	15	180	2111-5	3.70
74011	LM2246	15	180	2111-6	3.70
74012	LM2247	15	180	2111-7	3.70
74013	LM2248	15	180	2111-8	3.70
74014	LM2249	15	180	2111-9	3.70
74015	LM2250	15	180	2111-10	3.70
74016	LM2251	15	180	2111-11	3.70
74017	LM2252	15	180	2111-12	3.70
74018	LM2253	15	180	2111-13	3.70
74019	LM2254	15	180	2111-14	3.70
74020	LM2255	15	180	2111-15	3.70
74021	LM2256	15	180	2111-16	3.70
74022	LM2257	15	180	2111-17	3.70
74023	LM2258	15	180	2111-18	3.70
74024	LM2259	15	180	2111-19	3.70
74025	LM2260	15	180	2111-20	3.70
74026	LM2261	15	180	2111-21	3.70
74027	LM2262	15	180	2111-22	3.70
74028	LM2263	15	180	2111-23	3.70
74029	LM2264	15	180	2111-24	3.70
74030	LM2265	15	180	2111-25	3.70
74031	LM2266	15	180	2111-26	3.70
74032	LM2267	15	180	2111-27	3.70
74033	LM2268	15	180	2111-28	3.70
74034	LM2269	15	180	2111-29	3.70
74035	LM2270	15	180	2111-30	3.70
74036	LM2271	15	180	2111-31	3.70
74037	LM2272	15	180	2111-32	3.70
74038	LM2273	15	180	2111-33	3.70
74039	LM2274	15	180	2111-34	3.70
74040	LM2275	15	180	2111-35	3.70
74041	LM2276	15	180	2111-36	3.70
74042	LM2277	15	180	2111-37	3.70
74043	LM2278	15	180	2111-38	3.70
74044	LM2279	15	180	2111-39	3.70
74045	LM2280	15	180	2111-40	3.70
74046	LM2281	15	180	2111-41	3.70
74047	LM2282	15	180	2111-42	3.70
74048	LM2283	15	180	2111-43	3.70
74049	LM2284	15	180	2111-44	3.70
74050	LM2285	15	180	2111-45	3.70
74051	LM2286	15	180	2111-46	3.70
74052	LM2287	15	180	2111-47	3.70
74053	LM2288	15	180	2111-48	3.70
74054	LM2289	15	180	2111-49	3.70
74055	LM2290	15	180	2111-50	3.70
74056	LM2291	15	180	2111-51	3.70
74057	LM2292	15	180	2111-52	3.70
74058	LM2293	15	180	2111-53	3.70
74059	LM2294	15	180	2111-54	3.70
74060	LM2295	15	180	2111-55	3.70
74061	LM2296	15	180	2111-56	3.70
74062	LM2297	15	180	2111-57	3.70
74063	LM2298	15	180	2111-58	3.70
74064	LM2299	15	180	2111-59	3.70
74065	LM2300	15	180	2111-60	3.70
74066	LM2301	15	180	2111-61	3.70
74067	LM2302	15	180	2111-62	3.70
74068	LM2303	15	180	2111-63	3.70
74069	LM2304	15	180	2111-64	3.70
74070	LM2305	15	180	2111-65	3.70
74071	LM2306	15	180	2111-66	3.70
74072	LM2307	15	180	2111-67	3.70
74073	LM2308	15	180	2111-68	3.70
74074	LM2309	15	180	2111-69	3.70
74075	LM2310	15	180	2111-70	3.70
74076	LM2311	15	180	2111-71	3.70
74077	LM2312	15	180	2111-72	3.70
74078	LM2313	15	180	2111-73	3.70
74079	LM2314	15	180	2111-74	3.70
74080	LM2315	15	180	2111-75	3.70
74081	LM2316	15	180	2111-76	3.70
74082	LM2317	15	180	2111-77	3.70
74083	LM2318	15	180	2111-78	3.70
74084	LM2319	15	180	2111-79	3.70
74085	LM2320	15	180	2111-80	3.70
74086	LM2321	15	180	2111-81	3.70
74087	LM2322	15	180	2111-82	3.70
74088	LM2323	15	180	2111-83	3.70
74089	LM2324	15	180	2111-84	3.70
74090	LM2325	15	180	2111-85	3.70
74091	LM2326	15	180	2111-86	3.70
74092	LM2327	15	180	2111-87	3.70
74093	LM2328	15	180	2111-88	3.70
74094	LM2329	15	180	2111-89	3.70
74095	LM2330	15	180	2111-90	3.70
74096	LM2331	15	180	2111-91	3.70
74097	LM2332	15	180	2111-92	3.70
74098	LM2333	15	180	2111-93	3.70
74099	LM2334	15	180	2111-94	3.70
74100	LM2335	15	180	2111-95	3.70
74101	LM2336	15	180	2111-96	3.70
74102	LM2337	15	180	2111-97	3.70
74103	LM2338	15	180	2111-98	3.70
74104	LM2339	15	180	2111-99	3.70
74105	LM2340	15	180	2111-100	3.70
74106	LM2341	15	180	2111-101	3.70
74107	LM2342	15	180	2111-102	3.70
74108	LM2343	15	180	2111-103	3.70
74109	LM2344	15	180	2111-104	3.70
74110	LM2345	15	180	2111-105	3.70
74111	LM2346	15	180	2111-106	3.70
74112	LM2347	15	180	2111-107	3.70
74113	LM2348	15	180	2111-108	3.70
74114	LM2349	15	180	2111-109	3.70
74115	LM2350	15	180	2111-110	3.70
74116	LM2351	15	180	2111-111	3.70
74117	LM2352	15	180	2111-112	3.70
74118	LM2353	15	180	2111-113	3.70
74119	LM2354	15	180	2111-114	3.70
74120	LM2355	15	180	2111-115	3.70
74121	LM2356	15	180	2111-116	3.70
74122	LM2357	15	180	2111-117	3.70
74123	LM2358	15	180	2111-118	3.70
74124	LM2359	15	180	2111-119	3.70
74125	LM2360	15	180	2111-120	3.70
74126	LM2361	15	180	2111-121	3.70
74127	LM2362	15	180	2111-122	3.70
74128	LM2363	15	180	2111-123	3.70
74129	LM2364	15	180	2111-124	3.70
74130	LM2365	15	180	2111-125	3.70
74131	LM2366	15	180	2111-126	3.70
74132	LM2367	15	180	2111-127	3.70
74133	LM2368	15	180	2111-128	3.70
74134	LM2369	15	180	2111-129	3.70
74135	LM2370	15	180	2111-130	3.70
74136	LM2371	15	180	2111-131	3.70
74137	LM2372	15	180	2111-132	3.70
74138	LM2373	15	180	2111-133	3.70
74139	LM2374	15	180	2111-134	3.70
74140	LM2375	15	180	2111-135	3.70
74141	LM2376	15	180	2111-136	3.70
74142	LM2377	15	180	2111-137	3.70
74143	LM2378	15	180	2111-138	3.70
74144	LM2379	15	180	2111-139	3.70
74145	LM2380	15	180	2111-140	3.70
74146	LM2381	15	180	2111-141	3.70
74147	LM2382	15	180	2111-142	3.70
74148	LM2383	15	180	2111-143	3.70
74149	LM2384	15	180	2111-144	3.70
74150	LM2385	15	180	2111-145	3.70
74151	LM2386	15	180	2111-146	3.70
74152	LM2387	15	180	2111-147	3.70
74153	LM2388	15	180	2111-148	3.70
74154	LM2389	15	180	2111-149	3.70
74155	LM2390	15	180	2111-150	3.70
74156	LM2391	15	180	2111-151	3.70
74157	LM2392	15	180	2111-152	3.70
74158	LM2393	15	180	2111-153	3.70
74159	LM2394	15	180	2111-154	3.70
74160	LM2395	15	180		

7400 74LS00

SN7400N	19	SN74123N	38	74LS00N	33	74LS164N	119
SN7401N	22	SN74125N	39	74LS01N	28	74LS166N	248
SN7402N	22	SN74126N	44	74LS02N	28	74LS166N	248
SN7403N	22	SN74128N	59	74LS03N	28	74LS168N	189
SN7404N	22	SN74132N	69	74LS04N	39	74LS168N	189
SN7405N	23	SN74136N	95	74LS05N	28	74LS172N	150
SN7406N	23	SN74139N	95	74LS06N	39	74LS173N	89
SN7407N	23	SN74141N	95	74LS07N	39	74LS174N	89
SN7408N	26	SN74142N	295	74LS10N	26	74LS175N	99
SN7409N	23	SN74143N	295	74LS11N	39	74LS181N	230
SN7410N	23	SN74144N	295	74LS12N	39	74LS182N	115
SN7411N	26	SN74145N	82	74LS13N	47	74LS191N	115
SN7412N	29	SN74147N	195	74LS14N	125	74LS192N	99
SN7413N	29	SN74148N	120	74LS15N	39	74LS193N	99
SN7414N	29	SN74150N	120	74LS20N	26	74LS194N	115
SN7415N	29	SN74151N	87	74LS21N	39	74LS194N	95
SN7416N	20	SN74152N	87	74LS22N	39	74LS194N	99
SN7420N	22	SN74153N	87	74LS24N	39	74LS197N	89
SN7421N	35	SN74154N	119	74LS27N	39	74LS221N	149
SN7422N	20	SN74155N	82	74LS28N	39	74LS240N	299
SN7423N	29	SN74156N	99	74LS29N	26	74LS240N	249
SN7425N	29	SN74157N	99	74LS32N	39	74LS242N	229
SN7426N	29	SN74158N	165	74LS33N	79	74LS243N	229
SN7427N	29	SN74160N	99	74LS36N	39	74LS244N	295
SN7429N	25	SN74161N	99	74LS40N	26	74LS249N	895
SN7430N	41	SN74162N	99	74LS41N	26	74LS249N	110
SN7432N	29	SN74163N	87	74LS47N	29	74LS249N	110
SN7437N	29	SN74164N	97	74LS48N	79	74LS249N	169
SN7438N	29	SN74165N	97	74LS51N	26	74LS251N	170
SN7439N	29	SN74166N	120	74LS54N	38	74LS252N	99
SN7440N	24	SN74167N	99	74LS55N	38	74LS257N	99
SN7441N	79	SN74170N	169	74LS73N	49	74LS258N	99
SN7442N	87	SN74172N	595	74LS74N	59	74LS258N	295
SN7443N	79	SN74173N	79	74LS75N	88	74LS260N	59
SN7444N	79	SN74174N	99	74LS78N	45	74LS261N	249
SN7445N	79	SN74175N	99	74LS79N	65	74LS261N	59
SN7446N	79	SN74176N	85	74LS83AN	99	74LS273N	175
SN7447N	59	SN74177N	85	74LS85N	110	74LS275N	440
SN7448N	79	SN74179N	85	74LS86N	45	74LS279N	99
SN7449N	23	SN74180N	170	74LS89N	75	74LS283N	110
SN7450N	23	SN74181N	375	74LS92N	79	74LS283N	129
SN7451N	23	SN74182N	75	74LS93N	75	74LS293N	199
SN7452N	23	SN74183N	195	74LS95N	88	74LS295N	110
SN7453N	23	SN74184N	195	74LS96N	98	74LS296N	129
SN7454N	23	SN74185N	195	74LS107N	45	74LS324N	179
SN7455N	23	SN74186N	955	74LS107N	45	74LS324N	179
SN7456N	23	SN74187N	955	74LS108N	88	74LS327N	199
SN7457N	23	SN74188N	955	74LS112N	49	74LS346N	189
SN7458N	23	SN74189N	955	74LS113N	49	74LS346N	189
SN7459N	23	SN74190N	115	74LS114N	49	74LS352N	165
SN7460N	36	SN74191N	115	74LS114N	55	74LS353N	165
SN7461N	36	SN74192N	85	74LS114N	55	74LS353N	165
SN7462N	36	SN74193N	85	74LS122N	55	74LS363N	149
SN7463N	36	SN74194N	95	74LS123N	55	74LS363N	149
SN7464N	460	SN74195N	85	74LS124N	135	74LS366N	99
SN7465N	59	SN74196N	85	74LS125N	89	74LS367N	99
SN7466N	110	SN74197N	85	74LS126N	89	74LS368N	99
SN7467N	110	SN74198N	139	74LS132N	79	74LS373N	275
SN7468N	110	SN74199N	139	74LS133N	79	74LS373N	275
SN7469N	85	SN74200N	139	74LS134N	89	74LS375N	275
SN7470N	85	SN74201N	139	74LS138N	89	74LS375N	275
SN7471N	85	SN74202N	139	74LS139N	89	74LS375N	275
SN7472N	85	SN74203N	139	74LS139N	89	74LS375N	275
SN7473N	85	SN74204N	139	74LS145N	125	74LS385N	195
SN7474N	85	SN74205N	139	74LS145N	125	74LS385N	195
SN7475N	85	SN74206N	139	74LS145N	125	74LS385N	195
SN7476N	85	SN74207N	139	74LS145N	125	74LS385N	195
SN7477N	85	SN74208N	139	74LS145N	125	74LS385N	195
SN7478N	85	SN74209N	139	74LS145N	125	74LS385N	195
SN7479N	85	SN74210N	139	74LS145N	125	74LS385N	195
SN7480N	85	SN74211N	139	74LS145N	125	74LS385N	195
SN7481N	85	SN74212N	139	74LS145N	125	74LS385N	195
SN7482N	85	SN74213N	139	74LS145N	125	74LS385N	195
SN7483N	85	SN74214N	139	74LS145N	125	74LS385N	195
SN7484N	85	SN74215N	139	74LS145N	125	74LS385N	195
SN7485N	85	SN74216N	139	74LS145N	125	74LS385N	195
SN7486N	85	SN74217N	139	74LS145N	125	74LS385N	195
SN7487N	85	SN74218N	139	74LS145N	125	74LS385N	195
SN7488N	85	SN74219N	139	74LS145N	125	74LS385N	195
SN7489N	85	SN74220N	139	74LS145N	125	74LS385N	195
SN7490N	85	SN74221N	139	74LS145N	125	74LS385N	195
SN7491N	85	SN74222N	139	74LS145N	125	74LS385N	195
SN7492N	85	SN74223N	139	74LS145N	125	74LS385N	195
SN7493N	85	SN74224N	139	74LS145N	125	74LS385N	195
SN7494N	85	SN74225N	139	74LS145N	125	74LS385N	195
SN7495N	85	SN74226N	139	74LS145N	125	74LS385N	195
SN7496N	85	SN74227N	139	74LS145N	125	74LS385N	195
SN7497N	85	SN74228N	139	74LS145N	125	74LS385N	195
SN7498N	85	SN74229N	139	74LS145N	125	74LS385N	195
SN7499N	85	SN74230N	139	74LS145N	125	74LS385N	195
SN7500N	85	SN74231N	139	74LS145N	125	74LS385N	195
SN7501N	85	SN74232N	139	74LS145N	125	74LS385N	195
SN7502N	85	SN74233N	139	74LS145N	125	74LS385N	195
SN7503N	85	SN74234N	139	74LS145N	125	74LS385N	195
SN7504N	85	SN74235N	139	74LS145N	125	74LS385N	195
SN7505N	85	SN74236N	139	74LS145N	125	74LS385N	195
SN7506N	85	SN74237N	139	74LS145N	125	74LS385N	195
SN7507N	85	SN74238N	139	74LS145N	125	74LS385N	195
SN7508N	85	SN74239N	139	74LS145N	125	74LS385N	195
SN7509N	85	SN74240N	139	74LS145N	125	74LS385N	195
SN7510N	85	SN74241N	139	74LS145N	125	74LS385N	195
SN7511N	85	SN74242N	139	74LS145N	125	74LS385N	195
SN7512N	85	SN74243N	139	74LS145N	125	74LS385N	195
SN7513N	85	SN74244N	139	74LS145N	125	74LS385N	195
SN7514N	85	SN74245N	139	74LS145N	125	74LS385N	195
SN7515N	85	SN74246N	139	74LS145N	125	74LS385N	195
SN7516N	85	SN74247N	139	74LS145N	125	74LS385N	195
SN7517N	85	SN74248N	139	74LS145N	125	74LS385N	195
SN7518N	85	SN74249N	139	74LS145N	125	74LS385N	195
SN7519N	85	SN74250N	139	74LS145N	125	74LS385N	195
SN7520N	85	SN74251N	139	74LS145N	125	74LS385N	195
SN7521N	85	SN74252N	139	74LS145N	125	74LS385N	195
SN7522N	85	SN74253N	139	74LS145N	125	74LS385N	195
SN7523N	85	SN74254N	139	74LS145N	125	74LS385N	195
SN7524N	85	SN74255N	139	74LS145N	125	74LS385N	195
SN7525N	85	SN74256N	139	74LS145N	125	74LS385N	195
SN7526N	85	SN74257N	139	74LS145N	125	74LS385N	195
SN7527N	85	SN74258N	139	74LS145N	125	74LS385N	195
SN7528N	85	SN74259N	139	74LS145N	125	74LS385N	195
SN7529N	85	SN74260N	139	74LS145N	125	74LS385N	195
SN7530N	85	SN74261N	139	74LS145N	125	74LS385N	195
SN7531N	85	SN74262N	139	74LS145N	125	74LS385N	195
SN7532N	85	SN74263N	139	74LS145N	125	74LS385N	195
SN7533N	85	SN74264N	139	74LS145N	125	74LS385N	195
SN7534N	85	SN74265N	139	74LS145N	125	74LS385N	195
SN7535N	85	SN74266N	139	74LS145N	125	74LS385N	195
SN7536N	85	SN74267N	139	74LS145N	125	74LS385N	195
SN7537N	85	SN74268N	139	74LS145N	125	74LS385N	195
SN7538N	85	SN74269N	139	74LS145N	125	74LS385N	195
SN7539N	85	SN74270N	139	74LS145N	125	74LS385N	195
SN7540N	85	SN74271N	139	74LS145N	125	74LS385N	195
SN7541N	85	SN74272N	139	74LS145N	125	74LS385N	195
SN7542N	85	SN74273N	139	74LS145N	125	74LS385N	195
SN7543N	85	SN74274N	139	74LS145N	125	74LS385N	195
SN7544N	85	SN74275N	139	74LS145N	125	74LS385N	195
SN7545N	85	SN74276N	139	74LS145N	125	74LS385N	195
SN7546N	85	SN74277N	139	74LS145N	125	74LS385N	195
SN7547N	85	SN74278N	139	74LS145N	125	74LS385N	195
SN7548N	85	SN74279N	139	74LS145N	125	74LS385N	195
SN7549N	85	SN74280N	139	74LS145N	125	74LS385N	195
SN7550N	85	SN74281N	139	74LS145N	125	74LS385N	195
SN7551N	85	SN74282N	139	74LS145N	125	74LS385N	195
SN7552N	85	SN74283N	139	74LS145N	125	74LS385N	195
SN7553N	85	SN74284N	139	74LS145N	125	74LS385N	195
SN7554N	85	SN74285N	139	74LS145N	125	74LS385N	195
SN7555N	85	SN74286N	139	74LS145N	125	74LS385N	195
SN7556N	85	SN74287N	139	74LS145N	125	74LS385N	195
SN7557N	85	SN74288N	139	74LS145N	125	74LS385N	195
SN7558N	85	SN74289N	139	74LS145N	125	74LS385N	195
SN7559N	85	SN74290N	139	74LS145N	125	74LS385N	195

THERE'S GOLD IN THEM THAR PAKS!!



\$2.99'ERS

ARE PAKS EVEN A 49'ER CAN DIG!

- 200 PC-SEMICON SPECIAL, assorted semis of all types. Untested material, (#3300) \$2.99
- 200-MOTORS MOTORS, ass'd, sizes speeds & types, 1.5-12 volts, (#2551A) 2.99
- 200-ONC LEAD DISCS, prime, marked caps, assorted materials, (#2598) 2.99
- 100-PLASTIC TRANSISTORS, untested, TO-92, ass't. types, (#2604) 2.99
- 50-SLIDE SWITCHES, various shapes, sizes, and types, (#2726) 2.99
- 75-TRANSISTOR ELECTROLYTICS, epoxy encapsulated, ass't. values, (#2747) 2.99
- 250-HALF WATTERS, 100%, color-coded resistors, ass't. values, (#3046) 2.99
- 25-SLIDE VOLUME CONTROLS, various values & voltages, for HI-FI, etc., (#3057) 2.99
- 50-UPRIGHT ELECTROS, 100%, assorted values & types, marked, (#3226) 2.99
- 20-COCKER SWITCHES, white rockers, DPDT, solder lugs, 125V 4A, (#3302A) 2.99
- 50-MINI POTS, pc style, single turn, assorted values, (#3345) 2.99
- 20 JUMBO RED LEDS, 3V 10 mA, 100% good material, red dome lense, (#3369) 2.99
- 3-SOUND TRIGGERS, sound activated amp, SCR triggered, on 3" board, (#3625) 2.99
- 50-TRANSISTOR SOCKETS, assortment may include: TO-18, S, 6, 3, etc. (#3845) 2.99
- 100-CABLE TIES, 4" non-slip white plastic, like Ty-wrap, (#5218) 2.99
- 150-FEEDTHRU CAPS, assorted types & sizes, for RF, UHF, etc., (#5688) 2.99
- 250-WATT 1251STORS, ass'd, carbons, carbon-films, some 5Wets, (#5797A) 2.99
- 100-FLESSY CAPS, ceramic blocks in assorted sizes & values, (#6221) 2.99
- 30-1108BY LEDS, assorted types & colors, mostly dims, some good, (#6225) 2.99
- 100-TTLs, 7400 series, incl. gates, flip-flops, etc., untested, (#6226) 2.99
- 150 PC-HEATSHRINK, slip-over type, shrinks 50%, like Thermo-It, (#6239) 2.99

FREE! FREE!

WITH ANY \$30 ORDER, PICK A \$2.99er FREE!

- 5-BRASS LOCKS, with key, 1 1/2" long, for doors, windows, etc., (#6253) 2.99
- 250-MOLEX SOCKETS, "on-a-strip", make your own pc sockets, (#6255) 2.99
- 4-1M-747 OP AMPS, 100% prime, dual linear op amp, DIP package, (#6262) 2.99
- 50-RECA PHONO PLUGS, popular audio/speaker plugs, 100% material, (#1293) 2.99
- 25-CRYSTALS, assorted types, some HI-U, some frequency marked, (#6256) 2.99
- 150-SUBMINI RF TRANSFORMERS, ass't. may include: mc. antenna, etc., (#6259) 2.99
- 60-SQUARE OHM RESISTORS, prime resistors, ass't. values, grab 'em! (#6261) 2.99
- 30-MICRO MINI REED SWITCHES, 1" long, for alarms, relay systems, etc., (#6263) 2.99
- 200 PC-CAPACITOR SPECIAL, ass't. mylar, polyst, micas, etc. 100% good, (#6264) 2.99
- 20-PUSHBUTTON ALARM SWITCH, SPST, momentary, MC, w/hardware, (#6267) 2.99
- 300-PC-HARDWARE SURPRISE, (approx. 1 lb. ass't. screws, washers, etc., (#6271) 2.99
- 30-9V BATTERY CLIPS, snap connector, coded, insulated leads, (#6284) 2.99
- 6-WATCH CUTS, 5-function, LED style, assorted sizes, untested, (#6287) 2.99
- 10-HEAVY DUTY LINE CORDS, white, 3 cond. 6 ft. 36 gauge, (#6292) 2.99
- 20-SINGLE PIN LEDS, green, micro style, 3V 10mA, 100%, (#6293) 2.99
- 40-LED/TRANSISTOR SOCKETS, "snap-in", 3 pc leads, for TO-5, 18, 46, etc., (#6297) 2.99
- 200-PRE-FORMED 1/2 WATTERS, popular values, some S & 10 Wets, (#6246) 2.99

COMPACT CONDENSOR BOOM MIKE

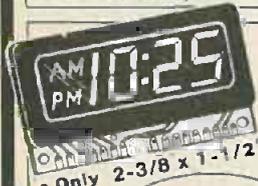
- Space Efficient
- Practical Overhead "Boom" Design
- Minimizes Sound Coloration



Supply Voltage: 9V, Sensitivity: 63 dB @ 1 KHz, (typ.) Frequency Response: 10-15 KHz Imped: 33K ohms @ 1 KHz Size: 3/8" dia. x 1-1/8" With Spec

Cat. No. **\$3.50**
92CU6374 **3 FOR \$9.**

ULTRA-SMALL LCD CHRONOGRAPH MODULE



Multi-Function Memory Enables Module To Function As: **STOPWATCH!**

\$24.50

ELAPSED TIME INDICATOR!
DUAL ZONE TIMER!
ALARM CLOCK!

Cat. No. 92CU6403

"ONE-HANDED" 40 CHANNEL DIGITAL COMPUTER MIKE

Only **\$24.88**

- Digitally Indicates 40 Channels
- Bright 3" Red LED Display
- Built-in Digital Car Clock
- 12 Pushbutton Programmable Keyboard
- All The Controls In The Palm Of Your Hand
- With 6' Coiled Cable & Plug



HOW TO ORDER We honor: MASTERCHARGE, VISA, check, and C.O.D. (25% down/Minimum Order: \$10 Order by phone or mail, state Cat. No. & description, name & month of magazine, POSTAGE: USA; add \$3. CANADIAN; add \$5. FOREIGN; add \$10. (US funds). Excess will be returned. OPEN ACCOUNTS: must be listed & rated in Dun & Bradstreet; Net - 30 PHONE: (617) 249-3828.

SEND FOR FREE CATALOG

POLY PAKS
P.O. BOX 942-RS
SO. LYNNFIELD, MA 01940

CIRCLE 48 ON FREE INFORMATION CARD

MICRO MART

552 Summit Ave.
Westfield, NJ. 07090
(201) 654-6008

MOTION DETECTOR

Completely assembled on circuit board with capacitors
Specs and application notes included—4.95
3 1/2" X 2 X 1 1/4" case with mng tabs/3.00
CRYSTALS—3.579545 MHz 99¢
6.0 MHz 2.95

JUMBO LED's
Green, 7/1.00-Yellow, 7/1.00-Red, 10/1.00
100/13.00 100/13.00 100/9.00
MOUNTING CLIPS—12/1.00

7 SEG Displays (comp. grade)
3"/95¢-6"/1.45 (specify ann. or cath.)
AM/FM RADIO CHIP—(#4408) 2.00 or 3/5.00
Complete AM/FM IC-external IF required

DIPPED TANTALUMS
47 µf 35V (1" leads) 10/1.00

SUPER SUB MINI LYTICS
(1" rad. leads, by Nichicon)
1000µf 50V (1 1/2" L X 1/4" W), 75¢ or 10/6.00
47 µf 25V (3/4" L X 1/4" W), 10/\$1.00
400µf 330V (photo flash or laser circuits)-2/1.00

COMPUTER GRADE TWIST LOCKS
3200µf 50V (ideal for power supplies) 1.00
1000µf 50V—1.00 1000µf 185V—2.00

DISCS—.001 1KV 25/1.00 .1 50V 15/1.00

HEAT SENSITIVE SWITCH—4/1.00
self contained unit opens at 150 C

9 DIGIT FLUORESCENT DISPLAY by NEC
complete with driving circuitry-2.50

EXTRA LOUD 9V BUZZER—3/2.00

WALL PLUG ADAPTER—5VDC @ 160ma-1.50
6.3V 1.2 Amp Transformer—1.75

MINI AUDIO TRANSFORMERS—3/1.00

DIGITAL MOTION/UNIT COUNTER MODULE
(Fairchild) with large 4 digit display & specs-7.00

B035 Microprocessor, 17.00
INTERFACE CHIP-D8243
16 line 1/0 extender for all single chip µ Ps 5.75

**BRAND NEW ITEM
FREQUENCY COUNTER CHIP
ICM 7225 IPL**

(40 pin), with on board dividers, decoders/drivers. 18.95-specs included
A/D CONVERTER by Datal
ADC-MC8BC-8 bit analog to digital converter, high speed-18.00
D/A CONVERTER- DAC-08BC-8 bit-12.00
na 741 OP AMPS (mini-dip) 4/1.00
ZENER DIODES—20V 1 amp 10/1.00
TV SATELLITE TRANSISTOR
MRF 901 (prime) \$4.50

LINEAR			
LM 323K	4.00	LM 1303	.70
LM 300H	70	LM 1304	.95
LM 301AA	30	LM 1305	1.55
LM 307H	50	LM 1307	.60
LM 307	30	LM 1307E	90
LM 308H	85	LM 1310	1.75
LM 308	85	LM 1391	2.00
LM 310	80	LM 1414	1.50
LM 311H	80	LM 1800	70
LM 317K	2.75	LM 1808	2.50
LM 318H	1.10	LM 1829	2.50
LM 320K 15	1.10	LM 1828	2.00
LM 320K 12	1.10	LM 1830	2.25
LM 324	1.10	LM 1841	2.50
LM 325	1.35	LM 1848	2.00
LM 339J	1.00	LM 1889	2.50
LM 340K 12	1.00	LM 2111	1.15
LM 341P 12	80	LM 2113	1.75
LM 343H	3.50	LM 2907	2.00
LM 373	2.50	LM 2917	2.00
LM 377	2.00	LM 3046	1.50
LM 380	1.00	LM 3054	1.50
LM 381	1.25	LM 3064	2.00
LM 384	1.50	LM 3065	2.50
LM 386	1.20	LM 3067	2.50
LM 389	1.20	LM 3070	2.50
LM 390	1.65	LM 3071	2.00
LM 746	2.50	LM 3075	1.25
LM 748CN	30	LM 3089	1.25

Terms MICRO-MART accepts Visa, MC, and telephone C.O.D.'S. Foreign orders \$50.00 minimum plus shipping-US funds only. Orders under \$10.00 include \$2.00 for shipping/handling. All components guaranteed or money refunded. Immediate shipping. N.J. residents add 5% sales tax.
MICRO-MART • 552 SUMMIT AVE., WESTFIELD, N.J. 07090 • (201) 654-6008

CIRCLE 56 ON FREE INFORMATION CARD



Electricity from the sun.
5 Volt panel 1/4 amp \$50 2.5 Volt panel 1/2 amp \$40
GIANT 3 1/2 inch cell, delivers 1 amp \$8.50
Above cell with special motor & prop, runs in sun \$10.25

Computer video monitor chassis 9 inch, 12 volt used \$50
Computer video monitor chassis 12 inch, new \$60
Hy Gain CB chassis, trunk mount \$9.00



Govt surplus walky talky, used cond.
47-55.4 mc range.
Ant. \$5 each extra.
With data.

\$25 ea 2 for \$45
AN/PRC-6

SEE IN THE DARKNESS
IR viewer, portable, new with choice of one lens...close up, telephoto or gen. purpose.
Requires 6 volt DC btry. \$250

PRINTER CENTRONICS # 101
Visually OK, with head.
Sold as is..... \$400.00

Shipping extra on all merchandise



Meshna Inc., PO Box 62, E. Lynn, Mass. 01904

CIRCLE 16 ON FREE INFORMATION CARD

AVAILABLE NOW!

ONLY \$3.95 Add \$1.00 for shipping

JAPANESE TRANSISTOR SUBSTITUTION MANUAL



An invaluable Japanese to Japanese substitution guide for approximately 3000 transistors.

- Covers the 2SA, 2SD, 2SC and 2SD series.
Introduction includes a guide to understanding Japanese transistors.
A 90 page 8 1/2 by 11 soft cover book.

PARTS PROCUREMENT PROBLEMS

FUJI-SVEA Has the Largest Inventory of Original Japanese Parts Anywhere

Seeking Original Japanese Replacement Parts for CB, TV and Stereo Repair Use?

Large table with 5 columns of transistor part numbers and their prices. Columns are labeled TYPE, 25-UP, 10-24, 1-9. Rows list various part numbers like 25A 473, 25A 483, etc., with corresponding prices.

PRICES MAY CHANGE WITHOUT NOTICE COD ORDERS WELCOMED

Minimum order \$5.00 Ohio residents add 4% sales tax Add \$1.00 postage and handling. Quantity discount prices Ask For Our Complete Price List Manufacturer inquiries Welcomed.

IMMEDIATE DELIVERY WITHIN 48 HOURS

All parts guaranteed against factory defect. TOLL FREE TELEPHONE

ON ALL TRANSISTORS IN STOCK

Nationwide 800-543-1607 LOCAL 513/874-0220

FUJI-SVEA ENTERPRISE

a Division of Fuji Svea Incorporated

Ohio 800 583-1630

874-0223

P.O. Box 40325 Cincinnati, Ohio 45240.

Telex 21-4732

Hours Mon-Fri 10-7 Sat 11-5

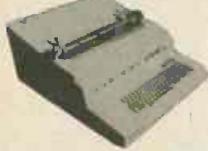
CIRCLE 43 ON FREE INFORMATION CARD



CFR
Associates, Inc.
Newton, N.H. 03858

A MILESTONE PRINTER OFFER!!!

Used **DAISY WHEEL TERMINALS**
Featuring **DIABLO 'HYTYPE' PRINTERS**



- Features:
- KSR & Plot Modes
 - ASCII RS-232 I/O
 - 110, 115, 300 Baud Input
 - Dual Pitch (10,12)
 - 30 Day Guarantee
 - Many More Excl'ing Features!

These used, cleaned and refurbished Daisy Wheel Terminals feature the FAMOUS DIABLO 'HYTYPE' Daisy Wheel Printer with its multitude of capabilities. Includes 1/80" horizontal & 1/48" vertical spacing in the "PLOT" mode - LIMITED OFFER. SPECIAL PRICE!

While They Last! **Now From \$1500!!**

We also offer many types of printers
"Selectric", KSR, RO & More

FOR EXAMPLE

I/O ELECTRIC Printer/Typewriter. Corp. code 15" frame hy duty 735-745 machine and peripherals. etc. Data and schematics included.
Removed Operational Condition. **Only \$469.00** Call For From Word Processors (Price includes crating & shipping within the U.S.) Int'l

MEMORY CHIPS... 'RAMS'

AM9550	\$1.99 ea	2102A	\$1.50 ea
TMS4050	\$1.99 ea	7107	\$3.75 ea
TMS4050	\$2.95 ea	4115	\$11.95 ea
	2101A	\$3.95 ea	

9" (diag.), 12V VIDEO DISPLAYS

- Featuring 12VDC Operation!
- Draws 800 mA @ 78 Volts DC
- NEW in original boxes ready to use!
- LOW, LOW PRICE
- Video Input
- Mfg. by Motorola

ONLY \$89.00

2 FOR \$165.00

Write or Call for Our Exclusive
"USED PERIPHERAL FLYER"

(603)382-5179

- Mastercharge & VISA Accepted
- Phone Orders Are Welcome
- Prices May Not Include Shipping & Handling
- Quantities Are Limited • Prices Are Subject To Change

CIRCLE 59 ON FREE INFORMATION CARD

BSR X-10 SUPER SPECIAL DELUXE ULTRASONIC CONSOLE

REGULARLY \$49.95
NOW \$29.95



With the purchase of
three or more modules
Modules normally \$17.00 ea.
Modules of your choice
3 for \$47.95 6 for \$83.95
Ultrasonic Hand Unit
Normally \$24.95 Now \$18.95
Please add \$3.00 for shipping

TOLL FREE HOT LINE
800-223-0474

54 WEST 45TH STREET, NEW YORK, N.Y. 10038
212-687-2224

ADVANCE ELECTRONICS

LONG PLAY 10 HOUR TAPE RECORDER

Top quality AC-DC cassette recorder, modified to provide 5 continuous hours of recording and playback of true fidelity, distortion-free sound on each side of cassette for a total of 10 hours. Unit has many special built in features. TOK D-C180 cassette supplied. **NOW ONLY 125.00.**



PHONE RECORDING ADAPTER

Record incoming and outgoing calls automatically with this all solid state unit connected to your telephone jack and tape recorder. Starts recording when phone is lifted. Stops when you hang up, making a permanent record. Easily installed. No monthly charges. **FCC APPROVED \$24.50***



VOX VOICE ACTIVATED CONTROL SWITCH

Solid state. Self contained. Excellent adjustable sensitivity. Voices or other sounds activate recorder. Uses recorder mike or remote mike. 2 1/4 x 1 3/4 x 3/4" **\$24.95***



AMAZING ELECTRONIC MICRO MINI MIKE

Among world's smallest, solid state, self contained WIRELESS MIKE. Mercury Bat. furn. Picks up most sounds and transmits without wires up to 300 ft. thru FM Radio. Tunable. Use as mike, ampl., alarm & alert system, baby sitter, hot line, etc. 2-1/4 x 3/4 x 1/2" **\$24.95***



Phone Call Adapter, VOX, MIKE, (* plus \$1.00 ea. ship. & hdg.), 10 hr. Recorder (* plus \$4.00 ship. & hdg.), Calif. res. add tax. Mail Order, VISA, M/C, cod's o.k., quan. dis. avail. Money back guar. Free data.

AMC SALES, Dept. 19, 9335 Lubec St., Box 928, Downey, CA 90241 (213) 869-8519

CIRCLE 60 ON FREE INFORMATION CARD

Z-80

*

\$1250

MISCELLANEOUS CIRCUIT SPECIALS

7408	.20	74LS27	.30	CD4049B	.45
7416	.20	74LS122	.50	MC14520B	1.25
7474	.35	74LS175	.95	MC14528BCP	1.00
74181	1.55	74LS367	.75	NE555	.28
74393	1.85	74LS386	.75	NE556	.75
74LS03	.24	74LS390	.60	1A3900B	.58
74LS08	.32	74LS393	1.95	IC3083T	1.25
74LS09	.38	74S05	.45	C2416	3.99
74LS20	.30	74S15	.50	X2431	1.99

80-COLUMN IMPACT PRINTER

LOWEST IN PRICE... HIGHEST IN PERFORMANCE

Complete file
60 Lines per Sheet
11.5x14.5" 80 or 90 lbs.
Prints 60 or 120 per min.
Character Line
Self start printer

\$599.00

base 2, inc.



4116

16Kx1 Static RAM
MEMORY ADD-ON FOR THE
TRS-80 OR APPLE II™
to 450ms
8 for \$59.95

8038C
VCO Waveform Gen.
w/sine **\$265**

78H05
\$595

video 100

12" BLACK & WHITE
LOW COST VIDEO
MONITOR **\$129.00**



LOGIC PROBE KIT

I.C. MASTER

2708
1024X8 EPROM

\$745

450ns AMD. SGS



SOROC
IQ120

\$749.00

8216 \$199
BUS DRIVER

T.I./M.M.I.
74LS240
74LS241
74LS243
74LS244
74LS373
74LS374
\$245

2716 16K EPROM
\$27.95
450ns single+5V
T.I., HIT., INT., SGS

8212
I/O PORT
3.95

"1980" \$59.95

SILICON SOLAR CELLS
3" 1 AMP
\$7.95



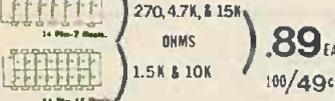
1 1/2" 150 mA
\$2.95

S-100 16K ADD-ON BARE BOARD
WITH DOCUMENTATION AND DETAILED INSTRUCTION BOOK. **\$28.95**

ULN2001
High-current Drivers.
Darlingtons **69c**

16K STATIC RAM
S-100 MEMORY ADD-ON

RESISTOR NETWORKS
values
270, 4.7K, & 15K
OHMS
1.5K & 10K
.89 EA
100/49c



MH0026CJ
DUAL CLOCK DRIVER **\$1.00**

74S373
74S374
\$3.25

2114L
1024 x4 Static RAM
450 ns **\$4.75**

16K STATIC RAM
S-100 MEMORY ADD-ON

16K STATIC RAM
S-100 MEMORY ADD-ON

EPROM ERASER BY SPECTOLINE
UP TO 6 EPROMS IN 19 MINUTES
6000 HOUR BULB LIFE **\$49.95**

CONCORD COMPUTER COMPONENTS

1971 SOUTH STATE COLLEGE - ANAHEIM, CA. 92806

VISA-MASTER CHARGE (714) 937-0637 MINIMUM ORDER-\$10.00
CHECK OR M.O. ADD \$1.50 FOR FRT. ADD CAL. RES. ADD 6%
NO COD. We stock and sell over 12,000 types of semi-conductors

- ** FULLY STATIC OPERATION
- ** USES 2114 TYPE STATIC RAMS
- ** +5 VDC INPUT AT LESS THAN 2 AMPS
- ** BANK SELECT AVAILABLE BY BANK PORT AND BANK BYTE
- ** PHANTOM LINE CAPABILITY
- ** ADDRESSABLE IN 4K BLOCKS IN 4K INCREMENTS
- ** LED INDICATORS FOR BOARD/BANK
- ** SOLDER MASK ON BOTH SIDES OF BOARD

ASSEMBLED & TESTED \$269.00

California Computer Systems

CIRCLE 66 ON FREE INFORMATION CARD

DIGI-KEY CORPORATION

TOLL FREE 1-800-346-5144

Quality Electronic Components

MINN., AK., HI. RESIDENTS 218-681-6674

DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

**I.C.'s • RESISTORS • TRANSISTORS • CAPACITORS • DIODES • I.C. SOCKETS & PINS • SWITCHES
CLOCK MODULES • OPTOELECTRONICS • BREADBOARDING & TESTING DEVICES • DRAFTING SUPPLIES
DATA BOOKS • HEAT SINKS • WIRE • TOOLS ... AND MORE ... WRITE FOR FREE CATALOG ...**

TEXAS INSTRUMENTS I.C. SOCKETS



SOLDER TAIL DIP SOCKETS

• Range of designs for maximum component tolerance
• Replacement socket types
• "YOUR CHOICE" - Two Gold Sockets
• Reduction of 71 pin sockets (only on gold sockets)
• 100% Reliability

THE HEAT TAIL SOLIDER TAIL
Series C-11, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400, 1500, 1600, 1700, 1800, 1900, 2000, 2100, 2200, 2300, 2400, 2500, 2600, 2700, 2800, 2900, 3000, 3100, 3200, 3300, 3400, 3500, 3600, 3700, 3800, 3900, 4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700, 4800, 4900, 5000, 5100, 5200, 5300, 5400, 5500, 5600, 5700, 5800, 5900, 6000, 6100, 6200, 6300, 6400, 6500, 6600, 6700, 6800, 6900, 7000, 7100, 7200, 7300, 7400, 7500, 7600, 7700, 7800, 7900, 8000, 8100, 8200, 8300, 8400, 8500, 8600, 8700, 8800, 8900, 9000, 9100, 9200, 9300, 9400, 9500, 9600, 9700, 9800, 9900, 10000, 10100, 10200, 10300, 10400, 10500, 10600, 10700, 10800, 10900, 11000, 11100, 11200, 11300, 11400, 11500, 11600, 11700, 11800, 11900, 12000, 12100, 12200, 12300, 12400, 12500, 12600, 12700, 12800, 12900, 13000, 13100, 13200, 13300, 13400, 13500, 13600, 13700, 13800, 13900, 14000, 14100, 14200, 14300, 14400, 14500, 14600, 14700, 14800, 14900, 15000, 15100, 15200, 15300, 15400, 15500, 15600, 15700, 15800, 15900, 16000, 16100, 16200, 16300, 16400, 16500, 16600, 16700, 16800, 16900, 17000, 17100, 17200, 17300, 17400, 17500, 17600, 17700, 17800, 17900, 18000, 18100, 18200, 18300, 18400, 18500, 18600, 18700, 18800, 18900, 19000, 19100, 19200, 19300, 19400, 19500, 19600, 19700, 19800, 19900, 20000, 20100, 20200, 20300, 20400, 20500, 20600, 20700, 20800, 20900, 21000, 21100, 21200, 21300, 21400, 21500, 21600, 21700, 21800, 21900, 22000, 22100, 22200, 22300, 22400, 22500, 22600, 22700, 22800, 22900, 23000, 23100, 23200, 23300, 23400, 23500, 23600, 23700, 23800, 23900, 24000, 24100, 24200, 24300, 24400, 24500, 24600, 24700, 24800, 24900, 25000, 25100, 25200, 25300, 25400, 25500, 25600, 25700, 25800, 25900, 26000, 26100, 26200, 26300, 26400, 26500, 26600, 26700, 26800, 26900, 27000, 27100, 27200, 27300, 27400, 27500, 27600, 27700, 27800, 27900, 28000, 28100, 28200, 28300, 28400, 28500, 28600, 28700, 28800, 28900, 29000, 29100, 29200, 29300, 29400, 29500, 29600, 29700, 29800, 29900, 30000, 30100, 30200, 30300, 30400, 30500, 30600, 30700, 30800, 30900, 31000, 31100, 31200, 31300, 31400, 31500, 31600, 31700, 31800, 31900, 32000, 32100, 32200, 32300, 32400, 32500, 32600, 32700, 32800, 32900, 33000, 33100, 33200, 33300, 33400, 33500, 33600, 33700, 33800, 33900, 34000, 34100, 34200, 34300, 34400, 34500, 34600, 34700, 34800, 34900, 35000, 35100, 35200, 35300, 35400, 35500, 35600, 35700, 35800, 35900, 36000, 36100, 36200, 36300, 36400, 36500, 36600, 36700, 36800, 36900, 37000, 37100, 37200, 37300, 37400, 37500, 37600, 37700, 37800, 37900, 38000, 38100, 38200, 38300, 38400, 38500, 38600, 38700, 38800, 38900, 39000, 39100, 39200, 39300, 39400, 39500, 39600, 39700, 39800, 39900, 40000, 40100, 40200, 40300, 40400, 40500, 40600, 40700, 40800, 40900, 41000, 41100, 41200, 41300, 41400, 41500, 41600, 41700, 41800, 41900, 42000, 42100, 42200, 42300, 42400, 42500, 42600, 42700, 42800, 42900, 43000, 43100, 43200, 43300, 43400, 43500, 43600, 43700, 43800, 43900, 44000, 44100, 44200, 44300, 44400, 44500, 44600, 44700, 44800, 44900, 45000, 45100, 45200, 45300, 45400, 45500, 45600, 45700, 45800, 45900, 46000, 46100, 46200, 46300, 46400, 46500, 46600, 46700, 46800, 46900, 47000, 47100, 47200, 47300, 47400, 47500, 47600, 47700, 47800, 47900, 48000, 48100, 48200, 48300, 48400, 48500, 48600, 48700, 48800, 48900, 49000, 49100, 49200, 49300, 49400, 49500, 49600, 49700, 49800, 49900, 50000, 50100, 50200, 50300, 50400, 50500, 50600, 50700, 50800, 50900, 51000, 51100, 51200, 51300, 51400, 51500, 51600, 51700, 51800, 51900, 52000, 52100, 52200, 52300, 52400, 52500, 52600, 52700, 52800, 52900, 53000, 53100, 53200, 53300, 53400, 53500, 53600, 53700, 53800, 53900, 54000, 54100, 54200, 54300, 54400, 54500, 54600, 54700, 54800, 54900, 55000, 55100, 55200, 55300, 55400, 55500, 55600, 55700, 55800, 55900, 56000, 56100, 56200, 56300, 56400, 56500, 56600, 56700, 56800, 56900, 57000, 57100, 57200, 57300, 57400, 57500, 57600, 57700, 57800, 57900, 58000, 58100, 58200, 58300, 58400, 58500, 58600, 58700, 58800, 58900, 59000, 59100, 59200, 59300, 59400, 59500, 59600, 59700, 59800, 59900, 60000, 60100, 60200, 60300, 60400, 60500, 60600, 60700, 60800, 60900, 61000, 61100, 61200, 61300, 61400, 61500, 61600, 61700, 61800, 61900, 62000, 62100, 62200, 62300, 62400, 62500, 62600, 62700, 62800, 62900, 63000, 63100, 63200, 63300, 63400, 63500, 63600, 63700, 63800, 63900, 64000, 64100, 64200, 64300, 64400, 64500, 64600, 64700, 64800, 64900, 65000, 65100, 65200, 65300, 65400, 65500, 65600, 65700, 65800, 65900, 66000, 66100, 66200, 66300, 66400, 66500, 66600, 66700, 66800, 66900, 67000, 67100, 67200, 67300, 67400, 67500, 67600, 67700, 67800, 67900, 68000, 68100, 68200, 68300, 68400, 68500, 68600, 68700, 68800, 68900, 69000, 69100, 69200, 69300, 69400, 69500, 69600, 69700, 69800, 69900, 70000, 70100, 70200, 70300, 70400, 70500, 70600, 70700, 70800, 70900, 71000, 71100, 71200, 71300, 71400, 71500, 71600, 71700, 71800, 71900, 72000, 72100, 72200, 72300, 72400, 72500, 72600, 72700, 72800, 72900, 73000, 73100, 73200, 73300, 73400, 73500, 73600, 73700, 73800, 73900, 74000, 74100, 74200, 74300, 74400, 74500, 74600, 74700, 74800, 74900, 75000, 75100, 75200, 75300, 75400, 75500, 75600, 75700, 75800, 75900, 76000, 76100, 76200, 76300, 76400, 76500, 76600, 76700, 76800, 76900, 77000, 77100, 77200, 77300, 77400, 77500, 77600, 77700, 77800, 77900, 78000, 78100, 78200, 78300, 78400, 78500, 78600, 78700, 78800, 78900, 79000, 79100, 79200, 79300, 79400, 79500, 79600, 79700, 79800, 79900, 80000, 80100, 80200, 80300, 80400, 80500, 80600, 80700, 80800, 80900, 81000, 81100, 81200, 81300, 81400, 81500, 81600, 81700, 81800, 81900, 82000, 82100, 82200, 82300, 82400, 82500, 82600, 82700, 82800, 82900, 83000, 83100, 83200, 83300, 83400, 83500, 83600, 83700, 83800, 83900, 84000, 84100, 84200, 84300, 84400, 84500, 84600, 84700, 84800, 84900, 85000, 85100, 85200, 85300, 85400, 85500, 85600, 85700, 85800, 85900, 86000, 86100, 86200, 86300, 86400, 86500, 86600, 86700, 86800, 86900, 87000, 87100, 87200, 87300, 87400, 87500, 87600, 87700, 87800, 87900, 88000, 88100, 88200, 88300, 88400, 88500, 88600, 88700, 88800, 88900, 89000, 89100, 89200, 89300, 89400, 89500, 89600, 89700, 89800, 89900, 90000, 90100, 90200, 90300, 90400, 90500, 90600, 90700, 90800, 90900, 91000, 91100, 91200, 91300, 91400, 91500, 91600, 91700, 91800, 91900, 92000, 92100, 92200, 92300, 92400, 92500, 92600, 92700, 92800, 92900, 93000, 93100, 93200, 93300, 93400, 93500, 93600, 93700, 93800, 93900, 94000, 94100, 94200, 94300, 94400, 94500, 94600, 94700, 94800, 94900, 95000, 95100, 95200, 95300, 95400, 95500, 95600, 95700, 95800, 95900, 96000, 96100, 96200, 96300, 96400, 96500, 96600, 96700, 96800, 96900, 97000, 97100, 97200, 97300, 97400, 97500, 97600, 97700, 97800, 97900, 98000, 98100, 98200, 98300, 98400, 98500, 98600, 98700, 98800, 98900, 99000, 99100, 99200, 99300, 99400, 99500, 99600, 99700, 99800, 99900, 100000, 100100, 100200, 100300, 100400, 100500, 100600, 100700, 100800, 100900, 101000, 101100, 101200, 101300, 101400, 101500, 101600, 101700, 101800, 101900, 102000, 102100, 102200, 102300, 102400, 102500, 102600, 102700, 102800, 102900, 103000, 103100, 103200, 103300, 103400, 103500, 103600, 103700, 103800, 103900, 104000, 104100, 104200, 104300, 104400, 104500, 104600, 104700, 104800, 104900, 105000, 105100, 105200, 105300, 105400, 105500, 105600, 105700, 105800, 105900, 106000, 106100, 106200, 106300, 106400, 106500, 106600, 106700, 106800, 106900, 107000, 107100, 107200, 107300, 107400, 107500, 107600, 107700, 107800, 107900, 108000, 108100, 108200, 108300, 108400, 108500, 108600, 108700, 108800, 108900, 109000, 109100, 109200, 109300, 109400, 109500, 109600, 109700, 109800, 109900, 110000, 110100, 110200, 110300, 110400, 110500, 110600, 110700, 110800, 110900, 111000, 111100, 111200, 111300, 111400, 111500, 111600, 111700, 111800, 111900, 112000, 112100, 112200, 112300, 112400, 112500, 112600, 112700, 112800, 112900, 113000, 113100, 113200, 113300, 113400, 113500, 113600, 113700, 113800, 113900, 114000, 114100, 114200, 114300, 114400, 114500, 114600, 114700, 114800, 114900, 115000, 115100, 115200, 115300, 115400, 115500, 115600, 115700, 115800, 115900, 116000, 116100, 116200, 116300, 116400, 116500, 116600, 116700, 116800, 116900, 117000, 117100, 117200, 117300, 117400, 117500, 117600, 117700, 117800, 117900, 118000, 118100, 118200, 118300, 118400, 118500, 118600, 118700, 118800, 118900, 119000, 119100, 119200, 119300, 119400, 119500, 119600, 119700, 119800, 119900, 120000, 120100, 120200, 120300, 120400, 120500, 120600, 120700, 120800, 120900, 121000, 121100, 121200, 121300, 121400, 121500, 121600, 121700, 121800, 121900, 122000, 122100, 122200, 122300, 122400, 122500, 122600, 122700, 122800, 122900, 123000, 123100, 123200, 123300, 123400, 123500, 123600, 123700, 123800, 123900, 124000, 124100, 124200, 124300, 124400, 124500, 124600, 124700, 124800, 124900, 125000, 125100, 125200, 125300, 125400, 125500, 125600, 125700, 125800, 125900, 126000, 126100, 126200, 126300, 126400, 126500, 126600, 126700, 126800, 126900, 127000, 127100, 127200, 127300, 127400, 127500, 127600, 127700, 127800, 127900, 128000, 128100, 128200, 128300, 128400, 128500, 128600, 128700, 128800, 128900, 129000, 129100, 129200, 129300, 129400, 129500, 129600, 129700, 129800, 129900, 130000, 130100, 130200, 130300, 130400, 130500, 130600, 130700, 130800, 130900, 131000, 131100, 131200, 131300, 131400, 131500, 131600, 131700, 131800, 131900, 132000, 132100, 132200, 132300, 132400, 132500, 132600, 132700, 132800, 132900, 133000, 133100, 133200, 133300, 133400, 133500, 133600, 133700, 133800, 133900, 134000, 134100, 134200, 134300, 134400, 134500, 134600, 134700, 134800, 134900, 135000, 135100, 135200, 135300, 135400, 135500, 135600, 135700, 135800, 135900, 136000, 136100, 136200, 136300, 136400, 136500, 136600, 136700, 136800, 136900, 137000, 137100, 137200, 137300, 137400, 137500, 137600, 137700, 137800, 137900, 138000, 138100, 138200, 138300, 138400, 138500, 138600, 138700, 138800, 138900, 139000, 139100, 139200, 139300, 139400, 139500, 139600, 139700, 139800, 139900, 140000, 140100, 140200, 140300, 140400, 140500, 140600, 140700, 140800, 140900, 141000, 141100, 141200, 141300, 141400, 141500, 141600, 141700, 141800, 141900, 142000, 142100, 142200, 142300, 142400, 142500, 142600, 142700, 142800, 142900, 143000, 143100, 143200, 143300, 143400, 143500, 143600, 143700, 143800, 143900, 144000, 144100, 144200, 144300, 144400, 144500, 144600, 144700, 144800, 144900, 145000, 145100, 145200, 145300, 145400, 145500, 145600, 145700, 145800, 145900, 146000, 146100, 146200, 146300, 146400, 146500, 146600, 146700, 146800, 146900, 147000, 147100, 147200, 147300, 147400, 147500, 147600, 147700, 147800, 147900, 148000, 148100, 148200, 148300, 148400, 148500, 148600, 148700, 148800, 148900, 149000, 149100, 149200, 149300, 149400, 149500, 149600, 149700, 149800, 149900, 150000, 150100, 150200, 150300, 150400, 150500, 150600, 150700, 150800, 150900, 151000, 151100, 151200, 151300, 151400, 151500, 151600, 151700, 151800, 151900, 152000, 152100, 152200, 152300, 152400, 152500, 152600, 152700, 152800, 152900, 153000, 153100, 153200, 153300, 153400, 153500, 153600, 153700, 153800, 153900, 154000, 154100, 154200, 154300, 154400, 154500, 154600, 154700, 154800, 154900, 155000, 155100, 155200, 155300, 155400, 155500, 155600, 155700, 155800, 155900, 156000, 156100, 156200, 156300, 156400, 156500, 156600, 156700, 156800, 156900, 157000, 157100, 157200, 157300, 157400, 157500, 157600, 157700, 157800, 157900, 158000, 158100, 158200, 158300, 158400, 158500, 158600, 158700, 158800, 158900, 159000, 159100, 159200, 159300, 159400, 159500, 159600, 159700, 159800, 159900, 160000, 160100, 160200, 160300, 160400, 160500, 160600, 160700, 160800, 160900, 161000, 161100, 161200, 161300, 161400, 16150

We now have available a bunch of goodies too good to bypass. Items are limited so order today.

Call Your Phone Order In Today

**MINI KITS - YOU HAVE SEEN THESE BEFORE NOW
HERE ARE OLD FAVORITE AND NEW ONES TOO.
GREAT FOR THAT AFTERNOON HOBBY.**



TERMS: Satisfaction guaranteed or money refunded. COD add \$1.50. Minimum order \$6.00. Orders under \$10.00 add \$ 75. Add 5% for postage, insurance, handling. Overseas add 15%. NY residents add 7% tax.

**FM
MINI
MIKE**



A super high performance FM wireless mike kit! Transmits a stable signal up to 300 yards with exceptional audio quality by means of its built in electric mike. Kit includes case, mike, on-off switch, antenna, battery and super instructions. This is the finest unit available.

FM-3 Kit \$14.95
FM-3 Wired and Tested 19.95

Color Organ

See music come alive! 3 different lights flicker with music. One light each for, high, mid-range and lows. Each individually adjustable and drives up to 300 W. runs on 110 VAC.

Complete kit, ML-1 \$8.95

Video Modulator Kit
Converts any TV to video monitor. Super stable, tunable over ch 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market! Complete kit, VD-1 \$7.95



Led Blinky Kit
A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons, warning panel lights, anything! Runs on 3 to 15 volts. Complete kit, BL-1 \$2.95

Super Sleuth
A super sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as general purpose amplifier. Full 2 W rms output, runs on 6 to 15 volts, uses 8-45 ohm speaker. Complete kit, BN-9 \$5.95

CPO-1
Runs on 3-12 Vdc 1 wall out, 1 KHZ good for CPO, Alarm, Audio Oscillator. Complete kit \$2.95

CLOCK KITS

Your old favorites are here again. Over 7,000 Sold to Date. Be one of the gang and order yours today!



Try your hand at building the finest looking clock on the market. Its satin finish anodized aluminum case looks great anywhere, while six .4" LED digits provide a highly readable display. This is a complete kit, no extras needed, and it only takes 1-2 hours to assemble. Your choice of case colors: silver, gold, black (specify).
Clock kit, 12/24 hour, DC-5 \$24.95
Clock with 10 min. ID timer, 12/24 hour, DC-10 \$29.95
Alarm clock, 12 hour only, DC-8 \$29.95
12V DC car clock, DC-7 \$29.95

For wired and tested clocks add \$10.00 to kit price.

FM Wireless Mike Kit



Transmits up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added sensitive mike preamp stage.

FM-1 kit \$3.95 FM-2 kit \$4.95

Whisper Light Kit

An interesting kit, small mike picks up sounds and converts them to light. The louder the sound, the brighter the light. Includes mike, controls up to 300 W, runs on 110 VAC.

Complete kit, WL-1 \$6.95

Tone Decoder

A complete tone decoder on a single PC board. Features: 400-5000 Hz adjustable range via 20 turn pot, voltage regulation, 567 IC. Useful for touch-tone burst detection, FSK, etc. Can also be used as a stable tone encoder. Runs on 5 to 12 volts. Complete kit, TD-1 \$5.95



Universal Timer Kit

Provides the basic parts and PC board required to provide a source of precision timing and pulse generation. Uses 555 timer IC and includes a range of parts for most timing needs.

UT-5 Kit \$5.95

Mad Blaster Kit

Produces LOUD ear shattering and attention getting siren like sound. Can supply up to 15 watts of obnoxious audio, runs on 6-15 VDC.

MB-1 Kit \$4.95

Siren Kit

Produces upward and downward wail characteristic of a police siren. 5 W peak audio output, runs on 3-15 volts, uses 3-45 ohm speaker. Complete kit, SM-3 \$2.95

80 Hz Time Base
Runs on 5-15 VDC. Low current (2.5ma) 1 min/month accuracy TB-7 Kit \$5.50
TB-7 Assy \$9.95

Car Clock

The UN-KIT, only 5 solder connections

Here's a super looking rugged and accurate auto clock, which is a snap to build and install. Clock generated by completely assembled, you only solder 3 wires and 2 switches. Takes about 15 minutes! Display is bright green with automatic brightness control photocell - assures you of a highly readable display, day or night. Comes in a satin finish anodized aluminum case which can be attached 5 different ways using 2 sided tape. Choice of silver, black or gold case (specify).

DC-3 kit, 12 hour format \$22.95
DC-3 wired and tested \$29.95

Calendar Alarm Clock

The clock that's got it all. 6-5" LEDs, 12/24 hour, snooze, 24 hour alarm, 4 year calendar, battery backup and lots more. The super 7001 chip is used. Size 5x4x2 inches. Complete kit, less case (not available) DC-9 \$34.95

Under Dash Car Clock

12/24 hour clock in a beautiful plastic case features: 6 jumbo RED LEDs, high accuracy (100%), easy 3 wire hookup, display blanks with ignition, and super instructions. Optional dimmer automatically adjusts display to ambient light level. DC-11 clock with mtg. bracket \$27.95 kit
Dim-11 dimmer adapter \$2.50
Add \$10.00 Assy and Test

Video Terminal

A completely self contained, stand alone video terminal card. Requires only an ASCII keyboard and TV set to become a complete terminal unit. Features are: single 5V supply, XTAL, controlled sync and baud rates, 16 9600, complete computer and keyboard control of cursor, parity error control and display control, and generates serial ASCII plus parallel keyboard input. The 6416 is 84 char by 16 lines, with scrolling, upper and lower case (optional) and has RS-232 and 20ma loop interfaces on board. Kits include sockets and complete documentation.
RE 6416 terminal card kit (add \$60.00 for wired unit) \$199.95
Lower Case option \$13.95
Power Supply \$14.95
RF Modulator kit \$7.95

PARTS PARADE

IC SPECIALS

LINEAR		TTL	
301	\$.35	74S00	\$.40
324	\$1.50	7447	\$.65
380	\$1.50	7475	\$.50
555	\$.45	7490	\$.50
556	\$1.00	74196	\$1.25
565	\$1.00		
566	\$1.00		
567	\$1.25		
741	10/\$2.00		
1458	\$.50		
3900	\$.50		
3314	\$2.95		
8038	\$2.95		
CMOS		SPECIAL	
4011	20	11C90	\$13.50
4013	25	10116	\$1.25
4046	\$1.85	7208	\$17.50
4049	.40	7207A	\$ 5.50
4059	\$9.00	7216D	\$21.00
4511	\$2.00	7107C	\$12.50
4518	\$1.35	5314	\$ 2.95
5639	\$1.75	5375AB/G	\$ 2.95
		7001	\$ 6.50

Resistor Ass't Assortment of Popular values - 1/4 watt. Cut lead for PC mounting. 1/2" center, 1/2" leads, bag of 300 or more. \$1.50	Crystals 3.579545 MHZ \$1.50 10,00000 MHZ \$5.00 5.248800 MHZ \$5.00
Switches Mini toggle SPDT \$1.00 Red Pushbuttons N.O. 3/\$1.00	AC Adapters Good for clocks, nicad chargers, all 110 VAC plug one end. 8.5 vdc @ 20 mA \$1.60 16 vdc @ 160mA \$2.50 12 vdc @ 250mA \$3.00
Earphones 3" leads, 8 ohm, good for small tone speakers, alarm clocks, etc. 10 for \$1.00	Solid State Buzzers small buzzer #50 Hz, 86 db, sound output on 5-12 vdc at 10-30 mA TTL compatible. \$1.50
Mini 8 ohm Speaker Approx 2 1/2" diam. Round type for radios, mike etc. 3 for \$2.00	AC Outlet Panel Mount with Leads, 3 turns. 15/\$1.00, 4/\$1.00
Slug Tuned Coils Small 3/16" Hex Slugs turned coil, 3 turns. 15/\$1.00	AC Outlet Panel Mount with Leads, 3 turns. 15/\$1.00, 4/\$1.00
CAPACITORS	
TANTALUM Doped Epoxy 1.5 uF 25V \$4.00 1.8 uF 25V \$3.00 25 uF 25V \$3.00	ALUMINUM Electrolytic 1000 uF 16V Radial \$5.00 500 uF 20V Axial \$5.00 150 uF 16V Axial \$21.00 10 uF 15V Radial 10V11.00
	DISK CERAMIC 01 16V disk 20/\$1.00 1 16V \$15.00 001 16V 20/\$1.00 100 pF 20/\$1.00 047 16V 20/\$1.00

Audio Prescaler Make high resolution audio measurements, great for musical instrument tuning, PL tones, etc. Multiplies audio UP in frequency, selectable x10 or x100, gives .01 Hz resolution with 1 sec. gate time! High sensitivity of 25 mv, 1 meg input z and built-in filtering gives great performance. Runs on 9V battery, all CMOS. PS-2 kit \$29.95 PS-2 wired \$39.95	600 MHz PRESCALER Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity, specify -10 or -100 Wired, tested, PS-1B \$59.95 Kit, PS-1B \$44.95
30 Watt 2 mtr PWR AMP Simple Class C power amp features 8 times power gain. 1 W in for 8 out, 2 W in for 15 out, 4W in for 30 out. Max output of 35 W, incredible value, complete with all parts, less case and T-R relay. PA-1, 30 W pwr amp kit \$22.95 TR-1, RF sensed T-R relay kit 6.95	Power Supply Kit Complete triple regulated power supply provides variable 6 to 18 volts at 200 ma and +5 at 1 Amp. Excellent load regulation, good filtering and small size. Less transformers, requires 6.3 V 1/2 A and 24 VCT Complete kit, PS-3LT \$6.95
MRF-236 transistor as used in PA-1 8-10db gain 150 mhz \$11.95	RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay TR-1 Kit \$6.95
DC-DC Converter -5 vdc input prod. 9 vdc @ 30ma +9 vdc produces -15 vdc @ 35ma \$1.25	Ceramic IF Filters Mini ceramic filters 7 KHz B/W very sharp \$1.50 ea.
25K 20 Turn Trm Pot \$1.00 1K 20 Turn Trm Pot \$ 5.50	Trimmer Caps Sprague - 3-40 pf Stable Polypropylene .50 ea.

READOUTS FND 359 4" C.C. \$1.00 FND 507/910 5" C.A. 1.00 MAN 72/HP7730 33" C.A. 1.00 HP 7651 43" C.A. 2.00	Sockets 8 Pin 10/\$2.00 14 Pin 10/\$2.00 16 Pin 10/\$2.00 24 Pin 4/\$2.00 28 Pin 4/\$2.00 40 Pin 3/\$2.00
TRANSISTORS 2N3804 NPN C-F 15/\$1.00 2N3806 NPN C-F 15/\$1.00 2N4403 PNP C-F 15/\$1.00 2N4410 NPN C-F 15/\$1.00 2N4916 PNP C-F 4/\$1.00 2N5401 PNP C-F 5/\$1.00 2N4628 C-F 4/\$1.00 2N3371 NPN Silicon \$1.99 2N5179 NPN NPN \$3.20 Power Tab NPN 40W \$21.00 Power Tab PNP 40W \$1.00 MPP 102/2N5484 \$3.99 NPN 3004 Type T-R 80/\$2.50 PNP 3006 Type T-R 50/\$2.50 2N3055 \$ 8.00 2N2646 LJT 3/\$2.00	Diodes 5.1 V Zener 20/\$1.00 1N914 Type 50/\$1.00 1KV 2Amp 8/\$1.00 100V 1Amp 15/\$1.00
25 AMP 100V Bridge \$1.50 each	Crystal Microphone Small 1" diameter 1/2" thick crystal mike cartridge \$7.75
Mini-Bridge 50V 1 AMP 4 for \$1.00	Coax Connector Chassis mount BNC type \$1.00
	9 Volt Battery Clips Nice quality clips 5 for \$1.00 1/2" Rubber Grommets 10 for \$1.00
	Parts Bag Ass't of chokes, disc caps, tantal resistors, transistors, diodes, MICAs, caps etc. 5m bag (100 pc) \$1.00 bag (300 pc) \$2.50
	Connectors 6 pin type gold contacts for mA, 1003 car clock module price .75 ea.
	Leds - your choice, please specify Mini Red, Jumbo Red, High Intensity Red, Illuminator Red 8/\$1 Mini Yellow, Jumbo Yellow, Jumbo Green 6/\$1
	Varactors Motorola MV 2209 30 PF Nominal cap 20-80 PF - Tunable range - .50 each or 3/\$1.00

Mini RG-174 Coax 10 ft. for \$1.00	Regulators 78M \$1.25 79MG \$1.25 723 \$ 5.50 309K \$1.15 7805 \$1.00
	Shrink Tubing Nubs Nice precut pieces of shrink size 1" x 1/4" shrink to 1/8" Great for splices. 50/\$1.00
	Mini TO-92 Heat Sinks Thermalloy Brand 5 for \$1.00 To-220 Heat Sinks 3 for \$1.00
	Opto Isolators - 4N28 type \$1.50 ea. Opto Reflectors - Photo diode + LED \$1.00 ea.
	Molex Pins Molex already precut in length of 7. Perfect for 14 pin sockets. 20 strips for \$1.00.
	CDS Photocells Resistance varies with light, 250 ohms to over 3 meg 3 for \$1.00.

RF actuated relay senses RF (1W) and closes DPDT relay. For RF sensed T-R relay TR-1 Kit \$6.95	OP-AMP Special BI-FET LF 13741 - Direct pin for pin 741 compatible, but 500,000 MEG input z, super low 50 pa input current, low power drain 50 for only \$9.00 10 for \$2.00
	78M \$1.25 79MG \$1.25 723 \$ 5.50 309K \$1.15 7805 \$1.00
	Shrink Tubing Nubs Nice precut pieces of shrink size 1" x 1/4" shrink to 1/8" Great for splices. 50/\$1.00
	Mini TO-92 Heat Sinks Thermalloy Brand 5 for \$1.00 To-220 Heat Sinks 3 for \$1.00
	Opto Isolators - 4N28 type \$1.50 ea. Opto Reflectors - Photo diode + LED \$1.00 ea.
	Molex Pins Molex already precut in length of 7. Perfect for 14 pin sockets. 20 strips for \$1.00.
	CDS Photocells Resistance varies with light, 250 ohms to over 3 meg 3 for \$1.00.

TEST EQUIPMENT, TOOLS, TELEPHONE DEVICES, AUTO STEREO PRODUCTS

FREE 8 pc. Tool Set (value \$14.95) with \$200.00 purchase of merchandise from this ad.

Logic Probe

Compact circuit powered
Detects pulses as short as 50
µsec • DTU/TTL/ULCMOS
compatibility
\$44.95



Model LP-1

100 MHz 8-Digit Counter

20 Hz to 100 MHz range • LED display
Fully automatic Reg. **\$127.50**
Model MAX100 \$150.00



Preassembled Proto Boards

Model PB-104 **\$49.95**
Fully assembled breadboard
contains four QT-59S sockets,
seven QT-59B bus strips and four
5-way binding posts



Proto Board with Built-in Power Supplies

Regulated • Short-proof
Reg. **\$154.95**
\$129.95 Model PB-203A



3½-Digit 0.1% Digital Capacitance Meter

9 ranges from 1999 pF to 199.9 µF
0.1% of reading accuracy • Auto
over and under range indication



Model 3001
Reg. \$190.00
\$170



Function Generator

Model 2001 Reg. **\$185.95**
Sine, square,
triangle and
separate TTL
square wave
output



Portable Digital Capacitance Meter

Measures capacitance from
0.1pF to 1 Farad • Resolves to
0.1pF • 10 ranges for
accuracy and resolution • 4
digit easy-to-read LED display
• 0.5% accuracy



Model 829

3½-Digit DMM with LCD Readout

0.1% DC accuracy • 0.5%
LCD display for high
readability • 100µA current
range • 1000V/100mA/0.01
Ω resolution • Battery life of
over 100 hours • Shielded to
stay accurate in RF fields •
Low battery warning



Model 2815

Dual Trace 5" 30 MHz Triggered Scope

Rise time 11.7 nS or
less • Built-in signal
delay line • Flat
response with smooth
roll-off past 30 MHz •
5mV/cm vertical sensitivity
Probes included



Model 1479P

Call for Discount Prices

DIGITAL MULTIMETERS



Sinclair
PDM 35
Reg. \$60.95
\$49.95

Hickok
LX303
\$69.50



Beckman
TECH 310
22 MΩ input
resistance • 10 Amp
AC/DC • 1500V Overload
• 6KV Transient
Protection • 2 year
battery life
\$130.



Simpson 461
Complete with nickel-
cadmium batteries, AC
charger/adaptor, test
leads **\$149.95**

LEADER



25 MHz
Dual Trace
Time Base



RF Wide Band Signal Generator

Model LSG-16
Solid state FET oscillator circuitry •
100 kHz to 100 MHz freq. range • 300
MHz on harmonics

with Calibrated Variable Delay

Model LBO-515A with probes •
1 µsec to 5 sec built-in delay

Transistorized LCR Bridge

Model LCR-740
Highly accurate 3 digit readout •
Operates on one 9V battery or with AC
adaptor • Measures inductance,
capacitance, resistance and loss factor.



20 MHz Dual Trace Oscilloscope

Model LBO-508A with probes
Call for Discount Prices

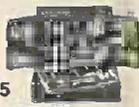


TECHNICIAN AIDS

Weller-Xcelite

Attache Style

Model TC100 ST
Reg. **\$279.95**
\$471



Service Master

Model 99-SM
Reg. **\$69.95** **\$47.50**



EDSYN SOLOPULL® Desoldering Tool

Model DS017 **\$15.95**



60 Cordless Soldering Iron \$29.95

Thermal-Spot Circuit Tester

Finds faulty components
quickly and easily



Weller Controlled Output Soldering Station

Model WTCPM
Reg. **\$77.50**
\$49.95

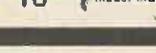


Econo-Lamp

Spring balanced arms •
Tension control knobs • Baked
enamel finish • Colors: Red,
Yellow, Blue, Black, Oyster
White • UL for 60W
Model XL-334A **\$16.95**

Magnifier Lamp

Precision ground and polished
magnification lens. **\$49.95**
Model MG10A



CAR STEREO PRODUCTS

In-Dash Car Stereos



8-Track Tape Player with
AM/FM/MPX Radio **\$52.50**
Model C-777



Auto Reverse Cassette Tape
Player with AM/FM/MPX Radio
Model CAS-999 **\$79.95**



Cassette Tape Player with
AM/FM/MPX Radio **\$57.50**
Model CAS-888

Stereo Power Booster

Model POW-40
40W stereo
20W per channel
Bass boost **\$24.95**



6" x 9" 3-Way Speaker

Model
BP2000-69TR
20 oz ceramic magnet
\$149.95 ea.

Miniature High Fidelity 3-Way Stereo Speakers

MINI speakers
MAXI
sound
Model
MF-9

\$69.50 pr. Reg. \$149.95

Die Cast Aluminum • Long Throw
Woofer • Soft Dome Tweeter
Extended Midrange Speaker
80-20,000 Hz • 50W, 8 ohms



30 MHz Portable Frequency Counter

Reg. \$130.00
\$65



Model 1827

HICKOK Digital CB In-Line Tester

Measures all 4
transmitter output
characteristics •
Frequency • Power
• SWR • Modulation %
Model 388 **\$169.95**



Portable VOM Multitester

20 KΩ VDC
10 KΩ VAC
\$19.95
Model VMS20



SPECIALS

RCA-VIZ Super Chro-Bar

Model WR-536A
Reg. \$129.95
\$89.95



RC Circuit Box

36 resistors (15 Ω
to 10 MΩ) • 18
capacitors (100 pf to
0.22 µf)
Reg. \$49.95
\$42.
includes test leads
Model WC 412A



Chess Challenger 7

7 levels of play
Model BBC
Reg. \$110.
\$79.95



CANON Calculator Portable Printer with Adding Machine Tape

Model P10-D
\$69.98



Portable Oscilloscopes

15 MHz Dual Trace Triggered Miniscope
Model MS-215
Reg. \$435.00
\$369.95

15 MHz Triggered Miniscope
Model MS-15
Reg. \$319.00
\$269.95

30 MHz Dual Trace Triggered Miniscope
Model MS-230
Reg. \$559.00
\$479.95



TELEPHONE DEVICES

MURAPHONE Cordless Telephone System

Reg. \$89.95
\$74.95



CODE-A-PHONE Telephone Answering

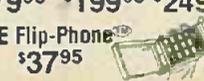
Model 1550
Automatic Dialing
Reg. \$399.95
\$279.95



Model 1400
Call Control
Reg. \$349.95
\$199.95

Model 1500
Call Control
Reg. \$349.95
\$249.95

GTE Flip-Phone
\$37.95



BSR X-10 Remote Control for Lights & Appliances



4 Pc Standard Starter Kit • One (1) Standard Command Reg. \$87.95
Console • Two (2) Lamp Modules • One (1) Appliance
Module **\$79.50**

5 Pc Ultrasonic Starter Kit • One (1) Deluxe Ultrasonic Reg. \$112.95
Command Console • One (1) Hand Held Remote Unit • Two
(2) Lamp Modules • One (1) Appliance Unit **\$99.95**

Lamp Modules \$14.50 Standard Command Console \$36.00
Appliance Modules \$14.50 Ultrasonic Command Console \$59.95
Wall Switch Modules \$14.50 with Hand Held Remote

FORDHAM

855 Conklin St. Farmingdale, N.Y. 11735

Master Charge • BankAmericard • VISA
COD • Check • Money Order

CODs, shipping and insurance extra
N.Y. State residents add appropriate sales tax
TOLL FREE (800) 645-9518

in N.Y. State call (516) 752-0050

1" ORANGE LED DISPLAY 7 segment RHD MHA4610 - common anode MHA4640 - common cathode	\$1.95ea 10/\$7.95 25/\$17.50 100/\$65.00
1" ORANGE over-flow MHA4630 - common anode	\$5.85ea 10/\$5.95
1" RED LED DISPLAY 7 segment RHD XAN72(MAN72 equiv) common anode	\$3.95ea 10/\$17.95 25/\$17.50 100/\$65.00

JUMBO RED LED .20" diffused	10/\$1.00
SUBMIN RED LED .125" diffused	25/\$2.00
JUMBO GREEN LED .20" diffused	7/\$1.50
SUBMIN GREEN LED .125" diffused	25/\$2.85
1" RED LED DISPLAY 7 segment RHD FR500 Common Cathode	\$3.85ea 10/\$17.75 25/\$17.00 100/\$62.00

Radio Shack METAL FILM RESISTORS

R-20M RESISTOR (R660) ±1% 50ppm/°C

1/4W MIL-R-10509 250V/70°C	1-999	.25	1.50	2.25	7.50
.130" dia X .35" long (body)	1000-	.25	1.25	1.20	7.25
ALL STANDARD DECADE VALUES	5000-	.25	1.00	1.90	6.75
FROM 10ohm to 475K	10000-	.25	.95	1.75	6.00

CLOCK CHIP MM5375AA
4-6 digit 60Hz 12hr
alarm 24 pin

IC BREADBOARD
2 5/16" X 6 9/16"

UNIVERSAL BREADBOARD
3 3/16" X 5 1/16"

\$1.15ea
10/\$10.00
100/\$75.00

TANTALUM CAPACITORS
solid dipped ± 20%

1-9 10-	1-9 10-	1-9 10-	1-9 10-
.10uF/35V .30 .25	4.7uF/16V .38 .30	22uF/16V .50 .40	
.22uF/35V .30 .25	4.7uF/25V .45 .35	22uF/35V .50 .55	
.33uF/35V .30 .25	6.8uF/6V .45 .38	33uF/6V .55 .45	
1uF/20V .30 .25	6.8uF/16V .40 .30	33uF/10V .60 .50	
1.5uF/20V .30 .25	10uF/16V .42 .35	47uF/15V .65 .55	
2.2uF/20V .35 .25	15uF/6V .42 .35	56uF/6V .85 .75	
2.2uF/35V .38 .28	15uF/20V .50 .40	100uF/20V 1.50 1.40	
3.3uF/35V .40 .30			

TRANSISTORS

2N3904 NPN TO-92 10/\$1.50
2N3906 PNP TO-92 25/\$3.00
100/\$11.00

WART 16028 \$3.95ea 10/\$35.00 100/\$275.00

DIODES

1N4148 400mA 15/\$1.00 100/\$5.00
1N4001 rectifier 12/\$1.00 100/\$7.00
1N4007 rectifier 10/\$1.00 100/\$9.00

PLL TONE DECODER \$3.95ea
567 8 pin DIP 10/\$8.55
100/\$80.00

DIPSWITCH - 4 sw
8 pin DIP SPST
1-9 \$1.65ea
10-24 1.55ea
25- 1.45ea

POWER SUPPLY KIT PS-29
provides simultaneous outputs of
plus & minus 5V, 12V, & 15V.
uses 115/230VCT transformer - 1amp
total output. kit includes PC board
(2 1/8" X 3 1/2"), all parts incl
transformer, schematic & layout dwg.
\$14.95ea

10-24 13.50ea
25- 12.50ea

DIPSWITCH - 8 sw
16 pin DIP SPST
1-9 \$2.10ea
10-24 1.95ea
25- 1.85ea

CRYSTAL CONTROLLED TIME BASE KIT
provides accurate 1 Hz, 10 Hz & 60 Hz
double buffered outputs from 9VDC input.
CMOS compatible. kit includes PC board,
(1 5/8" X 3 1/2"), all parts (except battery),
schematic, layout dwg. & instructions.
\$15.50ea

10-24 13.75ea
25- 12.50ea

Payment by check, M.O., UPS-COD, M/C
or VISA. Add \$1.00 shipping/handling
in US, Canada & Mexico. Other countries
\$1.00 + 5% of order. California residents
add sales tax. Minimum order \$10.00

INTERNATIONAL ELECTRONICS UNLIMITED
225 Broadway Jackson Ca 95642
phone 209 223 3870

DON'T FORGET



USE YOUR READER SERVICE CARD

Power @ 12 volts
13 amps
SURPLUS UNITS IN LIKE NEW CONDITION



INPUT: 115 vac 43-53 Hz
OUTPUT: 12 vdc 0-13 amps
REGULATION: 0.1% ± 5 mV
NL-FL. ± 0.1% ± 5mV for 10%
input change
RIPPLE: 2mV RMS max., 20 mV
P-P max.
STABILITY: Typically 10 mV for
eight hour period

79.00 per unit

REMOTE SENSING, REMOTE VOLTAGE ADJUSTMENT,
OVERLOAD PROTECTION and OVERVOLTAGE PROTECTION
ALSO AVAILABLE in 2 VDC @ 25 AMPS \$79.00 per unit

10 MEG POTS
Standard & Watt Size
3/4" Long Shaft
1/4" Dia
25 For \$5.00 4 For \$1.00

50K AUDIO SLIDE POTS
Knobs for Slide
Pots 20c each 75c Each

22/44 EDGEBOARD CONNECTOR
TIN SOLDER TAIL .186" x .200"

LARGE QUANTITIES AVAILABLE
\$1.35 each 10 for \$12.50

PHOTO - FLASH CAPACITOR
100 MFD 330 VOLTS
3/4" x 1 1/4" \$1.50 Each

REED RELAYS
9-15 VOLT D.C.
NORMALLY OPENED
CONTACTS: 1 amp max.
switch - 2 amp max. carry
BODY SIZE: approx. 1 inch
long 1/4 inch high

S.P.S.T. 1500 ohm coil \$1.15 each
D.P.S.T. 1200 ohm coil \$1.30 each

POTTER BRUMFIELD 4 PDT RELAYS
14 pin style
3 amp contacts
24 Volt d.c. coil
120 volt a.c. coil
Used but fully tested

\$1.25 each
Specify coil voltage
LARGE QUANTITIES AVAILABLE

3x5" OAKTRON SPEAKER
3oz. Magnet
8 OHM Impedance
\$2.50 each

ALL ELECTRONICS CORP.
905 S. Vermont Ave. SEND FOR OUR FREE CATALOG
Los Angeles, CA 90006
(213) 380-8000

TERMS
• Quantities Limited
• Min. Order \$10.00
• Add \$2.00 Shipping USA
• Calif. Res. Add 6%
• Prompt Shipping

CIRCLE 69 ON FREE INFORMATION CARD

CIRCLE 15 ON FREE INFORMATION CARD

PRINTED CIRCUIT BOARD

4" x 6" DOUBLE SIDED EPOXY BOARD 1/16" thick
8.50 mm 5/82.60

EPOXY glass vector board
1/16" thick with 1/10" spacing \$1.95

74500 - 30 74515 - 40 745181 - 1.25
74502 - 30 74532 - 40 745187 - 1.25
74508 - 40 74586 - .85 745188 - 1.25
74511 - 35 745112 - .85 745174 - 1.40

7 WATT LD 65 LASER DIODE IR \$8.95

25 watt Infra Red Pulse ISG 2008 equiv.
Laser Diode (Spec sheet included) \$24.95

MINIATURE MULTI-TURN TRIM POTS
100K, 5K, 10K, 20K, 250K, 1 Meg, 5.75 each \$32.00

2N3820 P-FET 0.45
2N5467 N-FET 0.45
2N2646 LUT. 0.45
2N 900 TRIGGER DIODES 4.91 00
2N 5028 PROG. LUJ. 0.65

FP 100 PHOTO TRANS. 0.50
RED, YELLOW, GREEN LARGE LED 2" 6.91 00
RED/GREEN BIPOLAR LED 2" 8.95
TL-118 OPTO ISOLATOR 6.75
MCT-6 OPTO ISOLATOR 0.80
1 WATT ZENERS, 3.3, 4.7, 5.1, 5.6, 9.1, 10,
12, 15, 18, or 22V 6.91 00

TTL REED RELAY - SPST 5V 20ma \$1.00

Silicon Rectifiers

PRV	1A	3A	12A	50A	125A	240A
100	08	14	35	90	3.70	5.00
200	07	20	45	1.30	4.25	5.50
400	09	25	65	1.50	5.50	9.80
500	11	30	80	2.00	5.50	12.50
1000	15	35	1.00	2.50	10.50	18.50
8000	20	45	1.25	3.00	12.50	20.00

SILICON SOLAR CELLS \$10.00
4" diameter 4V at 1 AMP

IN 4148 (IN914) 15.91 00
.1 or .01 uF 25V ceramic disc. caps. 18.91 00, 100.95 00

R232 CONNECTORS
DB 25P male .82.95
DB 25S female .63.50
HOOKS .81.50

REGULATORS
323K 5V 3A .15.75 340K 12, 15 or 24 V \$1.50
709 .01 .81.60 340T-5, 6, 8, 12, 15, \$1.30
320T-5, 12, or 15V \$1.30 79M-C .01.35
LM308H .75 320MS .8.75

LEO READOUTS
FCS 8024 - 4 digit
C.C. 8" display .85.95 DL 707 C.A. 3" 8.75
FND 503 C.C. 8" .85 DL 747 C.A. 8" \$1.50
FND 10 C.A. 8" .85 HP400 8" C.A. \$1.95
DL704-3" C.C. .85 HP340S 8" CC \$1.95

Terms: FOB Cambridge, Mass
Send Check or Money Order
Include Postage Minimum
1 telephone, C.O.D. Purchase
Order or Charge \$70.00
Wire with Mail Order 10.00

Send ZFC for our catalog featuring
Transistors and Rectifiers
146 Hampshire St., Cambridge, Mass.

TRANSISTOR SPECIALS

2N6236 NPN SWITCHING POWER \$1.95
MPS 6604 P CB PNP Transistor NPN .8.75
2N3772 NPN Si TO-3 \$1.00
2N1808 PNP Si TO-3 \$1.00
2N3068 PNP Si TO-3 \$4.00 00
2N3137 NPN Si TO-3 \$1.50
2N3818 NPN Si TO-3 RF \$1.50
2N1426 NPN Si TO-8 \$9.00
2N3870 NPN Si TO-18 \$1.70
2N2222 NPN Si TO-18 .5.91 00
2N3055 NPN Si TO-3 \$1.00
2N0084 NPN Si TO-82 6.91 00
2N3055 PNP Si TO-3 \$1.00
2N3930 NPN Si TO-220 .8.55
2N1548 PNP GERM TO-3 .9.95
2N1306 PNP 68 TO-8 1.40

TTL IC SERIES

7400 - .17	74155 - .75
74101 - .17	74157 - .85
7402 - .17	7472 - .38
7403 - .17	7473 - .35
7405 - .24	7474 - .42
7406 - .34	7475 - .45
7407 - .35	7476 - .48
7408 - .37	7477 - .50
7409 - .24	7478 - .55
7410 - .17	7479 - .60
7411 - .22	7480 - 1.00
7412 - .22	7481 - 1.25
7413 - .42	7482 - .58
7414 - .80	7483 - .58
7415 - .22	7484 - .55
7416 - .27	7485 - .60
7417 - .27	7486 - .60
7418 - .27	7487 - .65
7419 - .27	7488 - .65
7420 - .17	7489 - .60
7421 - .27	7490 - .60
7422 - .35	7491 - .65
7423 - .35	7492 - .65
7424 - .35	7493 - .65
7425 - .35	7494 - .65
7426 - .35	7495 - .65
7427 - .35	7496 - .65
7428 - .35	7497 - .65
7429 - .35	7498 - .65
7430 - .35	7499 - .65
7431 - .35	7500 - .65
7432 - .35	7501 - .65
7433 - .35	7502 - .65
7434 - .35	7503 - .65
7435 - .35	7504 - .65
7436 - .35	7505 - .65
7437 - .35	7506 - .65
7438 - .35	7507 - .65
7439 - .35	7508 - .65
7440 - .35	7509 - .65
7441 - .35	7510 - .65
7442 - .35	7511 - .65
7443 - .35	7512 - .65
7444 - .35	7513 - .65
7445 - .35	7514 - .65
7446 - .35	7515 - .65
7447 - .35	7516 - .65

14 pin headers \$3.00 00
18 pin headers \$4.00 ca

MMS387AACLOCK CHIPS .45.95
MMS314 \$4.75

NO. 30 WIRE WRAP WIRE SINGLE STRAND \$1.40
100'

ALCO MINIATURE TOGGLE SWITCHES
MIA 106 SPDT \$1.75
MIA 206 DPDT \$1.70
MIA 208 P-DPDT CENTER OFF \$1.85
MSD 206 P-DPDT CENTER OFF LEVER SWITCH \$1.85

Full Wave Bridges

PRV	2A	6A	25A
100	8.75	1.50	1.50
200	8.00	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

SANKEN AUDIO POWER AMPS
Si 1010 G 10 WATTS \$1.75
Si 1020 G 20 WATTS \$1.75
Si 1050 G 50 WATTS \$28.90

TANTALUM CAPACITORS

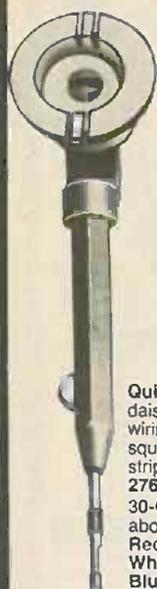
22UF 35 V	5.61 00	4.7 UF 15 V	5.61 00
47UF 35 V	5.61 00	6.8 UF 35V	4.11 00
68UF 35 V	5.61 00	22UF 25V	9.40
1UF 36V	5.61 00	30UF 6V	5.61 00
2.2UF 20V	5.61 00	100UF 15V	9.70
3.3UF 20V	4.01 00	150UF 15V	9.95

74LS SERIES

74LS00	25	74LS153	1.30
74LS01	25	74LS154	1.30
74LS02	25	74LS155	1.30
74LS04	25	74LS156	1.30
74LS05	25	74LS157	1.30
74LS08	25	74LS158	1.30
74LS10	25	74LS159	1.30
74LS11	25	74LS160	1.30
74LS12	25	74LS161	1.30
74LS13	25	74LS162	1.30
74LS14	25	74LS163	1.30
74LS16	25	74LS164	1.30
74LS17	25	74LS165	1.30
74LS18	25	74LS166	1.30
74LS19	25	74LS167	1.30
74LS20	25	74LS168	1.30
74LS21	25	74LS169	1.30
74LS22	25	74LS170	1.30
74LS23	25	74LS171	1.30
74LS24	25	74LS172	1.30
74LS25	25	74LS173	1.30
74LS26	25	74LS174	1.30
74LS27	25	74LS175	1.30
74LS28	25	74LS176	1.30
74LS29	25	74LS177	1.30
74LS30	25	74LS178	1.30
74LS31	25	74LS179	1.30
74LS32	25	74LS180	1.30
74LS33	25	74LS181	1.30
74LS34	25	74LS182	1.30
74LS35	25	74LS183	1.30
74LS36	25	74LS184	1.30
74LS37	25	74LS185	1.30
74LS38	25	74LS186	1.30
74LS39	25	74LS187	1.30
74LS40	25	74LS188	1.30
74LS41	25	74LS189	1.30
74LS42	25	74LS190	1.30
74LS43	25	74LS191	1.30
74LS44	25	74LS192	1.30
74LS45	25	74LS193	1.30
74LS46	25	74LS194	1.30
74LS47	25	74LS195	1.30
74LS48	25	74LS196	1.30
74LS49	25	74LS197	1.30
74LS50	25	74LS198	1.30
74LS51	25	74LS199	1.30
74LS52	25	74LS200	1.30
74LS53	25	74LS201	1.30
74LS54	25	74LS202	1.30
74LS55	25	74LS203	1.30
74LS56	25	74LS204	1.30
74LS57	25	74LS205	1.30
74LS58	25	74LS206	1.30
74LS59	25	74LS207	1.30
74LS60	25	74LS208	1.30
74LS61	25	74LS209	1.30
74LS62	25	74LS210	1.30
74LS63	25	74LS211	1.30
74LS64	25	74LS212	1.30
74LS65	25	74LS213	1.30
74LS66	25	74LS214	1.30
74LS67	25	74LS215	1.30
74LS68	25	74LS216	1.30
74LS69	25	74LS217	1.30
74LS70	25	74LS218	1.30
74LS71	25	74LS219	1.30
74LS72	25	74LS220	1.30
74LS73	25	74LS221	1.30
74LS74	25	74LS222	1.30
74LS75	25	74LS223	1.30
74LS76	25	74LS224	1.30
74LS77	25	74LS225	1.30
74LS78	25	74LS226	1.30
74LS79	25	74LS227	1.30
74LS80	25	74LS228	1.30
74LS81	25	74LS229	1.30
74LS82	25	74LS230	1.30
74LS83	25	74LS231	1.30
74LS84	25	74LS232	1.30
74LS85	25		

Make The Shack[®] Your Parts Place!

Low Prices and New Items Every Day



Speed Up Your Wiring with This No-Strip Wrapping Tool!

12⁹⁵

Pro-Quality Wiring

Quick-Wrap Tool[™] is ideal for daisy chain or point-to-point wiring between std. 0.025" square wrapping posts. Cuts, strips, easy to load!

276-1572 12.95
30-Gauge Kynar Wire. For above. 50 ft. spool.
Red. 278-501 1.99
White. 278-502 1.99
Blue. 278-503 1.99

Project Case With Panel

Flip-Open Cover

Only **2⁹⁹**



Easy-to-work reversible inner panel accepts a meter, switches or readouts.
5½x3¾x2" 2.99

8-Position DIP Switch

1⁹⁹



8 SPST sections. Fits standard 16-pin DIP socket. Ideal for digital and low current circuits.
275-1301 1.99

Tricolor and Pulsing LEDs



Low As **1²⁹**

[A] Red on DC, green on reverse DC, yellow on AC! 25 mA max. at 2.2VDC. T-1½ case. 276-035 1.39
[B] Red. Built-in 3 Hz flasher! 20 mA max. at 5VDC.
276-034 1.29

Accurate Sensitive VOM

29⁹⁵



• 27 Ranges
• 30K Ohms/Volt

Ideal for testing solid-state circuits! 4"-wide color-coded, mirrored scale. Reads DC Volts: 0 to 0.3-1-3-10-30-100-300-1000. AC Volts: 0 to 10-30-100-300-1000. DC Current: 0 to 100µA-3mA-30mA-300mA-10A. Resistance: 0 to 1K-10K-1 Meg-10 MegΩ. Decibels: -10 to +62 in 5 ranges. Accuracy: ±3% DC, ±4% AC. 6½x4½x1½". With 47" leads. Requires one 9V, one "AA" batteries. 22-203 29.95

Alarm Clock/Thermometer Module



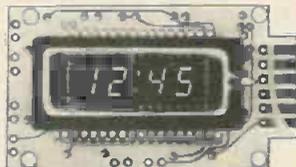
User Programmable 12 or 24-Hour Format!

24⁹⁵

Bright 0.7"-tall LED readout displays 12/24-hour time plus temperature in degrees C or F! 24-hour alarm and snooze features. With complete data. 277-1006 24.95
Temp. Sensor IC. LM-334. 276-1734 1.99
Power Transformer. For above. 273-1530 4.99

12-Hour Auto Clock Module

Reg. 21.95
Save 21% 16⁹⁵



For all 12V neg. ground vehicles. Mounts in dash or with case (below). Bright green display has automatic dimmer, leading zero blanking. With data. 277-1003 Sale 16.95
Pushbutton Switches. For above. 275-1547 Pkg. 5/2.49
Custom Case. 270-303 (Reg. 5.95) Sale 3.95

High Performance Op Amps



Low-As **1⁸⁹**

[A] LF353N. Dual. Low noise JFET inputs, wide bandwidth. Fast 13V/µS slew rate. ±18V supply. 8-pin DIP. 276-1715 1.89
[B] TL084C. Quad. 13V/µS slew rate. ±18V supply. 14-pin DIP. 276-1714 2.99

Engineer's Notebook of IC Circuits

1⁹⁹

Sold Only At Radio Shack

This "must-have" sourcebook gives applications and circuit examples for most popular linear and digital ICs. 128 pages. 276-5001 1.99

Sound Generator IC



2⁹⁹

SN76477. Creates music and sound effects from phaser guns to steam whistles! Line level audio output. Microprocessor compatible. 28-pin DIP. With data. 276-1765 2.99

Semiconductor Reference Handbook

Only **1⁹⁹**

Cross reference/substitution listings for over 100,000 devices! Pin outs and data for transistors, ICs, diodes, SCRs, LEDs and more. 224 pages. 276-4003 1.99

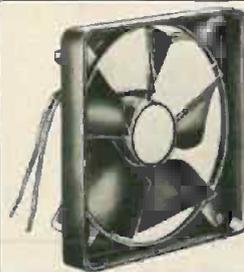
NEW

Mini DPDT Switches

Low As **1⁹⁹** Contacts Rated 6 Amps @ 125VAC



[A] DPDT Right Angle. Ideal for PC board mounting. On-Center Off-On contacts. 275-665 1.99
[B] DPDT. PC mtg. On-Center Off-On contacts. 275-668 2.19
[C] DPDT. Solder lugs for panel mounting. On-None-On contacts. 275-669 2.29



4" 120VAC Cooling Fan

12⁹⁵

Very Quiet Operation

Ideal for cooling power supplies, Ham and hi-fi gear, computers and more! Delivers 70 CFM. Sealed bearings. Diecast venturi. U.L. recognized motor. Corrosion-resistant metal parts. Low power consumption — only 11 watts! 273-241 12.95

WHY WAIT FOR MAIL ORDER DELIVERY? IN STOCK NOW AT OUR STORE NEAR YOU!

Radio Shack[®]

A DIVISION OF TANDY CORPORATION • FORT WORTH, TEXAS 76102
OVER 7000 LOCATIONS IN 40 COUNTRIES

Prices may vary at individual stores and dealers

CIRCLE 17 ON FREE INFORMATION CARD

MAY 1980

129

100W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low T.L.M. stereo pre-amp.

Specifications:

- Output power: 100W RMS into 8-ohm 125W RMS into 4-ohm
- Frequency response: 10Hz - 100 KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: 1V max.
- Power supply: ±40V @ 5 amp



TA-1000 KIT
\$51.95
Power
transformer
\$15.00 each

PROFESSIONAL 10 OCTAVE STEREO GRAPHIC EQUALIZER!!



Graphic equalizer have been used for years in sound studios and concert arenas but were too expensive to be considered for home use. Now we offer you the facility at an affordable price. This unit can extend your control of your Hi-Fi system by minimizing the non-linearities of the combined speaker/room system. Fantastic features as follows:

- 10 double slide controls for two channels
- Cut out rumble, surface noise and hiss
- Minimizes speaker/room non-linearities
- Frequency response from 30Hz to 16KHz
- 10 tone controls plus defeat, monitor and tape selector.
- Control range ± 12dB in 10 octaves (30Hz, 60Hz, 120Hz, 240Hz, 500Hz, 1KHz, 2KHz, 4KHz, 8KHz, 16KHz.)
- Operating voltage 117V 50/60Hz.

FACTORY ASSEMBLED UNIT, NOT A KIT
SPECIAL PRICE \$117.00 ea

SUB MINI SIZE FET CONDENSER MICROPHONE



Specification:

Sensitivity: - 65dB ± 3db
FEQ. Response: 50 Hz - 8 KHz
Output Impedance: 1K ohm max.
Polar Pattern: Omni-directional
Power Supply: 1.5V - 10V D.C.
Sound Pressure Level: Max. 120dB
EM4RP \$2.50 ea. or 2 for \$4.50

NEW MARK III 9 Steps 4 Colors LED VU

Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large, from -30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V - 9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output!

IN KIT FORM \$18.50

MARK II SOUND ACTIVATED SWITCH KIT



A new designed circuit employed 2 I.C., a DPDT relay with a led indicator. A condenser microphone comes with the kit. The relay can handle up to 200 watts contact to allow to control most things. Just click the finger, the relay will close, the second click will release it. Sensitivity can be adjusted by an on board trim-pot. Operating voltage 9V D.C. TY-18
\$8.50 PER KIT

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from -36dB ~ +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6 ~ 12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!

Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.



MARK IV KIT \$31.50

30W + 30W STEREO HYBRID AMPLIFIER KIT

It works in 12V DC as well! KIT includes 1 PC SANYO STK-043 stereo power amp. IC LM 1458 as pre amp, all other electronic parts, PC Board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 60 watts (30 watts per channel) yet gives out less than 0.1% total harmonic distortion between 100Hz and 10KHz.



\$32.50 PER KIT

BATTERY POWERED FLUORESCENT LANTERN

MODEL 888 R

FEATURES



- Circuitry: designed for operation by high efficient, high power silicon transistor which enable illumination maintain in a standard level even the battery supply drops to a certain low voltage.
- 9" 6W cool/daylight miniature fluorescent tube.
- 8 x 1.5V UM-1 (size D) dry cell battery.
- Easy sliding door for changing batteries.
- Stainless reflector with wide angle increasing illumination of the lantern.

\$10.50 EA

STEREO AMPLIFIER



60 W
+
60 W

COMPLETED UNIT - NOT A KIT!

OCL pre amp. & power stereo amp. with bass, middle, treble 3-way tone control. Fully assembled and tested, ready to work. Total harmonic distortion less than 0.5% at full power. Output maximum is 60 watts per channel at 8Ω. Power supply is 24 - 36V AC or DC. Complete unit. Assembled \$49.50 ea. Power transformer \$ 8.50 ea.

SW AUDIO AMP KIT



2 LM 380 with Volume Control
Power Supply 6 18V DC
ONLY \$6.00 EACH

PROFESSIONAL PANEL METERS



- A. 0-50UA 8.50 ea.
- B. 0-30VDC 8.50 ea.
- C. 0-50VDC 8.50 ea.
- D. 0-3ADC 9.00 ea.
- E. 0-100VDC 9.00 ea.

Two MU-52E All meters white face with black scales. Plastic cover.

SPECIAL 0.5" LED SALE ALARM CLOCK MODULE

ASSEMBLED! NOT A KIT!
Features: • 4 digits 0.5" LED Displays • 12 hours real time format • 24 hours alarm audio output • 59 min. countdown timer • 10 min. snooze control.



ONLY \$7.00 EACH
SPECIAL TRANSFORMER FOR CLOCK (FREE)

DIGITAL AUTO SECURITY SYSTEM

4 DIGITS
PERSONAL CODE!!
SPECIAL \$19.95



- proximity triggered
- voltage triggered
- mechanically triggered

This alarm protects you and itself! Entering protected area will set it off, sounding your car horn or siren you add. Any change in voltage will also trigger the alarm into action. If cables within passenger compartment are cut, the unit protects itself by sounding the alarm. 3-WAY PROTECTION!
All units factory assembled and tested - Not a kit!

A NEW LED ARRAY AND DRIVER FOR LEVEL METERS

This series covers a wide range of level indication uses, output and input voltage, time related change, temperature, light measurement and sound level. The problem of uneven brilliance often encountered with LED arrangements as well as design problems caused by using several units of varying size are substantially reduced. 12 LEDs in one bar:

LED ARRAY	
GL-112R3 Red, Red, Red	\$5.50
GL-112N3 Green, Yellow, Red	\$6.50
GL-112M2 Green, Green, Red	\$6.50
GL-112G3 Green, Green, Green	\$6.50



LED DRIVERS

1R 2406G is an I.C. specially designed to drive 12 LED. The number of LED is linearly illuminated according to the control voltage input terminal 21. Operating voltage is 9 12V D.C. \$5.35 EACH

PROFESSIONAL FM WIRELESS MICROPHONE

TCT model WEM-16 is a factory assembled FM wireless microphone powered by an AA size battery. Transmits in the range of 88-108MHz with 3 transistor circuits and an omni-directional electric condenser. Element built-in plastic tube type case; mike is 6 1/4" long. With a standard FM radio, can be heard anywhere on a one-acre lot; sound quality was judged very good.

\$16.50

FLASHER LED

Unique design combines a Jumbo red LED with an IC flasher chip in one package. Operates directly from 5V-7V DC. No dropping resistor needed. Pulse rate 3Hz @ 5V 20mA.

2 for \$2.20

BIPOLAR LED RED/GREEN

2 colors in one LED, green and red, changes color when reverse voltage supply. Amazing!
2 FOR \$1.60

LCD CLOCK MODULE!

• 0.5" LCD 4 digits display - X'tal controlled circuits - D.C. powered (1.5V battery) • 12 hr. or 24 hr. display • 24 hr. alarm set • 60 min. countdown timer • On board dual back-up lights • Dual time zone display • Stop watch function.

NIC1200 (12 hr) \$24.50 EA.
NIC2400 (24 hr) \$26.50 EA.

MINI-SIZED I.C. AM RADIO

Size smaller than a box of matches!
Receives all AM stations.
Batteries and ear phones included.
Only \$10.50

12 DC MINI RELAY

6V	SPDT	2 AMP	1.30
12V	SPDT	3 AMP	1.60
12V	DPDT	2 AMP	2.50
12V	4PDT	3 AMP	3.50



LINEAR SLIDE POT

500Ω SINGLE
Metal Case 3" Long
2 FOR \$1.20



FLUORESCENT LIGHT DRIVER KIT



With Case Only
\$6.50 Per Kit

12V DC POWERED
Lights up 8 ~ 15 Watt Fluorescent Light Tubes. Ideal for camper, outdoor, auto or boat. Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board, light tube not included!

SUPER FM WIRELESS MIC KIT — MARK III



FMC-105
\$11.50 PER KIT

This new designed circuit uses high FET. FET transistors with 2 stages pre amp. Transmits FM Range (88-120 MHz) up to 2 blocks away and with the ultra sensitive condenser microphone that comes with the kit, allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, OSC coils, and P.C. Board. Power supply 9V D.C.

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT



EXCLUSIVE! \$3.95 ea
Model F-179

Never worry about battery, because it has none! Easy to carry in pocket and handy to use. Ideal for emergency light. It generates its own electricity by squeezing grip lever. Put one in your car, boat, camper or home. You may need it some time!

ELECTRONIC DUAL SPEAKER PROTECTOR



Cut off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.

KIT FORM
\$8.75 EA.

"FISHER" 30 WATT STEREO AMP



Super Buy
Only \$18.50

MAIN AMP (15W x 2)
Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply \pm 16V DC (not included). Power band with (KF 1% \pm 3dB). Voltage gain 33dB. 20Hz - 20KHz.

SUPER 15 WATT AUDIO AMP KIT

Uses STK-015 Hybrid Power Amp
Kit includes: STK-015 Hybrid IC, power supply with power transformer, front Amp with tone control, all electronic parts as well as PC Board. Less than 0.5% harmonic distortion at full power $\frac{1}{2}$ dB response from 20-100,000 Hz. This amplifier has QUASI — Complimentary class B output. Output max is watt (10 watt RMS) at 4 Ω . ONLY \$23.50 each



HICKOK LX303 DIGITAL LCD MULTIMETER



3 1/2 digits multimeter • 200 hours 9V battery life • Auto zero; polarity; overrange indication • 100MV DC F.S. sensitivity • 19 ranges and functions • D.C. volt: 0.1 MV to 1000V • A.C. volt: 0.1 V to 600 V • Resistance: 0.1 Ω to 20 M Ω • D.C. current: 0.01 A to 100 MA

OUR PRICE \$71.45

PUSH-BUTTON SWITCH



N/Open Contact
Color: Red, White, Blue, Green, Black
3/\$1.00
N/Close also Available
50¢ each
LARGE QTY. AVAILABLE

HEAVY DUTY CLIP LEADS



10 pairs — 5 colors Alligator clips on a 22" long lead. Ideal for any testing.
\$2.20/pack

MANY SOUND DECISIONS!

Solid state sound indicator operating voltage 6V DC 30mA. Small size approximately 3/4" x 1 1/4".

Model EB2116 (Continuous)
Model EB2126 (Slow Pulse)
Model EB2136 (Fast Pulse)



Continuous Slow Pulse Fast Pulse

"C" SIZE BATTERY PACK

10 C size ni-cd battery in dng pack, gives out 12.5V D.C. 1.8 amp per hour. All fresh code, pull-out from movie cameras. Can be disconnected to use as single c cells. Hard to find \$15.00 per pack of 10 batteries

ELECTRONIC ALARM SIRE COMPLETE UNIT

Ideal for use as an Alarm Unit or hookup to your car back-up to make a reverse Indicator. Light Output up to 130dB. Voltage supply 6 12V

AU-999 \$7.50

SUB MINIATURE TOGGLE SWITCH

SPST 2 FOR 2.80 SPDT 2 FOR 3.20
6 AMP 125V AC CONTACT

TRANSFORMERS

ALL 117 VOLT INPUT

30V	4 AMP	\$8.50 EA.
36V CT	3 AMP	\$10.50 EA.
48V CT	3 AMP	\$10.50 EA.
24V CT	3 AMP	\$10.50 EA.
24V CT	0.8 AMP	\$2.50 EA.
12V CT	0.5 AMP	\$2.50 EA.
12V CT	120 MA	\$1.80 EA.

AC POWER SUPPLY

Wall Type Transformer		
12V AC	Output 200 MA	\$2.75 EA.
16V CT AC	Output 100 MA	\$2.10 EA.
6V DC	Output 120 MA	\$1.90 EA.
12V DC	Output 100 MA	\$1.90 EA.

ULTRASONIC SWITCH KIT



Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC. \$15.50

COMPLETE TIME MODULE

0.3" digits LCD Clock Module with month and date, hour, minute and seconds. As well as stop watch function! Battery and back up light is with the module. Size of the module is 1" dia. Ideal for use in auto panel, computer, instrument and many others!
\$8.95 EACH

SOUND ACTIVATED SWITCH

All parts completed on a PC Board SCR will turn on relay, buzzer or trigger other circuit for 2 - 10 sec. (adjustable). Ideal for use as door alarm, sound controlled toys and many other projects. Supply voltage 4.5V 9V D.C. 2 for \$3.00

FM WIRELESS MIC KIT

It is not a pack of cigarettes. It is a new FM wireless mic kit! New design PC board fits into a plastic cigarette box (case included). Uses a condenser microphone to allow you to have a better response in sound pick-up. Transmits up to 350 ft. With an LED indicator to signal the unit is on #FMM2 KIT FORM \$7.95

REGULATED DUAL VOLTAGE SUPPLY KIT

30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C. heat sinks and P.C. board.

\$12.50 PER KIT

AA SIZE NI-CD SPECIAL SALE

RECHARGEABLE BATTERIES
LIMITED QUANTITY AVAILABLE
4 FOR \$3.60

BECKMAN FET LIQUID CRYSTAL DISPLAY

Overall size 2" x 1.2" 0.5" characters reflective type.

Model 737-01 — for clock 4 digits with PM, alarm, snooze, colon indicators.
Model 739-04 — for panel meter 4 digits.

Model 739-03 — for panel meter 3 1/2 digits with \pm sign and over range indicator.

All displays include zeber connectors and front bezel. With data sheets.
Your choice — any model \$7.50 EACH



POWER SUPPLY KIT

0-30V D.C. REGULATED
Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts.
Transformer for Power Supply, 0-30 Power Supply
2 AMP 24V x 2 \$8.50 \$10.50 each



I.C. TEST CLIPS

Same as the E-Z clips \$2.75
With 20" Long Leads
In Black and Red Colors per pair



SOUND GENERATOR I.C.

Creates almost any type of sound — gun shot, explosion, train, car crash, star war, birds, organ ext. A built-in audio amplifier provides high level output. Operates from one 9V battery, 28 pin dip; we supply the datas. \$2.90 EACH



ELECTRONIC SWITCH KIT

CONDENSER TYPE
Touch On Touch Off
uses 7473 I.C. and 12V relay
\$5.50 each



1 WATT AUDIO AMP

All parts are pre-assembled on a mini PC Board. Supply Voltage 6 9V D.C. SPECIAL PRICE \$1.95 ea.

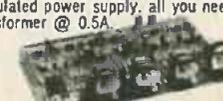


LOW TIM DC STEREO PRE-AMP KIT TA-10 20

Incorporates brand-new D.C. design that gives a frequency response from 0Hz — 100KHz \pm 0.5dB! Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation!

Specifications: • T.H.D. less than .005% • T.I.M. less than .005% • Frequency response: DC to 100KHz \pm 0.5dB • RIAA deviation: \pm 0.2dB • S/N ratio: better than 70dB • Sensitivity: Phono 2MV 47K/Aux. 100MV 100K • Output level: 1.3V • Max. output: 15V • Tone control: bass \pm 10dB @ 50Hz/treble \pm 10dB @ 15Hz • Power supply: \pm 24 D.C. @ 0.5A
Kit comes with regulated power supply, all you need is a 48V C.T. transformer @ 0.5A

ONLY \$44.50
X'tormer



SOLID STATE ELECTRONIC BUZZER

Mini size 1" x 3/4" x 3/4"
Supply voltage 1.5V - 12V
Ideal for Alarm or Tone Indicator
\$1.50 each



FORMULA INTERNATIONAL INC. 5/80

SHIPPING AND HANDLING CHARGES
Under \$50.00 purchase 1.00 Over \$50.00 purchase 1.50
Send \$1.00 For Detailed Catalogue

Outside Continental	1.00
Outside U.S. (includes Mexico & Canada)	2.00
Outside U.S. (includes Mexico & Canada)	2.00
Outside U.S. (includes Mexico & Canada)	2.00

Minimum Order \$10.00/Call. Residents Add 6% Sales Tax
Phone Orders Accepted on Visa or MC ONLY, NO C.O.D./Store Hours 10-7 Mon. thru Sat.
12403 CRENSHAW BLVD., HAWTHORNE, CA 90250
PHONE: (213) 973-1921 • (213) 678-5182

8 Instruments in 1

- Out-of-Circuit Transistor Analyzer
- Dynamic In-Circuit Transistor & Radio Tester
- Signal Generator
- Signal Tracer
- Voltmeter
- Milliammeter
- Battery Tester
- Diode Checker



Model
Transistor Analyzer 212
Factory Wired & Tested — \$35.98
Easy-to-Assemble Kit — \$23.97

Now you can pinpoint defective transistors and their circuit troubles speedily with a single, feature-packed instrument instead of a costly elaborate set-up. Performance-proven by thousands! Checks all transistor types, hi or low power, for DC current gain (beta) to 200 in 3 ranges, and leakage.

Universal test socket accepts all base configurations. Identifies NPN or PNP transistors. Dynamically tests all transistors (oscillator check) and AF, IF, RF circuits.

No external power needed. Measures DC currents to 80 ma. Complete with test leads, instruction manual and transistor listing.

Write for FREE catalog of the world-famous EMC line of test instruments.

EMC ELECTRONIC MEASUREMENTS CORP.
625 Broadway, New York, NY 10012

HIGH STABILITY CRYSTALS FOR FREQUENCY OR TIME USE THE BEST BUY JAN CRYSTALS

- CB
- CB standard
- 2 meter
- Scanners
- Amateur Bands
- General Communication
- Industry
- Marine VHF
- Micro processor crystals

Send 10¢ for our latest catalog. Write or phone for more details.

Jan Crystals
2400 Crystal Drive
Ft. Myers, Florida 33907
all phones (813) 936-2397

easy to charge



CIRCLE 33 ON FREE INFORMATION CARD

SPECIALS!!!

Solderless sockets: 14 pin 50/\$4.95;
16 pin 50/\$4.95; 18 pin 50/\$4.95;
20 pin 40/\$4.95; 24 pin 30/\$4.95;
28 pin 30/\$4.95; 40 pin 20/\$4.95.

General purpose transistors:
NPN, similar 2N3904, 100/\$7.95;
PNP, similar 2N3906, 100/\$8.95.

16K Dynamic RAMs: 8/\$87.20. Expands memory in Radio Shack, Ekidy, Apple, Heath, newer PETs, etc. 250 ns (4 MHz), low power. Add \$3 for 2 dip shunts plus TRS-80 installation instructions.

THE FIRST OF A NEW GENERATION

Our innovative Z-80A CPU board is truly the first of a new generation of S-100 bus equipment... a generation that's designed to accommodate multi-user setups and other high level industrial, scientific, and commercial applications. Contains all standard Z-80 features, conforms to all proposed IEEE specs, and includes power on jump/clear, on-board fully maskable interrupts for interrupt-driven systems, selectable automatic wait state insertion, provision for adding up to 8K of EPROM, and on-board IEEE compatible extended addressing at port FD (hex).

These advanced features give you the power you need for future expansion, as well as the system flexibility that comes from superior design... combined with competitive pricing. \$225 unkit, \$295 assm, and \$395 for boards qualified under our high-reliability CSC program.

TERMS: Call res add tax. Allow 5% for shipping, excess refunded. VISA/Mastercharge call (415) 562-0636 24 hours. C.O.D. OK with street address for UPS. Special prices good through cover month of magazine while supplies last; other prices are subject to change without notice. Add \$1 handling to orders under \$15.

GODBOUNT
GODBOUNT ELECTRONICS
Bldg. 725, Oakland Airport, CA 94614

CIRCLE 67 ON FREE INFORMATION CARD

BULLET ELECTRONICS

PO Box 401244R
Garland TX 75040

NPN HIGH VOLTAGE 2.00



VCEO = 450 VDC IC = 3A (5A Peak)
FOR TV HORIZONTAL SECTIONS: HIGH VOLTAGE REGULATORS
REPLACES: 2N5078, 2N5077, 2N5838, 2N5865, BDY94, BU126, 2SC2121, 2N5840, 2SC1046, 2N5486, TIP558 AND MANY OTHERS.

LM3046	(CA3046) Transistor Array	.75
RCA 40430	400V 6A TRIAC TO-66	.75
CA3086	RCA Transistor Array	.80
MC1438R	Power Op Amp/Driver	.50
1N4148	Prime, Full Lead	100/2.50
LM3302	Quad Comparator	.89
2SC1849	High Freq NPN TO-92	6/1.00
MPS A20	NPN GEN PUR	8/1.00

SE 01 Sound Effects Kit 17.50



The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new Texas Instruments SN74477 Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator and Multiplex Oscillator for even more versatility. The 3 1/2" x 5" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate Explosions, Phaser Guns, Beam Trains, or almost an infinite number of other sounds. The unit has a multitude of applications. The low price includes all parts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100mW amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included)

- 76477 CHIP IS INCLUDED. EXTRA CHIPS \$2.95 EACH
- \$17.50 LESS SPEAKER & BATTERY

AY3-8910 PROGRAMMABLE SOUND GENERATOR

The AY3-8910 is a 40 pin LSI chip with three oscillators, three amplitude controls, programmable noise generator, three mixers, an envelope generator, and three D/A converters that are controlled by 8 BIT WORDS. No external pots or caps required. This chip hooked to an 8 bit microprocessor chip or Bus (8080, Z80, 6800 etc.) can be software controlled to produce almost any sound. It will play three note chords, make bangs, whistles, sirens, gunshots, explosions, bleats, whines, or grunts. In addition, it has provisions to control its own memory chips with two IO ports. The chip requires +5V @ 75ma and a standard TTL clock oscillator. A truly incredible circuit.

\$14.95 W/Basic Spec Sheet (4 pages)
60 page manual with S-100 interface Instructions and several programming examples, \$3.00 extra.



TUNES SYNTHESIZER
The AY3-1550 is a MOS microcomputer synthesizer of pre-programmed tunes for applications in toys, music boxes and door chimes. The standard device has a set of 25 different popular and classical tunes. In addition there are 3 chimes making a total of 28 tunes.

FEATURES

- Minimal external components
- Automatic switch-off signal at end of tune for power saving
- Envelope control to give organ or piano quality
- Sequential tune mode
- 4 door capability when used as door chime
- Operation with tunes in external PROM if required (2708)
- Single supply (+5V) Operation
- Tunes include: STAR WARS, BEETHOVEN'S 9th & 5th, JINGLE BELLS, YANKEE DOODLE, STAR SPANGLED BANNER, CLEMENTINE, GOD SAVE THE QUEEN, O SOLE MIO, WEST MINSTER AND DESCENDING OCTAVE CHIME PLUS MANY MORE!

\$14.50 WITH DETAILED SPECS AND INSTRUCTIONS

1/2W RESISTOR ASSORTMENT

A good mix of 5% and 10% values in both full lead and PC lead devices. All new, first quality

(Assl) 200 pieces-2.00

POTENTIOMETER ASSORTMENT

A mix of new, panel mount 3/8" bushing pots in various values. Some dual, some with switches

10/2.00

SLIDE SWITCH ASSORTMENT

An outstanding bargain! Includes miniature and standard sizes and multi-position units. All new first quality, name brand switches. Try one pack and you'll reorder more! SPECIAL — 12 for \$1.20 (Assortment)

XAN SUPER DIGITS

.6" JUMBO LED
7 SEGMENT
RED

99¢

8620 COMMON CATHODE
8640 COMMON ANODE



NOW A SUPER READOUT AT A SUPER BUY! These are factory fresh prime LED readouts, not seconds or rejects as sold by others. Compare our price and send for yours today, but hurry. The supply is limited! SPECIFY: COMMON ANODE OR COMMON CATHODE

7 WATT AUDIO AMP KIT

SMALL SINGLE HYBRID IC and COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP. LESS THAN 3% THD @ 5 WATTS COMPATIBLE WITH SE-01 SOUND KIT. \$6.99

ULTRASONIC RELAY KIT

INVISIBLE BEAM WORKS LIKE A PHOTO ELECTRIC EYE. USE UP TO 25 FT. APART. COMPLETE KIT. ALL PARTS @ PC BOARDS. \$21.50

From T.I.: TL490 BAR/DOT DRIVER IC. Drives 10 LED's with adjustable analog steps. Units are cascadable up to 10 (100 steps). Drives LED's directly. Great for voltage, current, or audio displays. Similar in features to LM3914 with specs and circuit notes. 2.95

- NO C.O.D.'s
 - SEND CHECK M.O. OR CHARGE CARD NO.
 - PHONE ORDERS ACCEPTED ON VISA AND MASTERCARD ONLY (214) 278-3553
 - ADD 5% FOR SHIPPING
 - TX RES. ADD 5% STATE SALES TAX
 - FOREIGN ORDERS ADD 10% (EXCEPT CANADA) (20% AIRMAIL) U.S. FUNDS ONLY
- catalog free on request

Active Electronic Sales Corp.



Z8001 \$195.00 16 Bit CPU with segmented address space to 8 Megabytes

Z8002 \$150.00 16 Bit CPU with non segmented address space to 64K bytes.

Z8000B \$1500.00 A complete single board Z8000 microcomputer system. Contains the Z8002 microprocessor, 16K words of dynamic RAM, 2K word monitor PROM, dual serial interfaces, four counter/timers and 32 programmable parallel I/O lines.

**All Products Stocked In Depth
Largest Zilog Inventory**

Z80-CPU	2.5 MHz	\$10.50	Z80-DMA	2.5 MHz	\$28.85
Z80A-CPU	4.0 MHz	12.80	Z80A-DMA	4.0 MHz	33.60
Z80-PIO	2.5 MHz	8.00	Z80-SIO/O	2.5 MHz	36.00
Z80A-PIO	4.0 MHz	9.60	Z80A-SIO/O	4.0 MHz	44.10
Z80-CTC	2.5 MHz	8.00	Z80-SIO/I	2.5 MHz	36.00
Z80A-CTC	4.0 MHz	9.60	Z80A-SIO/I	4.0 MHz	44.10
			Z80-SIO/2	2.5 MHz	36.00
			Z80A-SIO/2	4.0 MHz	44.10

MICROPROCESSOR CHIP SETS

Part No.	Price	Part No.	Price	Part No.	Price
8080A	\$5.95	6800	\$6.95	6502	\$9.95
8085	12.95	6802	11.95	6504	9.95
				6505	9.95
8212	2.95	6810	3.95		
8214	3.95	6820	3.95	6520	6.95
8216	2.95	6821	3.95	6522	9.95
8224	3.45	6850	4.25	6532	13.95
8226	2.95	6852	3.95	6551	13.95
8228	4.98				
8238	4.98				
8251	6.95				
8253	10.95				
8255	6.95				
8257	10.95				
8259	12.95				

METAL POWER TRANSISTORS

Homotaxial — Best Quality

2N3054	.65	60V	NPN	TO-66
2N3055	.69	70V	NPN	TO-3
2N3442	1.50	160V	NPN	TO-3
2N3771	1.95	50V	NPN	TO-3
2N3772	1.95	100V	NPN	TO-3
2N3773	2.50	160V	NPN	TO-3

Universal SCR

C106D	.34	400V	5.0 AMP	TO-220
-------	-----	------	---------	--------

EPROM'S

C2708
1K x 8 450 ns  \$ 6.95

TMS2716
16K (2K x 8) 450 ns
(3 power supplies) T.I. Version: \$24.95

C2716/TMS2516
16K (2K x 8) 450 ns
(Single 5V supply — Intel version) \$23.95

MOS MEMORIES

MOS Static RAM's

Part No.	Price
2102LPC	1.19
1K (1K x 1) Low Power 350ns 18 PIN	
2102LHPC	1.29
1K (1K x 1) Low Power High Performance 250ns 18 PIN	
2102-1PC	0.94
1K (1K x 1) 450ns 15 PIN	
2102-2PC	0.89
1K (1K x 1) 650ns 18 PIN	
P2111-25	2.25
1K (256 x 4) 250ns 18 PIN	
P2112-35	2.25
1K (256 x 4) 350ns 18 PIN	
2114L	5.95
Low Power 4K (1024 x 4) 300 ns	

MOS Dynamic RAM's

TMS4060-30 4K (4K x 1) 300ns 22 PIN \$2.95

TMS4060-20 4K (4K x 1) 200ns 22 PIN \$3.95

UART's

AY5-1013A 0 to 40K BAUD 40 PIN \$4.95

AY3-1015 0 to 30K BAUD 40 PIN Single 5V supply \$5.50

1K CMOS RAM

5101 1K (256 x 4) 450ns 22 PIN Low Power \$4.95

4K CMOS RAM

P4315-45L 4K (4K x 1) 450ns 18 PIN \$14.95

P5047-55/UPD455 4K (1024 x 4) 550ns 20 PIN 110MW \$14.95

P8504 4K (4K x 1) 550ns 18 PIN 110MW \$14.95

P6514 4K (1K x 4) 450ns 18 PIN 110MW \$18.95

SHIFT REGISTERS

3341PC RIFD 700 KHz \$4.95

3341APC FIFO 1 MHz \$5.50

3342PC 64 Bit Shift Register \$4.95

3347PC 80 Bit Shift Register \$4.95

ECL RAM

10410ADC/HM2106 256 x 1 Bit Fully Decoded 15ns 16 PIN **Special** \$1.95

Special of the month

16K MOS DYNAMIC RAM'S (18 PIN)

416-5 (300ns) CERAMIC	\$5.95
416-3 (200ns) CERAMIC	\$7.95

LINEAR I.C.'s

LM301N-8	.34	LM739CN-14	1.29
LM307N-8	.29	LM741CN-8	.49
LM308CH	.95	LM747CN-14	.59
LM311N-8	.59	LM748CN-8	.39
LM324N	.59	TBA8100AS	1.29
LM339N	.99	LM1458N-8	.49
LM348N-14	.55	LM1488N-14	.69
LM358N-8	.59	LM1489N-14	.69
LM555N-8	.99	LM3403N-14	.99
LM556N-14	.49	LM3903N	.59
LM723CN-14	.49	LM4136N-14	.99
LM725CN-8	1.25		

1980 IC MASTER

JUST RELEASED over 2700 PAGES

Complete integrated circuit data selector. Master guide to the latest I.C.'s including microprocessors and consumer circuits. 45,000 device types listed. 5,000 new device types added. Complete new section on MPU boards & Systems.

Free Quarterly Updates

Special \$59.95



SOUND & MUSIC GENERATOR I.C.

Creates almost any type of sound, from music to gunshots and explosions. High level on amp output. 28 pin DIP. Operates from one 9V battery. With data.

"Lowest Price Offered Anywhere"

SN76477N (.600" centers) \$2.49

SN76477NF (.400" centers) \$2.29

New small package

DUAL-IN-LINE — LOW PROFILE — I.C. SOCKETS

CONTACTS	PRICE	CONTACTS	PRICE
8 PIN	.07	22 PIN	.21
14 PIN	.11	24 PIN	.23
16 PIN	.13	28 PIN	.27
18 PIN	.17	40 PIN	.39
20 PIN	.19		

- LOWEST PRICES ANYWHERE FOR THE HIGHEST QUALITY, AN UNBEATABLE COMBINATION
- PERFORMANCE CHARACTERISTICS CONFORM TO THE REQUIREMENTS OF MIL-S-83734A
- OPERATING TEMPERATURE: -65°C TO +125°C
- FLAMEABILITY RATING UL94V-0

SOCKET SALE



L.E.D. LAMPS

LED209	T-1 3 mm Red	.09
LED211	T-1 3 mm Green	.19
LED212	T-1 3 mm Yellow	.14
LED220	T-1 5 mm Red	.11
LED222	T-1 5 mm Green	.24
LED224	T-1 5 mm Yellow	.16

DISPLAYS

FND357	.375	Common Cathode	1.09
FND367	.360	Common Cathode (high brightness)	1.29
FND500	.500	Common Cathode	1.09
FND507	.500	Common Anode	1.09
FND550	.500	Common Cathode (high brightness)	1.29
FND567	.500	Common Anode (high brightness)	1.29
DL704	.300	Common Cathode	1.29
DL707	.300	Common Anode	1.29
DL747	.630	Common Anode	2.29

ISOLATORS

1L074	Dual Opto Isolator	1500V	1.29
1L074	Quad Opto Isolator	1500V	3.95
MCT16	Opto Isolator	1500V	1.29
TL111	Opto Coupler	1500V	.59
4N28	Opto Isolator	2500V	.59
4N28	Opto Isolator	500V	.59
4N28	Opto Isolator	2500V	.59
4N32	Opto Isolator	2500V	.59

SMALL SIGNAL TRANSISTORS

METAL CAN	PLASTIC		
2N697 .29	2N2484 .21	2N3391A .10	2N4402 .09
2N918 .21	2N2904A .29	2N3415 .10	2N4403 .09
2N930 .21	2N2905A .29	2N3704 .10	2N4410 .13
2N1304 .48	2N2906A .21	2N3819 .29	2N5064 .24
2N1307 .59	2N2907A .21	2N3904 .00	2N5401 .14
2N1309 .79	2N301B .25	2N3906 .09	2N5550 .14
2N1613 .34	2N3053 .29	2N4058 .14	2N5770 .12
2N1893 .34	2N3250 .15	2N4123 .09	2N5772 .12
2N2219A .29	2N3251A .25	2N4124 .09	2N6027 .24
2N2222A .21	2N3962 .25	2N4125 .09	2N6028 .24
2N2270 .34	2N4093 .55	2N4126 .09	
2N2369A .21	2N5109 1.45	2N4400 .09	
2N2483 .15		2N4401 .09	

PLASTIC POWER TRANSISTORS

TIP30	.39	PNP	1 AMP	100V
TIP31	.42	NPN	3 AMP	100V
TIP32	.43	PNP	3 AMP	100V
TIP41	.59	PNP	6 AMP	100V
TIP42	.64	PNP	6 AMP	100V
TIP115	.59	PNP	2 AMP	60V
TIP120	.64	NPN	5 AMP	60V
TIP122	.74	NPN	5 AMP	100V
TIP125	.74	PNP	5 AMP	60V
TIP127	.85	PNP	5 AMP	100V
TIP2955	.83	PNP	15 AMP	60V
TIP3055	.70	NPN	15 AMP	60V
FT3055	.59	NPN	10 AMP	60V

Active Electronic Sales Corp.

P.O. BOX 1035 FRAMINGHAM, MASSACHUSETTS 01701

Over-the-counter sales: 12 Mercer Rd., Natick, Mass 01760
Behind Zayres on Rte. 9
Telephone Orders & Enquiries (617) 879-0077

MINIMUM ORDER \$10.00 + ADD \$2.00 TO COVER POSTAGE & HANDLING

Foreign customers please remit payment on an international bank draft or international postal money order in American dollars

IN CANADA

5651 FERRIER ST MONTREAL, QUEBEC H4P 2K5 Tel.: (514) 731-7451	3800 DUFFERIN ST DOWNSVIEW, ONTARIO M3H 5S9 Tel.: (416) 661-1115	84 KEELE CEMETERY 1050 BAXTER ROAD OTTAWA, ONTARIO K2C 3P2 Tel. (613) 820-9471	3070 KINGSWAY VANCOUVER B.C. V5R 5J7 Tel. (604) 438-3327
--	---	--	---




CIRCLE 23 ON FREE INFORMATION CARD

MAY 1980

SOUND EFFECTS GENERATOR BASIC KIT
 Now Chaney Electronics makes it possible to build your own SOUND EFFECTS GENERATOR WITHOUT SPENDING A FORTUNE. WE SUPPLY YOU WITH THE 1176A77 SOUND CHIP PLUS AN ETCHED AND DRILLED GLASS EPBAY PC BOARD WITH SCHEMATIC AND LAYOUT INSTRUCTIONS. THIS BOARD MAKES IT SIMPLE TO BUILD A GENERATOR CAPABLE OF PRODUCING ROARS, LAUGHTER, SIRENS, AIRPLANE, GUNBOYS, ETC. DOES NOT REQUIRE DIP SWITCHES OR OTHER EXPENSIVE/UNUSUAL COMPONENTS. YOU SUPPLY ONLY 5 Pcb STAND-IND RESISTORS, CAPACITORS, SWITCHES, POTS, SPEAKERS, 78222Z TRANSISTOR AND 9V BATTERY.

2N2222 TRANSISTOR FOR ABOVE C23884 \$3.50 EACH
 IF YOU HAVE ALREADY PURCHASED THE 1176A77 CHIP YOU MAY BUY THE PC BOARD AND INSTRUCTIONS ONLY. C23885 \$5.00

Strobe Tube & Trigger  **LED Flasher Kit**
 C23881 \$1.75

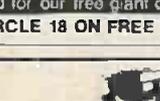
6VDC Xenon Flasher Kit  **Digital Counting Module**
 C23882 \$8.00

120 VAC Xenon Strobe Kit  **Wheel of Fortune**
 C23883 \$7.50

LED Panel Mounting Kit  **SUB-MINIATURE ELECTRET CONDENSER MIKE**
 C23886 \$1.50

RO170 Rectifier  **Mini Reed Switch**
 C23887 \$1.00

Tube Specials  **Microfilm CAP**
 C23888 \$1.00

Horse-shoe Tube  C23889 \$3.95

CHANEY electronics inc.
 P.O. BOX 27038, DENVER, CO. 80227 (303) 781-5750
 Send for our free giant catalog of unique items!!
CIRCLE 18 ON FREE INFORMATION CARD

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

Free Information Number Page

6 AMC Sales 124
 — ATV Research 112
 47 AP Products, Inc. 30
 23 Active Electronics 133
 — Advance Electronics 34-35,42,85,124
 51-52 Advanced Computer Products 118-119
 15 All Electronics 128
 30 American Antenna Cov. 4
 53 Ancrona 116
 48 B & K Precision Dynascan Corp. 106
 — Bagnall Electronics 114
 — Karel Barta 114
 64 Beacon Scientific 15
 37 Beckman 107
 62 Blonder Tongue 94
 27 Dr. Bohm 90
 — Bullet Electronics 132
 59 CFR Associates 124
 18 Chaney Electronics 134
 42 Channellock 102
 — CIE—Cleveland Institute of Electronics. 18-21
 — Command Productions 112
 66 Concord-Computer Components 124
 — Dage Scientific 134
 28 Delta Electronics 114
 73 Deltroniks 134
 9 Diamondback 116
 20 Digi-Key 125
 — EMC—Electronic Measurements Corp. 132
 — Edmund Scientific 108
 21 Electra Company 44
 — Fair Radio Sales 112
 24 Fluke 7
 — Fordham Radio Supply 127
 2-3 Formula International 130-131
 43 Fuji-Svea 121
 49 GC Electronics 90
 — General Electric 89
 31 Global Specialties Corporation 5
 67 Godbout Electronics 132
 — Grantbam College of Engineering 105
 68 Guardian Electronics 13
 34,35 Heath Cov. 3,101
 76 Hickock Electrical Instruments 33
 61 Hitachi Denshi 40
 26 Hustler, Inc. 110
 — Information Unlimited 116
 77 International Crystal Mfg. Co. 26
 69 International Electronics Unlimited 128
 — JS & A 1
 12-13 Jameco Electronics 122-123
 33 Jan Crystal 132
 — Keithley Instruments 96-97
 — Lakeside Industries 114
 60,78 Leader 31
 4 MCM Audio 113
 7 McKay Dymek 110
 16 Meshna 120
 56 Micro Mart 120
 — National Radio Institute (NRI)—Div. of McGraw Hill 8-14

— National Technical Schools 36-39
 22 Nesda 108
 54,55 Netronics 95,109
 39,40 O.K. Machine & Tool 17,32
 8 onComputing (BYTE) 103
 29 Optoelectronics 83
 25 PAIA 105
 11 Pac-Com 86
 38 Panasonic 43
 71 Panavise 100
 46 Poly Paks 120
 5 Quest 117
 74 Quietrole 108
 79 R & R Instrumentation 27
 — RCA 22-23
 17 Radio Shack 129
 57,58 Ramsey Electronics 115,126
 19 Rye Industries 26
 — Sabtronics 41,93
 — Howard W. Sams 99
 45 Schober Organ 105
 — Sheldahl 100
 72 Shure Brothers 104
 44 Simpson Electric 24-25
 14 Solid State Sales 128
 32 Sony 87
 — Spacecoast Research 112
 65 Sprague Products 111
 41 Symmetric Sound Systems 106
 — Telex Communications 28-29
 63 University of the Trees Press 2
 36 Vaco Cov. 2
 — VIZ Mfg. Co. 91
 10 Wersi Electronics 110
 75 Weston Instruments 27

FREE KIT Catalog
 AUTORANGE DIGITAL CAP-METER contains KIT. Still the best for only \$74.95 TEST & EXPERT-MENTER'S EQUIP.
 Phone 415-447-3433
 Write or Phone for FREE CATALOG. Average 1 minute Saturday call is 21¢.
DAGE SCIENTIFIC INSTRUMENTS
 BOX 1054R LIVERMORE CA 94550

Heart disease and stroke will cause half of all deaths this year.

 **American Heart Association**
 WE'RE FIGHTING FOR YOUR LIFE

1. 5 Volt, 3 amp, Regulated Power Supply. Great for TTL Projects \$19.50
2. EMM 4200A, 4K Static RAMs, Ceramic A local memory boards manufacturer closed. We bought the new memory boards and took these 4200A static RAMs out. They are tested and 90-day guaranteed 100% good.
 Prime tested 4200A 4K RAMs \$5.50 ea., 32/\$160.00, 300 pieces or more \$4.50 ea.
3. Motorola Triacs, 500 volt @ 15 amp MAC 20-7 10 for \$20.00
4. Power SCR's (GEC50A) 100 volts @ 110 amps \$6.95 ea.
5. LM 323 5 Volt 3 amps, voltage regulator 2.95 each or 10/25.00.
6. Super Saver. Micro PD411, Ceramic 4K x 1 dynamic RAMs 8 for \$10.00.

DELTRONIKS
 5151 BUFORD HIGHWAY D28
 ATLANTA, GA 30340
 404-458-4690

CIRCLE 73 ON FREE INFORMATION CARD

RADIO-ELECTRONICS

Big picture. Beautiful color.



It's more than just a big picture. Heathkit, Screen Star is a breakthrough in picture quality.

The finest f1.0 lenses you can buy beam a sharper, clearer picture.

Unique three-tube projection gives you brighter, more vivid color.

High-reflectivity, washable, six-foot diagonal screen gathers in every ray of light for a big, beautiful picture.

Your favorite movies, musicals and sports events never looked so good.

It's easy to adjust. Built-in crosshatch generator makes it simple to maintain convergence and sharpness. All convergence adjustments are on upper chassis for easy access.

Automatic Fine Tuning (AFT) keeps you in tune from channel to channel.

Special black level clamps maintain constant blacks for clearer, more realistic night scenes.

It's easy to build and easy to service. This is Heath's easiest-to-build solid-state TV. It's actually easier than conventional TV's. Like all Heath electronic kits, it comes with an easy-to-follow assembly manual that takes you step-by-step through every phase of assembly.

And when you build it yourself, you can service it yourself. Every set includes a detailed service manual that can save you money over the years.

The price will surprise you. Heath engineers have built in the quality while holding the line on price. This is one of the lowest priced three-tube projection TV's you can buy.

All the latest and the best in video technology is brought together in the Heathkit Screen Star.



FREE CATALOG

The new Heathkit Catalog has complete details on the Screen Star, plus nearly 400 exciting electronic kits for your home, work or pleasure. Send for your free catalog today or pick one up at your Heathkit Electronic Center.*

Heathkit®

Write to Heath Company,

Dept. 020-654, Benton Harbor, MI 49022

*Visit your Heathkit Electronic Center where Heathkit Products are displayed, sold and serviced. See your telephone white pages for the location nearest you. Heathkit Electronic Centers are units of Veritechnology Electronics Corporation.

GX-37B

Simulated TV Picture

Heathkit Screen Star
gives you movie-theatre excitement
in the comfort of
your own home.



THE K40 SPEECH PROCESSOR

The K40 Speech Processor.
So unique it's patented.
So good its guaranteed
to out-perform any
microphone on any radio.

CLIPS ANYWHERE WITHOUT A CLIP!

Molded four-pole internal magnet clamps instantly to any steel surface. Steering column, metal dash, roof top, or the side of your CB radio. No groping for your mounting clip.

PROCESSES SPEECH WITH A COMPUTER CIRCUIT!

It's its own computer—it automatically monitors your speech and adjusts it in micro-second increments pumping so much db gain into your speech that you get 400% more power than a standard mike.

Double Guarantee

GUARANTEE I:
 The K40 Speech Processor is guaranteed to outperform any microphone it replaces or return it for a complete and full refund within 7 days from the K40 Dealer that installed and tuned it.

GUARANTEE II:
 Unconditionally guaranteed for 12 months. Guaranteed against cracking, chipping, or rusting. Guaranteed against mechanical failure. Guaranteed against electrical failure. No exclusions. No gimmicks. For a full 12 months.



TWO MICS WITH ONE SWITCH!

Switch up for a high-pitched transmission for cutting congested city traffic. Switch down for a mellow base in open, uncluttered rural areas.

NOISE CANCELLING

Pull the Processor directly to your mouth and speak directly into the mic. The Processor adjusts to your voice—and blanks out all the cab noise while you're speaking. Automatically.

FRESH CHARGE WITH NO BATTERIES!

Patented electronic storage system recharges while you listen to the radio. It provides a fresh electrical charge every time you squeeze the trigger. You never replace batteries.

SOUND SENSITIVE 2 INCHES OR 2 FEET!

A microphone so sensitive it will select your voice and process your speech no matter how close or far you are from the microphone.

\$44.50*

American Antenna Eign., IL60120

*suggested retail.

CIRCLE 30 ON FREE INFORMATION CARD

SOLD AND SERVICED EXCLUSIVELY BY 3,500 REGISTERED K40 DEALERS THROUGHOUT THE U.S. AND CANADA