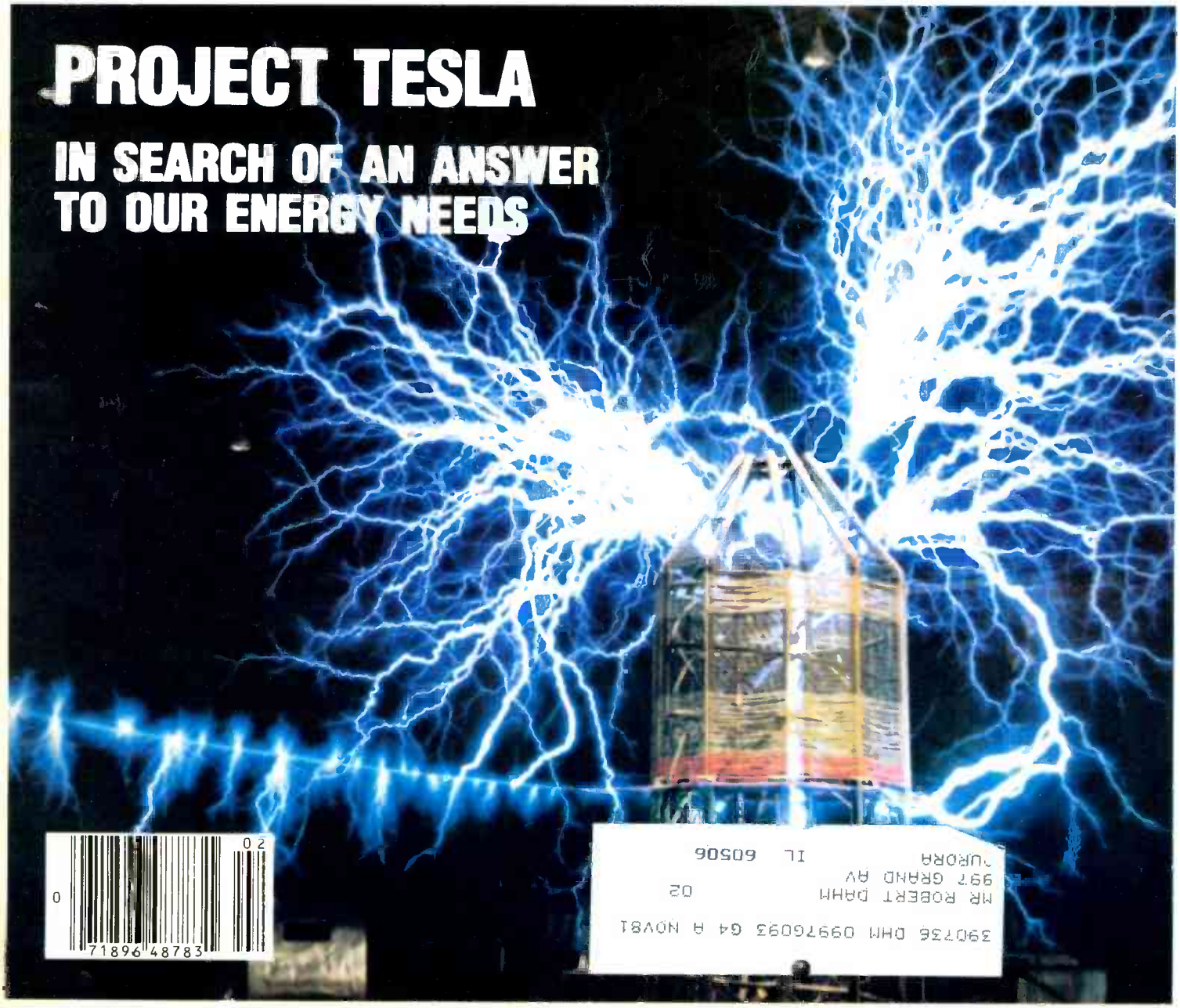
Radio-Electronics®

BUILD YOUR OWN PAY-TV DECODER

$1.25 FEB. 1981

Answer 10 top videotape questions
Today's hi-fi noise reduction devices
Measure ultra-low ohms with a DMM

Electronic gadgets in your next car
Better motor control for your robot
Build your own PROM programmer



Xcelite.

For nuts and screws in all the sizes you use – and in all the patterns you're ever likely to meet (including the new Torx® design that's becoming so widespread).

Choose from inches or metric, straight-on heads or ballpoints, regular or tee, fixed or ratcheting handles.

Buy singly, in packaged sets, or in comprehensive cased kits.

If you need to drive a nut or screw, trust Xcelite.

from Cooper The Toolmaker.™

CIRCLE 23 ON FREE INFORMATION CARD

COOPER INDUSTRIES

The Cooper Group

BOKER® CRESCENT® LUFKIN® NICHOLSON® PLUMB® WELLER® WISS® XCELITE®

P.O. Box 728, Apex, North Carolina 27502. Tel: (919) 362-7510 Telex: 579497

Torx® is the trademark of Camcar Division of Textron Incorporated

Space Scape

A new painting by Mark Rickerson offers opportunity for JS&A customers in this exclusive print offering.

The painting above is by one of America's fastest rising American artists, Mark Rickerson. Rickerson's works represent some of the most popular space paintings ever created and they have been displayed at some of America's leading galleries and purchased by many space-age companies.

About one year ago, JS&A's president was traveling through Honolulu on a trip back from the Far East when he stopped by an art gallery to examine some paintings.

PRESIDENT'S IDEA

While in the gallery he saw one of Rickerson's works. Since JS&A markets space-age products, our president thought it would be a great idea to feature one of Rickerson's paintings on the next cover of JS&A's space-age catalog.

So he bought the painting and traveled to the Hawaiian Island of Maui, where he met with Rickerson in his studio to discuss reproduction rights. Rickerson refused. His paintings were growing in value and he did not want to commercialize his efforts at that stage of his career.

PROGRAM UNACCEPTABLE

Several months later however, our president received a call from Rickerson. The artist wanted to know if JS&A would be interested in offering limited edition prints exclusively to its customers, many of whom would appreciate the subject matter because of their interest in space-age electronics.

This time we refused. Rickerson wanted JS&A to offer 300 signed and numbered proofs for $200 each. A typical JS&A response, however, would far exceed the available prints and we would have to return too many orders. In addition, Rickerson had been getting $350 for his prints and we didn't understand why he would lower his price.

RICKERSON'S PLAN

But Rickerson had a plan. Those who would respond to our offer would have their name placed in a computer and at the end of our promotion, the computer would randomly select 300 people eligible to purchase the prints. All respondents however, would make up his personal mailing list.

In the future, whenever a new Rickerson print would be announced for $350 or more, those on his personal list would be eligible to purchase that print during the next three years at only $200 regardless of Rickerson's status, fame or the value of his paintings.

Rickerson looked to this promotion as a way of establishing himself and his art firmly as a major factor on the American art scene and at the same time establish a strong following. JS&A in turn has not only agreed to assist Rickerson in that goal, but will be actively promoting his art and his products during the next three years. This offer to participate in his print program will end on February 28, 1981 and only those who respond will be allowed to participate during the next three years.

25 SEPARATE PLATES

Rickerson's painting shown above is called 'Space Scape,' and is one of a series of four that will be offered in this program. Space Scape is a spectacular view of outer space and expresses mankind's relationship to space in a dazzling display of colors, planets and shapes.

The serigraph prints are as spectacular as the original. Limited to only 300 hand-signed and numbered proofs, there are 26 separate overlaid colors from 26 separate silk screens to reproduce every exact detail on 100% museum-quality PH-balanced paper. And they are large—a 30" x 40" image size delivered in a well-constructed and protected carton.

PAINTING OFFERED

Later the original painting will be offered to the general public for $10,000, or for $5,000 to anyone on Rickerson's list on a first-come first-served basis.

There is no obligation to enter and no money is required. Simply fill in the information requested on the coupon and mail it to: One JS&A Plaza, Northbrook, Illinois 60062.

Each participant will be sent an acknowledgment letter with a number. The program will officially close on February 28, 1981 and those selected to receive the print will be notified directly by a public accounting firm by March 15, 1981. There is a strict limit of one entry per person and our computer will automatically reject duplicate applications. If for any reason you are dissatisfied with your purchase, you may return your print anytime during the next three years for a full refund.

Participate and join with us in a great opportunity to own a print from one of America's fastest rising American artists and become part of a select group. Send in your free reservation today.

FREE PARTICIPATION COUPON

Please accept this coupon as my eligibility for participation in the random selection drawing for the print shown above. I understand that I am under absolutely no obligation and that I will be eligible in future programs whether I obtain the print or not.

Name _____

Address _____

City _____ State _____

Zip _____

JS&A

One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-7000

RA

"Here's great news for electronics enthusiasts on small budgets.

Now you can take home a Fluke DMM for $125.*"

Whether you're just starting out in electronics or moving up from an analog VOM to a digital multimeter, you'll be smart to make sure that you're getting your money's worth.

In your search for a basic-performance DMM, be sure to consider the new D 800 from Fluke. Priced at only $125,* this dependable six-function handheld DMM is available now at select electronics supply stores throughout the U.S.

The D 800 offers 0.5% basic dc accuracy (five times better than analog voltmeters), a razor-sharp 3½-digit LCD readout, unsurpassed overload protection, and true, one-hand operation.

This hard-working basic measurement multimeter is designed from the inside out for long life and reliability. All D 800 specifications are traceable to the National Bureau of Standards.

As part of Fluke's new Series D line of low-cost digital multimeters, the D 800 carries a limited one-year parts and labor warranty and comes complete with the battery, and safety-designed test leads.

Ask your supplier about the D 800, then compare it feature-for-feature with any other low-cost DMM. You'll find that for only $125,* there's never been more multimeter than the new D 800 from Fluke.

From the world leader in DMM's. Now we've designed one for you.

*Suggested U.S. list price

CIRCLE 7 ON FREE INFORMATION CARD

If your dealer doesn't carry Series D Multimeters yet, call this number. We'll be happy to tell you who does. 1-800-426-9182

FLUKE®

Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

FEBRUARY 1981 VOL. 52 No. 2

ON THE COVER

The spectacular display of lightning is being produced by the largest Tesla coil in the United States. Erected inside an airplane hanger at Wendover Air Force base, it is a duplicate of Tesla's original coil, and is being used in a search for an answer to nuclear fusion.

ANNUAL INDEX JANUARY—DECEMBER

1980

To present the maximum number of articles to our readers, we have not published the Annual Index as part of this issue. A 4-page brochure containing this index is available for those who need one. To get your free copy, send a *stamped self-addressed envelope (legal size) to:*

Radio-Electronics
Annual Index
45 East 17th Street
New York, NY 10003

Any requests postmarked on or before April 30 are free. After that date there is a 25¢ fee. Questions and comments about anything other than the Index that are included with your request cannot be handled. Send them separately to our Editorial Offices.

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. 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.

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

TELETEXT STARTS

While an EIA all-industry committee continues to explore the advantages and disadvantages of the various proposed teletext systems, CBS is going ahead with a public program and audience test of the French-developed Antiope system on its Los Angeles station, KNXT, with actual transmissions scheduled to start in April. CBS president Thomas Wyman forecast in an interview that if the test were successful, the network's five owned stations would be broadcasting it within two years, and its independent affiliates would come along "one at a time" starting in the same period.

Decoder-equipped sets will be located in public areas at first, to be followed by actual in-home tests. Participating in the test will be Los Angeles public-television station KCET, which will develop educational uses for the system, while the Caption Center of public-TV station WGBH, Boston, will prepare captions for some CBS network programs for the benefit of the hearing-impaired. Telediffusion of France is lending the broadcast equipment, with 100 U.S. TV receivers to be used initially for the test.

VIDEODISC SCORECARD

With RCA poised to begin retail sales of its CED grooved-capacitance videodisc system, most of the industry is now choosing up sides among three systems. Here's how things stood at press-time: Capacitance Electronic Disc (CED) system—players to be marketed by RCA, Zenith, Sears, Sanyo, Hitachi, J.C. Penney, Toshiba, Radio Shack, and probably Montgomery Ward; discs to be made by RCA and CBS. LaserVision (LV) grooveless reflective optical system (on the market since December 1978)—players by Magnavox, Pioneer, Advent, Gold Star (Korea), with Sylvania and Philco probable if their planned sale to North American Philips is consummated; discs by DiscoVision Associates, Philips (England), Pioneer (Japan), 3M, with production for the industrial-institutional market by Sony. Video High Density (VHD) grooveless capacitance system (due on the market late this year)—players by General Electric, Quasar, Panasonic, JVC; discs by VHD Disc Manufacturing Co., owned jointly by GE, Matsushita, JVC and Thorn EMI.

UHF SOLUTIONS

The FCC seems to be moving away from the view that improvements in receiver design and tuning comparability hold the key to better UHF reception. The Commission's UHF Task Force, reporting results of its two-year, $1.5-million study, cited improvement in antennas as being the best path to UHF-VHF equality. Particularly, it stressed the need for consumer education to the value of outdoor antennas, noting that the change from an indoor to an outdoor antenna can "easily achieve an improvement more than five times as effective" as doubling of station transmitter power. The Task Force recommended an industry-government effort to produce antenna-effectiveness ratings as a guide for consumers. It also recommended that TV receivers no longer be required to tune to channels 70-83, since no new UHF stations are being granted in this range.

ONE COMPANY'S PROJECTS

What happened to consumer-electronics R&D? It moved to Japan some time ago. Although American companies are stepping up their pace of home-electronics development, generally each with one or two high-priority projects, the Japanese effort on new products is almost breathtaking. As an example, Hitachi gave Japanese consumers a peek at the near-term future with a huge exhibit of work nearing completion, to celebrate its 70th anniversary. Here are some of the electronic products it showed:

A flat-screen LCD portable television with a three-inch picture scheduled for sale this year or next . . . A five-inch digital audio disc with 96-dB dynamic range, with a solid-state laser pickup, using pulse-code modulation . . . A home information system capable of receiving SHF transmission direct from satellite, including character and pattern recognition . . . A viewdata interactive home computer terminal using telephone lines, which can transmit audio as well as video . . . A portable special-effects VHS home videocassette recorder weighting 11 pounds and scheduled for introduction this year . . . A super-high-resolution (1,023 lines) saticon television pickup tube . . . A home video camera with hydrogenated amorphous silicon pickup tube, which is claimed to provide higher resolution and to resist "burning" . . . The second generation of its home MOS camera (the first is due for introduction in Japan in April) with up to double the resolution . . . "Calcogenide" optical videodisc with recording capability for industrial use . . . A "speech typewriter" that converts speech into Japanese text . . . Optical-beam VHF transmission, capable of carrying seven TV channels simultaneously . . . A semiconductor laser diode for use in optical videodisc players.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

Magnavox introduces Gourmet Video.

Magnavision.® Video for people who know and love video.

Simulated TV picture.

You seek only the ultimate technology in the electronic gear you own. You'd like to control the sequence, speed and direction of what you watch on your television screen. And you wish for a range of programming far beyond the common fare.

For you we have a bright idea called Magnavision. It is Gourmet Video for the video gourmet.

A picture that's clearer than tape and less costly, too.

Magnavision is an advanced LaserVision™ videodisc player. Its optical laser scanner, a videodisc and your TV set team up to give you a picture that's amazingly sharp and clear. Even better, the Magnavision picture remains this good even after thousands of viewings. That's because there is no direct contact between our laser and the disc. Unlike your phonograph, Magnavision doesn't use a needle.

Instead, a laser beam of light "reads" encoded pictures and sounds through a protective coating on our grooveless videodisc. There's no contact. No scratching. No wear. No disc deterioration. The picture will remain as sharp and clear years from now as it is today.

The hearing's as good as the seeing.

Speaking of sound, Magnavision is designed to be played through your home stereo system so you can hear what you see in full high-fidelity stereophonic sound. And since there is no disc wear, the Magnavision sound stays crystal clear, playing after playing.

You can see and hear major movies with theater-like realism. Rock concerts and classical performances come alive before your ears and eyes. Magnavision has to be heard to be believed.

Studio-like controllability puts you in command of the action.

Now the real fun begins. You not only watch and hear Magnavision. You play with it, too. Magnavision's controls are so simple to operate, even children can enjoy putting it through its many playing modes.

Touch REVERSE to create your own instant replays or the sheer fun of looking at things backwards. SLOW MOTION lets you slow the action by a little or a lot so you can follow a golf pro's swing inch by inch until you've got it down pat.

STILL lets you see a museum full of art (up to 54,000 pictures on each side of a disc) one piece at a time. You can advance frame by frame like you would with slides. Or hold a single picture for as long as you like with no damage to the disc or the player.

FAST FORWARD moves the picture at three times normal speed for hilarious effects. While SEARCH lets you scan an entire side of a videodisc in just 26 seconds. INDEX displays the number of each disc frame (54,000 per side) on your TV screen to help you locate specific scenes.

AUDIO 1/AUDIO 2 gives you two separate audio channels for discs recorded in stereo. Or two individual sound tracks to give you the choice of hearing a movie in English or another language, like Japanese.

Only LaserVision systems like Magnavision let you watch and play so many different ways. Even in FAST FORWARD and REVERSE you never lose sight of the picture.

Watch what you want whenever you want.

With Magnavision you have a complete library of MCA DiscoVision® programming to choose from.

Blockbuster movies like *The Electric Horseman*. Classic films like *The Bride of Frankenstein*. Cooking lessons by Julia Child. Documentaries from Jacques Cousteau. How-to-do-it tennis, golf, swimming and crafts. Music, concerts, cartoons, the arts and NFL football. And videodiscs cost far less than prerecorded videotapes.

Full-length movies like *Smokey and the Bandit* are only $24.95. And many educational and instructional discs are only $5.95. (Suggested retail prices.)

Only Magnavision is Gourmet Video.

Magnavision is without a doubt the brightest idea in home video. Its picture, sound, playing action and library of available programming are bound to please the most discriminating video gourmet. For full information on Magnavision and your nearest dealer, call toll-free 800-447-4700. In Illinois, call 800-322-4400.

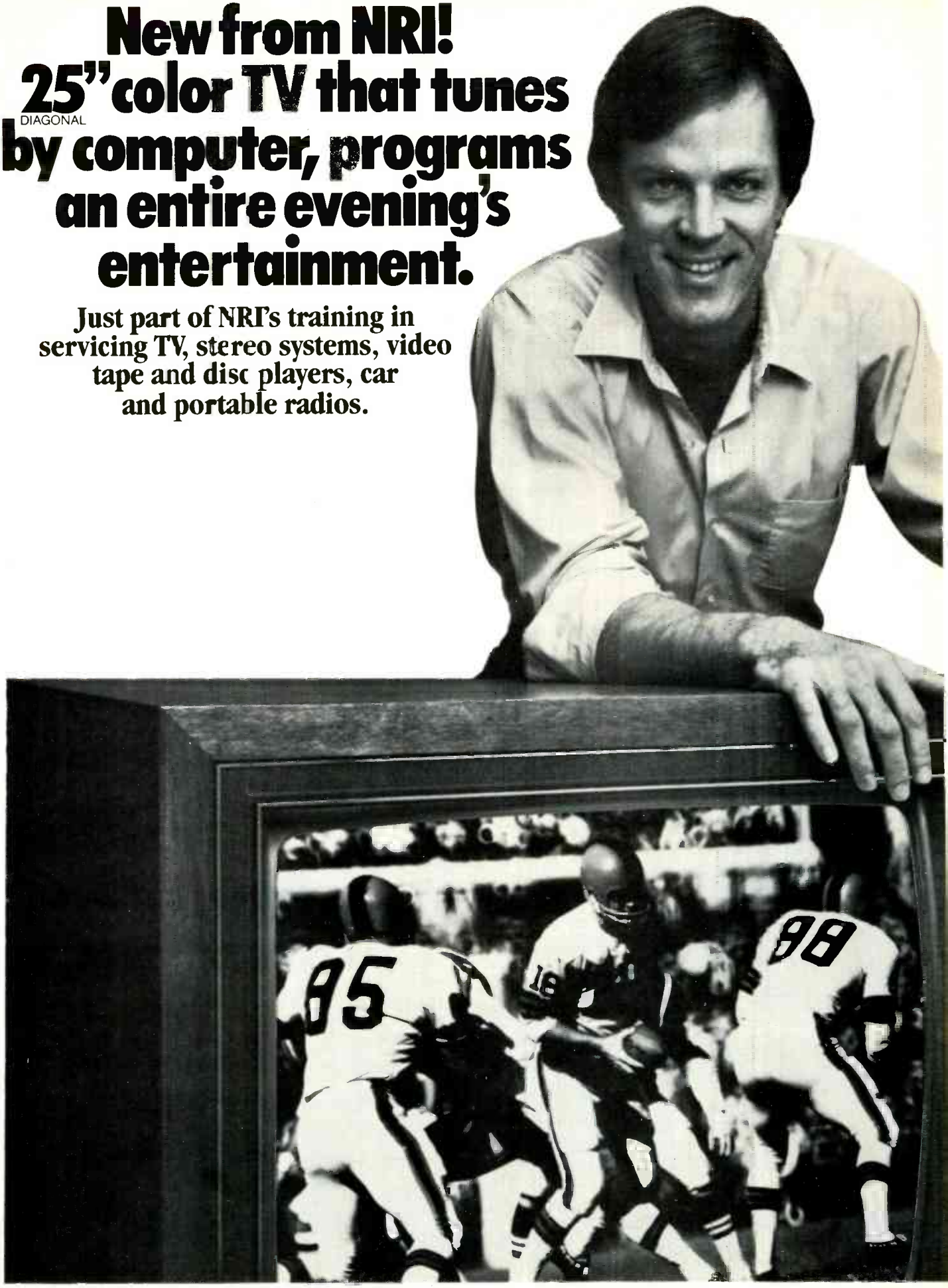
MAGNAVOX

The brightest ideas in the world are here to play.

CIRCLE 66 ON FREE INFORMATION CARD

New from NRI! 25" DIAGONAL color TV that tunes by computer, programs an entire evening's entertainment.

Just part of NRI's training in servicing TV, stereo systems, video tape and disc players, car and portable radios.



Only NRI home training prepares you so thoroughly for the next great leap forward in TV and audio...digital systems. Already, top-of-the-line TV's feature digital tuning, computer programming is appearing, and new digital audio recording equipment is about to go on the market.

NRI is the only home study school to give you the actual "hands-on" training you need to handle servicing problems on tomorrow's electronic equipment. Because only NRI includes this designed-for-learning, 25" diagonal color TV with electronic tuning, built-in digital clock, and computer programmer as part of your training. With this advanced feature, you can pre-program an entire evening's entertainment... even key lock it in to control children's viewing.

As you assemble it, you learn how digital tuning systems work, how to adjust and service them. You work with the same advanced features used in the new programmable TV's and video tape recorders. It's exclusive NRI training that keeps you up with the leading edge of technology.

Exclusive Designed-for-learning Concept

The color TV you build as part of NRI's Master Course looks, operates, and performs like the very finest commercial sets. But behind that pretty picture is a unique designed-for-learning chassis...

the only such unit in the world. Rather than retrofit lessons to a hobby kit or an already-built commercial set, NRI instructor/engineers have designed this television so each step of construction is a learning experience.

As you build it, you perform meaningful experiments. You see what makes each circuit work, what it does, how it interacts with other circuits. You even introduce defects, troubleshoot and correct them as you would in actual practice. And you end up with a magnificent, big-picture TV with advanced features. One you can sell or use in your home.

Also Build Stereo, Test Instruments

That's just a start. You demonstrate basic principles and circuits on the unique NRI Discovery Lab,® then apply them as you assemble a fine AM/FM stereo receiver, complete with speakers. You also get practical experience as you build your own test instruments, including a 5" triggered sweep oscilloscope, CMOS digital frequency counter, color bar generator, and transistorized volt-ohm meter. Use them for learning, use them for earning as a full- or part-time TV, audio, and video systems technician.

Complete, Effective Training Includes Video Systems

Using NRI's exclusive methods, you learn far more than TV servicing. You'll be prepared to work with stereo systems, car radios, record and tape players, transistor radios, short-wave receivers, PA systems, musical instrument amplifiers, electronic TV games, even video tape recorders and tape or disc video players. Your training covers just about every kind of electronic entertainment equipment available now or in the near future.

And because NRI has unmatched experience gained in over 60 years and a million students worth of training, your course is designed for ease of learning and practical utility. You need no previous experience of any kind. Starting with the basics, exclusive "bite-size" lessons cover subjects thoroughly, clearly, and concisely. "Hands-on" experiments reinforce theory for better comprehension and retention. And your personal NRI instructor is always available for consultation, ready with explanations, answers, and advice.

Send for Free Detailed Catalog... No Salesman Will Call

Get all the facts on this exciting course and its potential for you by mailing the postage-paid card today. Our free 100-page catalog includes color photos of all kits and equipment, complete lesson plans, convenient time payment plans, and information on other electronics courses. You'll also find out about NRI's new Computer Technology Course that includes your personal

microcomputer. Or Complete Communications with 2-meter transceiver that gets you ready for opportunities in broadcasting, 2-way radio, microwave, and other growing fields. If card has been removed, write to:

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

what's news

Dr. Vladimir K. Zworykin honored

Vladimir Zworykin, 91-year-old TV pioneer, was selected as the recipient of a new German honor by the Eduard Rhein Foundation, for his contributions to "fully electronic television." Eduard Rhein, German writer, publisher, and physicist, personally presented Zworykin with the first Rhein Ring, an award of honor for persons "who have made significant contributions to audio-visual techniques."

Zworykin, an honorary RCA vice president and a member of the U.S. National Inventors Hall of Fame, had already received America's highest technical honor (the National Medal of Science) from President Lyndon Johnson, in 1968.

Two other Americans have been honored by the Rhein Foundation. Last summer, Drs. Jon Clemens and Eugene Keiser of RCA Laboratories, Princeton, NJ, received prizes of 19,000 German marks (about $6,000) each for their work on video-disc systems. The presentations were made on August 23, Mr. Rhein's 80th birthday.

The multi-screen TV receiver is here

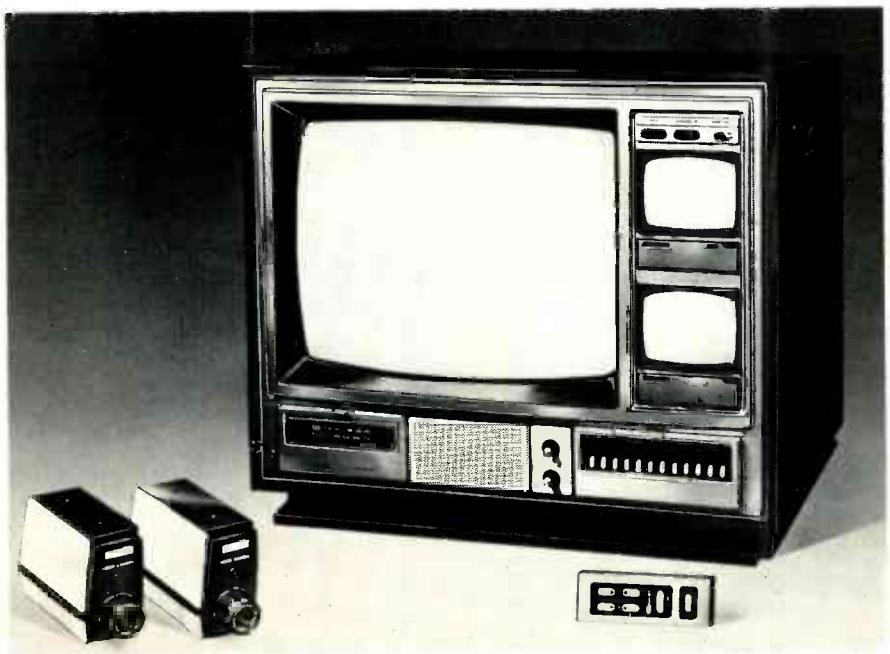
Multi-screen television, long predicted—and illustrated—in this magazine as a necessity of the future, has been realized in the Sampo Tri-Screen. It was introduced to the market in Chicago last Fall, with New York scheduled as the next step in the company's sales program.

The new set features a full 19-inch color screen with the 5-inch black-and-white screens at the side. The viewer can watch his main program while keeping an eye on two others.

That solves a problem not only for the family whose members are continually clamoring to "let's see what's on channel XX" but also for the person who wants to watch one program but needs to monitor one or two others for personal or professional reasons.

The unit is remote-controlled, and the push of a button rotates the pictures on all screens from one channel to another. Either or both of the 5-inch screens can be used as security monitors in the home, thus adding protection to home-entertainment capabilities.

The set was selling at $995 when first introduced in Chicago.



SAMPO MODEL 9519 TRI-SCREEN TELEVISION

NESDA Convention

Jim Rolison, president of Electromatic, Inc., a service-only company in Portland, Oregon, is the new President of the National Electronics Service Dealers Association (NESDA). Mr. Rolison, who recently served as the NESDA Region 10 Vice President, was elected August 21, 1980, in a lively 3-candidate race, during the association's annual convention at the Galt House in Louisville, KY.

The top association goals for 1980-81, Mr. Rolison stressed, are to carry the NESDA management schools to more states and to increase NESDA membership greatly. Another major priority, Rolison states, is the achievement of equitable warranty service rates for independent service agencies.

Elected to serve with Mr. Rolison on the national Executive Committee on NESDA are George Bluze, CET, of S.O.S. TV in Largo, FL as National Vice President; Keith Knox, CET, of Knox TV in Liberal, KS as Secretary, and Bill Abernathy of Westside Appliance Center in Ft. Worth, TX as Treasurer. Also serving as ex-officio members of the Executive Committee are outgoing president Bob Villont, CET (Tacoma, WA) ISCET Chairman Larry Steckler, CET (Massapequa Park, NY); and Executive Director J.W. Williams, CET (Ft. Worth, TX).

Regional Vice Presidents elected to complete the NESDA Executive Council are:

Region 1. Ted Stackhouse, CET, Mill Creek Service Corp., Portland, ME. 2. Warren Baker, CET, Baker Electronics, Albany, NY. 3. Earl Redman, Redman TV, Baltimore, MD. 4. Gene Dillingham, Magnetic Tape Recorder Co., Louisville, KY. 5. Art Nelson, Ronel Radio & TV Service, Milwaukee, WI. 6. Mike Webber, Rucker's TV, Fort Worth, TX. 7. John Krier, CET, Servus Electronics, Inc., Wichita, KS. 8. Robert Kavan, A. B. & K Service, Inc., Denner, CO. 9. Bill Lawler, Bill Lawler's TV Service, Los Angeles, CA. 10. Dick Scott, CET, Desco Electronics, Olympia, WA

Optimism about growth and progress for the association was apparent among the approximately 500 people who attended the convention, which ran from August 18 to 23. The convention was sponsored by the National Electronics Service Dealers Association, The International Society of Certified Electronics Technicians, and the Kentucky Electronics Service Association.

The educational sessions featured renowned management specialist, Dick Co., and technical seminars by top training specialists of several major manufacturers. The all-day "Electronics Derby" trade show also featured new avenues available to servicers as well as the latest in new products and service aids.

A two-day conference for electronics instructors was a high point of the convention; it will be expanded during the 1981 Convention.

During the week-long convention, elections were held for the International Society of Certified Electronics Technicians (ISCET), the technical division of NESDA. Re-elected to 1-year terms were: Chairman, Larry Steckler, CET, Massapequa Park, NY; Vice Chairman, Frank Grabiec, CET, Phoenix, AZ; Secretary, Bob Ocasio, CET, Bronx, NY, and Treasurer, Jack Kelley, CET, Goodyear, AZ.

The announced thrust of ISCET during the year will be increased availability of

continued on page 16

The first personal computer for under $200.

The Sinclair ZX80. A complete computer—only $199.95 *plus $5.00 shipping.*

Now, for just $199.95, you can get a complete, powerful, full-function computer, matching or surpassing other personal computers costing several times more.

It's the Sinclair ZX80. The computer that "Personal Computer World" gave 5 stars for 'excellent value.'

The ZX80 cuts away computer jargon and mystique. It takes you straight into BASIC, the most common, easy-to-use computer language.

You simply take it out of the box, connect it to your TV, and turn it on. And if you want, you can use an ordinary cassette recorder to store programs. With the manual in your hand, you'll be running programs in an hour. Within a week, you'll be writing complex programs with confidence.

All for under $200.

Sophisticated design makes the ZX80 easy to learn, easy to use.

We've packed the conventional computer onto fewer, more powerful LSI chips—including the Z80A microprocessor, the faster version of the famous Z80. This makes the ZX80 the world's first truly portable computer (6½" x 8½" x 1½" and a mere 12 oz.). The ZX80 also features a touch sensitive, wipe-clean keyboard and a 32-character by 24-line display.

Yet, with all this power, the ZX80 is easy to use, even for beginners.

Your course in computing.

The ZX80 comes complete with its own 128-page guide to computing. The manual is perfect for both novice and expert. For every chapter of theory, there's a chapter of practice. So you learn by doing—not just by reading. It makes learning easy, exciting and enjoyable.

You'll also receive a catalog packed with items that can make your ZX80 even more useful. Including 27 program cassettes, from games and home budgeting for just $6.95, to Sinclair's unique Computer Learning Lab. And books, hardware options and other accessories.

ZX80's advanced design features.

Sinclair's 4K integer BASIC has performance features you'd expect only on much larger and more expensive computers.

- Unique 'one touch' entry. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry to reduce typing and save memory space.

- Automatic error detection. A cursor identifies errors immediately to prevent entering programs with faults.
- Powerful text editing facilities.
- Also programmable in machine code.
- Excellent string handling capability—up to 26 string variables of any length.
- Graphics, with 22 standard symbols.
- Built-in random number generator for games and simulations.

Sinclair's BASIC places no arbitrary restrictions on you—with many other flexible features, such as variable names of any length.

And the computer that can do so much for you now will do even more in the future. Options will include expansion of 1K user memory to 16K, a plug-in 8K floating-point BASIC chip, applications software, and other peripherals.

Order your ZX80 now!

The ZX80 is available only by mail from Sinclair, a leading manufacturer of consumer electronics worldwide.

To order by mail, use the coupon below. But for fastest delivery, order by phone and charge to your Master Charge or VISA. The ZX80 is backed by a 30-day money-back guarantee, a 90-day limited warranty with a national service-by-mail facility, and extended service contracts are available for a minimal charge.

Price includes TV and cassette connectors, AC adaptor, and 128-page manual.

All you need to use your ZX80 is a standard TV (color or black and white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)

The ZX80 is a family learning aid. Children 10 and above will quickly understand the principles of computing—and have fun learning.

Master Charge or VISA orders call: (203) 265-9171. We'll refund the cost of your call.

Information: General and technical—(617) 367-1988, 367-1909, 367-1898, 367-2555. Phones open Monday-Friday from 8 AM to 8 PM EST.

sinclair

Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.

To: **Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.**

Please send me _____ ZX80 personal computer(s) at $199.95* each (US dollars), plus $5 shipping. (Your ZX80 may be tax deductible.)
I enclose a check/money order payable to Sinclair Research Ltd. for $_____.

Name _____

Address _____

City _____ State _____ Zip _____

Occupation: _____ Age: _____

Intended use of ZX80: _____

Have you ever used a computer? ☐ Yes ☐ No.
Do you own another personal computer? ☐ Yes ☐ No.

*For Conn. deliveries, add sales tax.

RE 2-1

editorial

Cable Television—The Cloud Behind The Silver Lining

30 channels...50 channels...more channels. Two-way TV. Direct-from-satellite TV. It's all in our future...our immediate future.

Authoratative statistics show that, conservatively, one-third of all TV families in the U.S. will be hooked up to pay cable-TV systems before the end of this decade. Sounds teriffic doesn't it? But there's another side to that coin, too.

That third of all the TV families in the United States will be *paying* a substantial fee for their *privilege* of watching TV. And much of what they will be paying to see, they used to see for free. The only price paid used to be sitting through a commercial or two.

Right now, the movie channels on cable are relatively commercial-free. You pay the price, watch the movies, and the only commercials you see are of coming attractions...convincing you that you should stay connected.

But already, behind the scenes, as documented by cable-industry trade publications, commercials are being planned. In many cable systems, the non-movie channels already carry commercials. So there's a good chance that by the time the '80s draw to close you'll not only be paying for what you watch, but you'll be paying to watch commercials, too.

The cable companies don't need those commercial dollars to make a buck, either. In one town on Long Island in New York, there are currently 125,000 cable subscribers. They pay an average of $20 per month. That adds up to $2.5 million a month or $30 million a year. Pretty fair income. That also adds up to a cost of $250 per year per family; and for another $120 per year you can add even more TV channels.

Other clouds are forming, too. In Pheonix, Arizona, the local cable company franchise permits it to sell and service TV sets. In one complete package you can buy the cable, the set, and the repair service. They'll even offer you a free year of cable if you buy your color set from them. Great buy? I don't think so. Once that cable company controls set sales and service, Pheonix residents may not have much choice as to where they buy their sets; and if they have trouble with the kind of service they receive, whom can they turn to? There won't be an independent service shop or TV retailer left in town.

Cable TV can be good. It should be beneficial. It can save us all a heap of gasoline by making it possible for us to shop locally without ever leaving our homes. It can bring us low-cost, first-rate entertainment. It can help educate our children and can even make it possible for many of us to work at home. But some restraints are needed; some controls are required.

There is regulation you know. The FCC wants to control decoders so that only the cable companies can sell them. They might like to require that the cable company do all the wiring in your home. The people, us, finally beat the phone company at that game and now it looks as if we are going to have to do it all over again.

If you are on a fixed income, $20 a month just to watch TV is a big bite. But if that fee grows to $30 or $40 or more.... And if you disconnect in 1990, what will you have left to watch...snow on vacant channels? ...local amateur hours?

Like all new technology, cable TV presents an opportunity. 24-hour news is not bad. Recent movies without commercials in your own home are worth a fee. But excessive fees are bad. Paying to see commercials—paying twice in effect—is bad. Replacing free programs with pay programs—the same programs—is bad.

continued on page 101.

Radio-Electronics®

Hugo Gernsback (1884-1967) founder
M. Harvey Gernsback, editor-in-chief
Larry Steckler, CET, publisher
Arthur Kleiman, managing editor
Josef Bernard, K2HUF, technical editor
Jack Darr, CET service editor
Leonard Feldman
contributing high-fidelity editor
Karl Savon, semiconductor editor
Herb Freidman, communications editor
Gary H. Arlen, contributing editor
David Lachenbruch, contributing editor
Earl "Doc" Savage, K4SDS, hobby editor
Ruby Yee, production manager
Robert A. W. Lowndes, production associate
Joan Burwick, production assistant
Gabriele Margules, circulation director
Arline R. Fishman,
advertising coordinator

Cover photo: *Robert Lewis*

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

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

ADVERTISING SALES 212-777-6400
Larry Steckler
Publisher

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

MIDWEST/Texas/Arkansas/Okla.
Ralph Bergen
The Ralph Bergen Co.
540 Frontage Road—Suite 361-A
Northfield, Illinois 60093
312-446-1444

WESTCOAST
Marvin Green
Radio-Electronics
413 So. La Brea Ave.
Los Angeles, Ca 90036
213-938-0166-7

SOUTHEAST
Paul McGinnis
Paul McGinnis Company
60 East 42nd Street
New York, N.Y. 10017
212-490-1021

Mood Maker

Set the mood in your home or office with this 13 inch wide AM-FM, cassette and 8 track Stereo Music Center.

You're sitting at your desk. Soft beautiful music in full stereo is gently caressing you. You feel your tensions melt, your mind clears, and you're ready to take on the world.

An overstatement? Not really. The power of music has been used for centuries to rouse the troops and relax the kings, not to mention "soothing the savage beast".

Listening to great sounding music while you work at the office or relax at home can make you feel like a whole different person at the end of the day.

The Stereo Music Center by IMA, a Craig company (the language translator people), represents the latest technology in micro-stereo. It is now possible to produce the sound of a full size stereo in the space of an ordinary radio.

IT'S A COMPLETE MUSIC SYSTEM

You're in command. Listen to your favorite FM stereo stations or enjoy your favorite music on the twin built-in stereo cassette and 8 track tape decks. You can also keep up on the latest news with the powerful AM radio.

Dual high fidelity speakers mounted in the acoustically designed wood cabinet are precisely aimed at 180 degrees to provide terrific stereo separation. Listening to the music center is like sitting 10th row center at a symphony concert.

Powerful twin amplifiers have plenty of power to drive extension speakers in other rooms or offices. (Convenient jacks are provided on the rear panel). To really appreciate the power and quality of the sound of this micro-stereo, set it in front of your home stereo and compare. The results may amaze you.

DIGITAL AM/FM STEREO TUNING

No more guessing. If you want to listen to radio station FM 103.4 or AM 1070, simply dial in the number on the large LED digital display.

With the powerful radio receivers and accurate digital tuning, you'll be able to locate and tune in radio stations other radios can't even find.

The old fashioned "slide rule" radio dial has been replaced by a sophisticated solid state device called a frequency counter. Frequency counters were developed for test equipment and now can be used for exact radio tuning. They actually count and display the exact frequency of each radio station.

The frequency display also becomes an LED clock with the push of a button.

EXTRA OFFICE FEATURES

The music center is also a useful business tool.

DICTATION--You are supplied with 2 microphones to dictate letters or leave memos on standard audio cassettes.

TELEPHONE--A sensitive pickup allows you to record both sides of any telephone conversation on cassette.

RECORD MEETINGS--Simply start the recorder. The microphones will pick up all nearby conversation. Even the recording level is automatic.

TRY THE STEREO MUSIC CENTER RISK FREE

Try the music center in your own home or office for 30 days. Enjoy the beautiful FM stereo, play your favorite cassettes or 8 track cartridges and keep up with the news on AM. Record cassettes from the radios, 8 track, microphones or from the telephone pickup.

If you aren't 100% satisfied for any reason, simply return the music center in its original box within 30 days for a full refund. It comes complete with a limited 90 day manufacturer's warranty.

To order your stereo music center simply send your check for **only $159** plus **$7** for postage and handling to DAK. Credit card buyers call our toll free number. (CA res. add 6% sales tax)

You'll be able to enjoy stereo music from cassettes, 8 track, FM or AM radio with this new 13 inch wide micro-electronic marvel.

DAK
INDUSTRIES
INCORPORATED

Call TOLL-FREE ..... (800) 423-2636
In California Call ..... (213) 984-1559
10845 Vanowen St., North Hollywood, CA 91605

CIRCLE 9 ON FREE INFORMATION CARD

what's news

continued from page 12

materials to upgrade the technological capabilities of electronics technicians everywhere.

The social functions were highlighted by a lead-off golf outing, an ice-breaking "get-acquainted" party and dance, an evening at the race track, and a steamboat ride on the moonlit Ohio River.

The 1981 NESDA/ISCET National Electronics Service Convention has been set for August 3-8 at the Innisbrook Resort in Tarpon Springs, Florida. Innisbrook is on Florida's west (Gulf) coast near the Tampa/St. Petersburg area.

KLH's home-trial program

KLH Research and Development Corp. of Westwood, MA, has initiated a nationwide home-trial program for its KLH-3 *Computer Controlled Loudspeaker* system. The KLH-3 Loaner Program enables the consumer to bring home the KLH-3 loudspeakers in a custom-made carrying case. That solves the problem of customers who do not believe that the sound they hear from speakers in the dealer's listening room will be as good with their own equipment and the specific acoustics of their own living rooms.

The home-trial program is supported by national advertising, and every consumer who replies to the ads receives a special Loaner Program mailer, including a list of participating dealers. To attract interest further, a free audiophile disc will be given to those customers who try the speakers.

"The response to an initial test marketing of the KLH-3 Loaner Program was so outstanding that we decided to launch it nationally," said KLH President Denis Wratten. "The dealers who participated in the trial program were delighted with the results. Their customers appreciated the chance to hear the KLH-3's in their own homes and that was reflected in sales results."

FCC refunding certain fees

Individuals who paid the FCC fees of more than $4 but not more than $20 between August 1, 1970 and February 28, 1975, may be eligible for a partial refund. However, the Commission emphasized that Citizens Band licenses that cost $4—granted March 1, 1975, or later—*do not* qualify for a refund.

Since June 1979—under Phase I of this program—the FCC has refunded more than $49 million in fees collected from broadcasters, common carriers, electronic equipment manufacturers, aviation and marine radio users, and certain amateurs.

Fees to be refunded in Phase II include those that were collected for amateur radio, aviation radio, land mobile, maritime radio microwave and CATV systems, restricted radio telephone permits, type certification requests for equipment operating under Part 18 of the Commission's rules, and cable-television notifications under Section 74.1105.

To request a refund under Phase II, licensees must obtain a copy of the Fee Refund Program request form and instructions (Phase II). It is available at FCC Field Offices or by mail from the FCC Refund Program Office, P.O. Box 19209, Washington, D.C. 20036.

For specific details about the fee refund program licensees may call the toll-free number: 800-424-2901. This number is not, however, to be used for other FCC business or complaints.

First computer home banking service

The United American Bank, Knoxville, TN, has been selected as the first bank to use a new "Express Information" bank-at-home service.

For an estimated price of $15 to $25 a month, 400 of the bank's customers will gain services of the new Radio Shack TRS-80 Color Computer, including a standard keyboard which plugs into the customer's own television set and telephone. Customers will have access to a comprehensive news and financial advisory service, be able to pay most of their bills, receive current information on their checking accounts, use a sophisticated bookkeeping service, and apply for loans.

The Express Information service is a joint venture of United American Service Corporation (USAC); Radio Shack, a division of Tandy Corporation, and CompuServe, a subsidiary of H & R Block. The United American Bank in Knoxville was selected as the first bank to use and market the service to its customers.

The new service is being released to customers in phases, giving them an opportunity to familiarize themselves with in-home computer use. The first phase will include the news and information network developed by CompuServe. Remaining phases include two-way communications with the bank for bill paying, bookkeeping, tax services, and electronic mail, giving customers the opportunity to communicate messages to each other through the system.

Court rules on radar detectors

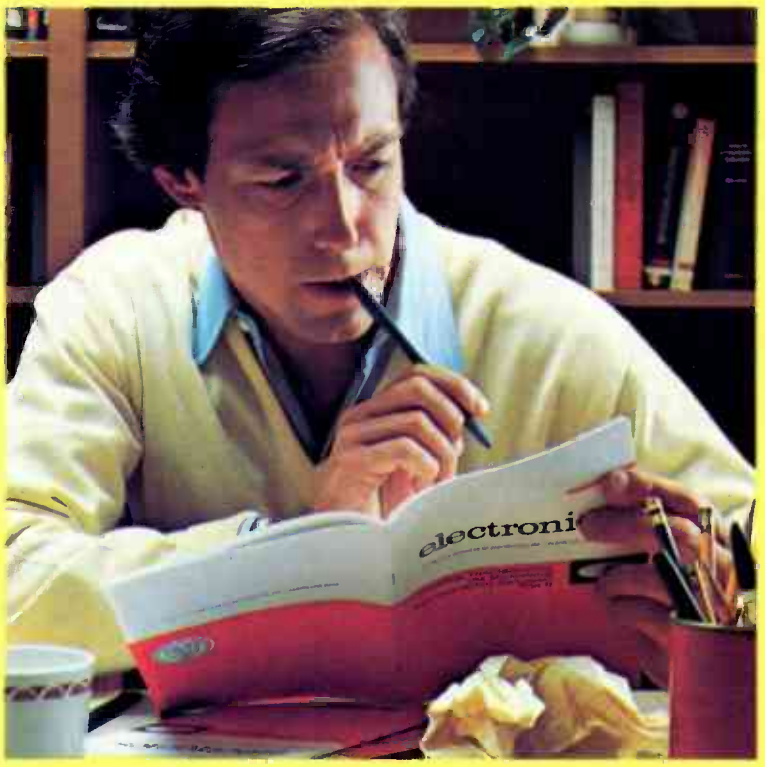
The Appelate Session of the Connecticut Superior Court has set a dual precedent by ruling that the state has no right to confiscate a motorist's radar detector; neither can it refuse a jury trial to a defendant in a radar-detector case.

Until recently, motorists facing a radar-detector summons also faced seizure of the unit. The panel of three Superior Court judges ruled that a radar detector could not be subject to forfeiture on the ground that it was being used to violate the law, any more than could the car, which was also being so used.

The same court confirmed the defendant's right to a jury trial, because of the fine that might be imposed on the motorist for a radar-detector infraction. That decision was considered important by radar-detector promoters, who feel that "the time and expense to the state in preparing for jury trials discourages enforcement in such cases."

THE KLH-3 COMPUTER-CONTROLLED LOUDSPEAKER system consists of a pair of speakers and a bass computer that compensates for any deficiencies in the bass frequency response of the speakers. The system is being offered as a loaner for home trials.

Learning electronics is no picnic.



At any level it takes work and a few sacrifices. But with CIE, it's worth it.

Whoever said, "The best things in life are free," was writing a song, not living a life. Life is not just a bowl of cherries, and we all know it.

You fight for what you get. You get what you fight for. If you want a thorough, practical, working knowledge of electronics, come to CIE.

You can learn electronics at home by spending just 12 hard-working hours a week, two hours a day. Or, would you rather go bowling? Your success is up to you.

At CIE, you *earn* your diploma. It is not handed to you simply for putting in hours. But the hours you do put in will be on your schedule, not ours. You don't have to go to a classroom. The classroom comes to you.

Why electronics training?

Today the world depends on technology. And the "brain" of technology is electronics. Every year, companies the world over are finding new ways to apply the wonders of electronics to control and program manufacturing, processing...even to create new leisure-time products and services. And the more electronics applications there are, the greater the need will be for trained technicians to keep sophisticated equipment finely tuned and operating efficiently. That means career opportunities in the eighties and beyond.

Which CIE training fits you?

Beginner? Intermediate? Advanced? CIE home study courses are designed for ambitious people at all entry levels. People who may have:

1. No previous electronics knowledge, but do have an interest in it;
2. Some basic knowledge or experience in electronics;
3. In-depth working experience or prior training in electronics.

You can start where you fit and fit where you start, then go on from there to your Diploma, FCC License and career.

Many people can be taught electronics.

There is no mystery to learning electronics. At CIE you simply start with what you know and build on it to develop the knowledge and techniques that make you a specialist. Thousands of CIE graduates have learned to master the simple principles of electronics and operate or maintain even the most sophisticated electronics equipment.

CIE specializes exclusively in electronics.

Why CIE? CIE is the largest independent home study school that specializes exclusively in electronics. Nothing else. CIE has the electronics course that's right for you.

Learning electronics is a lot more than memorizing a laundry list of facts about circuits and transistors. Electronics is interesting! It is based on recent developments in the industry. It's built on ideas. So, look for a program that starts with ideas and builds on them. Look to CIE.

Programmed learning.

That's exactly what happens with CIE's Auto-Programmed® Lessons. Each lesson uses famous "programmed learning" methods to teach you important principles. You explore them, master them completely, before you start to apply them. You thoroughly understand each step before you go on to the next. You learn at your own pace.

And, beyond theory, some courses come fully equipped with electronics gear (the things you see in technical magazines) to actually let you perform hundreds of checking, testing, and analyzing projects.

Experienced specialists work closely with you.

Even though you study at home, you are not alone! Each time you return a completed lesson, you can be sure it will be reviewed, graded and returned with appropriate instructional help. When you need additional individual help, you get it fast and in writing from the faculty technical specialist best qualified to answer your question in terms you can understand.

CIE prepares you for your FCC License.

For some jobs in electronics, you must have a Federal Communications Commission (FCC) License. For others, some employers tend to consider your license a mark in your favor. Either way, your license is government-certified proof of your knowledge and skills. It sets you apart from the crowd.

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

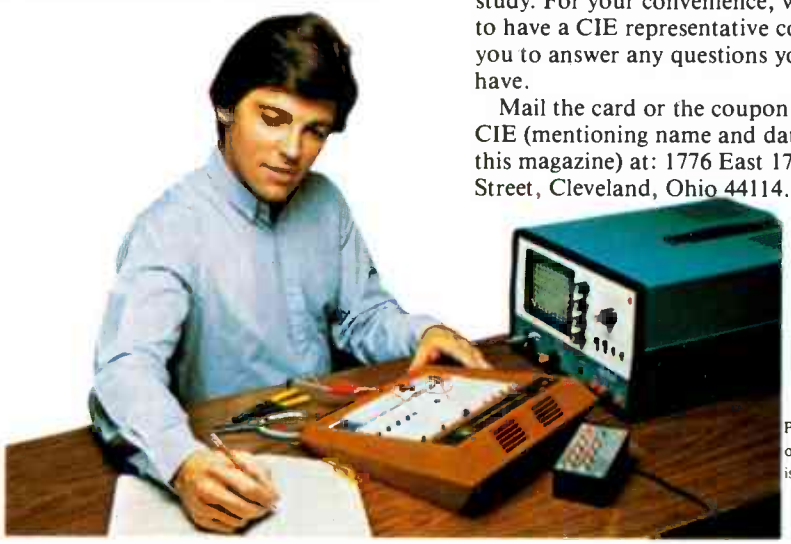
Associate Degree

Now, CIE offers an Associate in Applied Science Degree in Electronics Engineering Technology. In fact, all or most of every CIE Career Course is directly creditable towards the Associate Degree.

Today is the day. Send now.

Fill in and return the postage-free card attached. If some other ambitious person has removed it, 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.



Pattern shown on oscilloscope screen is simulated.

CIE **Cleveland Institute of Electronics, Inc.**
1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

☐ **YES...** I want to learn from the specialists in electronics—CIE. Send me my FREE CIE school catalog...including details about the Associate Degree program...plus my FREE package of home study information. RE-06

Print Name _____

Address _____ Apt. _____

City _____

State _____ Zip _____

Age _____ Phone (area code) _____

Check box for G.I. Bill bulletin on Educational Benefits: ☐ Veteran ☐ Active Duty

MAIL TODAY!

letters

CABLE TV

Your recent editorial (August issue): "Cable TV and Ma Bell; When Will We Ever Learn?" has prompted me to offer my personal opinion on the subject.

In this editorial, you have made major assumptions that, based on eight years of experience in the CATV industry, I would call incorrect. They are:

1. That cable-TV operators are a monopoly. This by comparison with "Ma Bell."
2. That the FCC has something to do with the rate structure.
3. That all cable-TV operators use the same type of system.

For the first assumption, I would like to point out that there are hundreds of different cable-TV companies. They are not connected in any way with one another. Most of them are still "Mom & Pop" operations. It is ludicrous even to compare cable TV with "Ma Bell." It evokes a vision of some monopolistic deity controlling the nation's TV sets.

The second assumption is that the FCC or federal government regulates how individual companies may charge their subscribers. That is far from the case. The FCC regulates only technical specifications—e.g.: frequencies, minimum signal levels, radiation, etc. It is the local government that awards the franchise and determines the rates. If anyone wishes to complain, you take it to the city council, city manager, or the mayor.

The third assumption is that all systems use the same equipment and the same operating system. There are dual-trunked systems, two-way systems, single-trunked systems, one-way systems, 400-MHz systems, 300-MHz systems, ad infinitum. As an example of just some of the technology, look at page 4 of **Radio-Electronics,** August 1980: "Cable Progress." There is no way that a customer who purchased a converter could assure himself that it would be capatible with his system. The CATV industry is not standardized like "Ma Bell." For a person who is not involved with the industry, it would be impossible to keep up with the system developments.

Finally, you state that television technicians should be allowed to hook up additional outlets. I have a problem with this, in that most television techicians lack training in CATV-equipment installation and equipment specifications. That would give us a quality-control problem. As a CATV field technician, I have had trouble calls from people who had their TV tech add an outlet. Some of those illegal hookups were causing serious problems; all of them generated a trouble call. If TV techs were allowed to install CATV outlets and that caused a problem, the CATV company should be allowed to charge for a service call. Thus, the consumer would get it in the end again.

All in all, I don't believe that your proposal will benefit the paying public.

RICHARD JOHNSON
El Cajon, CA

NUMBERS STATIONS

I read the article, "International Numbers Stations," in your June 1980 issue, with much interest. The author asks, "What is the nature of their encoded messages?" Who knows now, but approximately 40 years ago, such numbers were used to transmit weather information. I was working in a weather station in a Communist-occupied country. They told us that five number-groups were used to transmit weather information. They gave us a chart on which it was stated that the first three numbers in the first group were always used to identify the station. I'll try to make up a sample of a series, but remember that 40 years is a long time to recall anything very clearly. However, I can give you an idea: 17426, 23920, 21050, 03001. That was for weather information all over the world.

As I said, the first three numbers in the first group were for station identification (174); the fourth number in the first group was for visibility in km (kilometers) or certain ranges (like 0 = 0 to .1 km; 1= .1 to .3; 2 = .3 to 1 km, 3 = 1 to 3 km, etc.)

The fifth number in the first group was for the amount of cloud cover in 1/10—in this case, .6 was covered; the rest, .4 had no clouds. It could have been that those bits of information were reversed. Anyway, the second group was for barometric pressure in millibars, corrected to temperature and to sea level. In this case, 239 looks quite high, but remember that it is just a sample. As you noticed, three numbers were used for that purpose.

In the second group, the fourth number was used to identify what particular cloud cover we had. It starts with 0 as a clear sky, 1 as high cirrus clouds, and so on. The last number was for the height of the cloud cover in km, 0 being very clear, 1 as very low, below 2 km; 2 being 2 - 3 km; 3 being 3 -4 km, etc. In the third group, the first three numbers were used to identify the Celsius degrees, in this case 2^0C.

In the third group, two numbers were used to state the humidity in percentage—in this case, 50%. In the fourth group, the first three numbers were used to identify the wind direction—in this case 030 could be 30, or something else—I just don't remember. And in the fourth group, the last two numbers identified the wind speed at the scale of a weather vane.

At 7AM every morning, there was a fifth group for rain in millimeters, three numbers for the last 24 hours, or the snow cover in millimeters. The last two numbers in that group were for wet thermometer readings. And we had a sixth group of numbers for stations at sea—for water temperature, wave height, etc.
FORMER WEATHER OBSERVER

I appreciate "Former Weather Observer" 's explanations for the mysterious numbers stations. Unfortuantely, the MAFOR (Maritime Forecast) stations are a well documented service, operating on assigned frequencies with well publicized schedules. They are definitely not *the source of the clandestine numbers broadcasts.*

Another reader agrees that they may have psychological value in confusing adversaries, or that they are used for training sessions.

A recent forum, which I conducted at a hamfest, generated considerable interest (several attendees had heard them), but no one could come up with any idea as to what they were.

Can any other of our readers shed some light on the puzzling numbers stations?
ROBERT R. GROVE

CASSETTE BOOKS

In relation to the news item in the July **R-E** (page 12) about Nakamichi and SBI's 15/16 ips cassette books, you should mention that Cassette Talking Books put out by the Library of Congress for blind persons are indeed 15/16 ips for most new issues, but the older issues are 1-7/8th only. The C76 machine that is loaned to talking-book users has rechargeable batteries and AC line power. That machine has variable speed, too—15/16 and 1-7/8 ips; it must be like SBI's.
PAUL F. WILLIAMS, JR. CET,
Timonium, MD

SYNTHESIZED PULSE GENERATOR

Here's a tip for readers who built the Synthesized Pulse Generator described in the October, 1980 issue of *Radio-Electronics.* Changing capacitor C6 from 4.7 μF to 1.0 μF may result in better performance, as some CD4046 IC's produce slight jitter using the old value. That will allow the project to give the premium performance that it was designed for, regardless of IC manufacturer.
GARY McCLELLAN

"CLOAD?"—NOT "LOAD"

While going through the October 1980 issue, I noticed an error in the "computer" section. In the write-up on the TRS-80, the author said that, in order to compare a program stored on cassette to the original in memory, it was necessary to enter the command, LOAD.

That is not the correct compare-function call; the proper command is CLOAD?

To keep the record straight, there *is* a LOAD function: It is a disk command to load a machine-language program from disk to memory.

Other than that, your 40-page section was quite accurate (as far as I could tell), and very interesting. Keep up the good work.
MARK TSETSI
Tiverton, RI **R-E**

equipment reports

VIZ Model WR-515B Color Bar Signalyst

CIRCLE 101 ON FREE INFORMATION CARD

ALTHOUGH THE *WR-515B* (VIZ MFG. CO., 335 E. Price St., Phila., PA 19144) is no larger than most other units now on the market, it is by no means an ordinary color-bar/dot/crosshatch generator.

VIZ has coined a term to describe the new unit that seems quite fitting. They call it the *Color Bar Signalyst* for reasons which become apparent once you take the time to read the instruction manual. It takes only a short time to realize that the manual teaches both the use of the unit and the finer points of color-TV operation and alignment. Once a general description of the unit has been given (including the controls, interconnections, and the patterns to be used), the manual turns to the actual use of the instrument. Even though the *WR-515B* was developed for general in-home use, it can also serve as a valuable tool in the shop as well. For instance, when it is used with a dual-trace scope, color problems should be simple to identify and correct.

Published specifications include: crystal-controlled RF output on Channel 3 or 4 (variable from 5 μV to 100 mV into 75 ohms; 10 μV to 200 mV into 300 ohms). An IF output is also provided at 45.75 MHz at a level of 5 μV to 100 mV. There is also a direct video output that contains frequencies in the range of 30 Hz to over 10 MHz at levels of 0 to 1.7 V P-P into 75 ohms. Either positive or negative polarity is available at the throw of a switch. There is also a 4.5 MHz unmodulated carrier to be used for sound circuits, as well as for a tuning aid. Other outputs include a trigger pulse for an oscilloscope when use is made of the more sophisticated features of the *WR-515B*.

Patterns generated by the *WR-515B* include a normal gated rainbow-pattern and this same pattern with a luminance pedestal. A normal pattern, less the color-burst signal, is also available for adjusting the free-running frequency of the 3.58 MHz oscillator in TV receivers.

A red, blue or green raster is selectable by the function switch. The latter makes it easy to check for purity without shorting the guns of the CRT or adjusting the G-2 controls. At another setting of the switch is a color trio . . . with the screen divided into red, blue and green sections. There is also a gray-quad, where four large areas of the screen display different luminance levels. This is good for making tracking adjustments and other important checks and tests. And, there is the "superpulse"—a large white area (called a window) in the center of a blank (black) screen.

As if all that were not enough, we still have the traditional dots and crosshatch patterns. VIZ has even enhanced these patterns by adding one they call "hatch dots". This is a crosshatch with a center dot, and a frame of dots in the outer area where dynamic convergence adjustments are normally made. That pattern

continued on page 26

Non-Linear Systems introduces the 2 lb. 4 oz. test lab.

The new Touch Test 20 DMM weighs only 2 lbs. 4 oz. Yet it puts twenty key test functions at your fingertips. Plus exclusive light pressure touch function selection. Shown from above on leather shoulder sling (optional).

Introducing the remarkable Touch Test 20. Now, with its 20 key test functions at your fingertips, (plus the ability to measure 10 electrical parameters and 44 ranges) you can take one lab to the field instead of a cumbersome collection of individual testers.

Another bright idea. The Touch Test 20 is the only DMM with light pressure touch function selection. No more dials to fiddle with. Instead, an LED shows the function you choose. And when you switch, you get an audible bleep and a visual blip to let you know.

Operation's a snap. A light touch chooses the function. An LED shows it.

Functional. Not gimmicky. We believe that in DMM design, form should follow function. For example, it's rare that a DMM is used hand-held. Usually it's placed so the operator's hands are free to manipulate the test leads and the equipment being tested. That's why we developed the Touch Test 20—to fit where and how it would be used. The result is the most innovative portable/bench-type multimeter in the industry today.

Small wonder. The Touch Test 20 is designed specifically for mainline electronics measurement and testing. It checks AC and DC voltage, AC and DC current as well as resistance. Analyzes temperature in Celsius and Fahrenheit. Measures conductance and capacitance. It also performs diode/transistor and continuity tests. All with the accuracy that's synonymous with the name Non-Linear Systems.

Shop-proven. Field-proven. The Touch Test 20 is ideal for benchtop use. The large, 0.55-inch LED numbers make it easy to read. And its dial-free, light touch selection system prevents the unit from skittering across the tabletop. Light and versatile, it's the perfect, portable road lab, too.

The Touch Test 20 comes with test leads, temperature probe and resistor/capacitor test adapter. It features automatic polarity and overload indication plus in-circuit test capabilities. The Touch Test 20 is available in two models—rechargeable battery or line operated. All parts and labor are guaranteed for a full year. And each model is available with optional accessories like a leather carrying case with shoulder strap and belt loop, to help you get the job done.

Touch Test 20 at a glance

Measurements	
AC Voltage	10 μV to 750 VRMS, 6 ranges.
DC Voltage	10 μV to 1000 VDC, 6 ranges.
AC Current	10 μA to 10 A, 4 ranges.
DC Current	0.01 μA to 10 A, 7 ranges.
Resistance	10 milli Ω to 20 meg Ω, 7 ranges.
Temperature	−40°C to 150°C, −40°F to 302°F, 2 ranges.
Conductance	0.01 nS to 200 nS (equivalent to 5 megohms to 100,000 megohms) 2 ranges.
Capacitance	1 pF to 200μF, 6 ranges.
Tests	
Diode	Diode and transistor junctions in conducting and non-conducting directions.
Continuity	Audible signal.
Size	2.9" H x 6.4" W x 7.5" D (74 mm x 163 mm x 191 mm)
Weight	2 lb. 4 oz. (1.02 kg)
Price	$425.00 with batteries $399.50 without batteries

8 DMMs. One right for you. Non-Linear Systems also offers eight other outstanding digital multimeters. Trim and low-priced, each of our three, three and one-half and four-digit DMMs is a performance and value-packed instrument.

Get the word on us. NLS has been intelligently innovating in the digital instrument industry for nearly three decades. From the introduction of the first digital voltmeter to breakthrough products like the Touch Test 20.

To get the whole story, from product facts to philosophy, write for our free 1980 Catalog today. Non-Linear Systems, Inc., Box N, Del Mar, California 92014. Telephone (714) 755-1134, TWX 910-322-1132.

Non-Linear Systems, Inc.
Specialists in the science of staying ahead.

004 006/02/1

Non-Linear Systems, Inc.
Box N, Del Mar, California 92014.
Please send me your free 1980 Catalog.

Name_____
Company_____
Phone_____
Address_____
City_____
State_____ Zip_____

CIRCLE 90 ON FREE INFORMATION CARD

EQUIPMENT REPORTS

continued from page 24

is excellent for adjusting convergence as it combines the properties of both dots and cross-hatch at the same time.

Some of the *WR-515B*'s nicer features, not always mentioned in the specification sheets, include the use of BNC connectors for the RF and IF outputs as well as for the video output line. The need to connect the Signalyst to another series of connectors has been considered by the inclusion of a BNC-to-"F" adaptor with the *WR515B*. A 75- to 300-ohm transformer and an isolation head are also supplied as standard accessories. By using the IF output connected directly to a TV set's IF stage it is a simple matter to check for a defective tuner in much the same way as one would use a tuner-subber.

The polarity of the trigger pulses allows for viewing events which occur either during the scan time or during the blanking period. The sixth bar of the color-bar display is marked for ease in identification on both the TV screen and the scope pattern. The latter is useful for checking the demodulation angle since the marked bar will represent the B-Y signal.

The amount of theory provided by the instruction manual is enormous and can be of great assistance to any technician who takes the time to study it. One section in particular stands out as something that most instrument companies fail to provide. That is a special troubleshooting section to aid the user in servicing the unit should it fail. VIZ has provided no fewer than eight pages of schematics, as well as a complete description of the theory of operation.

One thing is important if you are to realize the most benefit from the *WR515B* . . . read the instruction book before assuming that you know how to operate the unit. If you take the time to become acquainted with the operational aspects of the Signalyst, then you will soon realize that the unit is more than an ordinary, run-of-the-mill color-bar generator. The VIZ *WR-515B* carries a suggested list price of $275. **R-E**

TODAY PRACTICING TECHNCIANS, AS WELL AS home experimenters, are rapidly discovering that a digital voltmeter (DVM) of some sort is a must on their benches. With the lower voltages found in solid-state units, a fraction of a

continued on page 32

Problem:
Build an oscilloscope light enough to carry in the field, yet sophisticated enough to use in the repair shop. And bring it in at under $600.

Solution:
Non-Linear Systems' MS-230. A 3 lb. 10 oz. miniscope.

At 3 lbs. 10 oz., the MS-230 is the lightest miniscope around. Now you can take the scope to the problem. Or bring the problem to the scope.

It's easy to get carried away with the MS-230. Our remarkable, new 30-megahertz, battery-operated, dual-trace miniscope. At 3 lbs. 10 oz., it's the smallest, lightest miniscope in the field today. Suddenly, portability's not a problem anymore.

On a benchtop or a belt, over a shoulder or in a tool kit, the MS-230's ready to go.

Sets up shop. Makes housecalls. The state-of-the-art MS-230 is at home anywhere there's a need to accurately test or measure electronics equipment.

TV repairmen find it works wonders in the field. Tuck it in the tool kit, sling it over a shoulder or slip it on a belt, and it's ready to make a quick on-site diagnosis.

It's a great benchmate in the shop, too. Checks distortion, compares circuit inputs and outputs, finds faulty components. All with equal ease. And the MS-230 is so compact it doesn't clutter up the work area.

What's more, the versatile MS-230 is perfect for servicing microcomputer systems, maintaining avionics equipment and diagnosing sophisticated medical equipment.

A trio to pick from. If your work demands an oscilloscope that handles virtually all normal applications with unblinking accuracy, we've got your number. The MS-230. A superb value at $598.15.

We also make miniscopes to match other budgets and needs. Take the MS-215, for example. It's a 15 MHz, dual-trace scope priced at $465.45. Or the MS-15, 15 MHz, single-trace at $349.80.

And each model is available with optional accessories to help you get the job done. Like a 10:1, 10 megohm probe and leather carrying case with shoulder strap and belt loop.

When it comes to portable, affordable, accurate miniscopes Non-Linear Systems leads the way.

MS-230 at a glance

Vertical Bandwidth:	30 MHz
Deflection Factor:	10 mV/div to 50 V/div, 12 calibrated ranges
Input Impedance:	1 megohm in parallel with 50 pF
Time Base:	0.05 μSec/div to 0.2 Sec/div, 21 calibrated ranges
Horizontal Bandwidth:	200 kHz
Trigger Modes:	Automatic, Internal, External and Line
Power Sources:	
Internal:	Rechargeable lead acid batteries
External:	115 VAC or 230 VAC, 50-60 Hz via plug-in transformer
Size:	2.9" H x 6.4" W x 8.6" D (74 mm x 163 mm x 218 mm)
Weight:	3 lbs. 10 oz. (1.65 Kg)

Get the word on us. Non-Linear Systems has been intelligently innovating in the digital testing industry for nearly three decades. From the introduction of the first digital voltmeter to breakthrough products like the MS-230.

To get the whole story, from product facts to philosophy, write for our free 1980 Catalog today. Non-Linear Systems, Inc., Box N, Del Mar, California 92014. Telephone (714) 755-1134, TWX 910-322-1132.

Non-Linear Systems, Inc.
Specialists in the science of staying ahead.

003 006/02/1

Non-Linear Systems, Inc.
Box N, Del Mar, California 92014

Please send me your free 1980 Catalog.

Name_____
Company_____
Phone_____
Address_____
City_____
State_____ Zip_____

CIRCLE 24 ON FREE INFORMATION CARD

THESE ARE NOT HOME-MADE TRAINING DEVICES. THESE ARE PRODUCTION MODEL MICRO-SYSTEMS. NO OTHER HOME STUDY SCHOOL OFFERS THEM EXCEPT NTS.

2-Meter FM Transceiver

IN FACT, NTS ELECTRONICS PROGRAMS INCLUDE THE WIDEST ARRAY OF SOLID-STATE AND DIGITAL EQUIPMENT EVER OFFERED BY ANY HOME STUDY SCHOOL.

Now, for the first time, you can learn all about microcomputers by working with your own production model at home. We'll explain the principles of troubleshooting and testing this remarkable instrument and, best of all, we'll show you how to program it to do what you want.

It's the perfect opportunity for you to learn BASIC high level language programming *and* assembly language programming.

Then, to learn how to localize microcomputer problems and solve them, you'll experiment and test with a digital multimeter and other testing gear.

Simulated TV Reception

But most important, you get to assemble and work with today's most sophisticated microcomputers, not home-made training devices. We believe this makes learning a lot more relevant and exciting.

In fact, production-model equipment is featured in all NTS electronics programs.

Our Color TV servicing program boasts the NTS/HEATH digital color TV (25" diagonal) you actually build and keep.

In Communications Electronics you'll build and keep an NTS/HEATH 2-meter FM transceiver, along with digital multimeter and service trainer.

Whichever NTS electronics program you choose, you can count on working with much the same kind of equipment you'll encounter in the field.

Find out more in our full color catalog on the program of your choice.

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

Digital Multimeter

1. **The NTS/HEATH H-89 Microcomputer** features floppy disk storage, "smart" video terminal, two Z80 microprocessors, 16K RAM memory, expandable to 48K. Available in NTS's Master Course in Microcomputers.
2. **The NTS/Rockwell AIM 65 Microcomputer** A single board unit featuring an on-board 20 column alphanumeric printer with 20 character display. A 6502-based unit 4K RAM, expandable. Available in NTS's Microprocessor Technology Course.
3. **The NTS/KIM-1 Microcomputer** A single board unit featuring a 6 digit LED display with an on-board 24 key hexadecimal calculator-type keyboard. A 6502 based microcomputer with 1K of RAM memory, expandable. Available in NTS's Master Course in Electronic and Industrial Technology.

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

NATIONAL TECHNICAL SCHOOLS

TECHNICAL-TRADE TRAINING SINCE 1905
Resident and Home-Study Schools
4000 SO. FIGUEROA ST., LOS ANGELES, CA. 90037

NATIONAL TECHNICAL SCHOOLS
4000 South Figueroa Street, Dept. 206-021
Los Angeles, California 90037

Please rush FREE color catalog on course checked below

- ☐ **MicroComputers/MicroProcessors**
- ☐ **Communications Electronics**
- ☐ **Digital Electronics**
- ☐ **Industrial Technology**
- ☐ **Auto Mechanics**
- ☐ **Air Conditioning**
- ☐ **Home Appliances**
- ☐ **Color TV Servicing**

Name _____ Age _____

Address _____

Apt. _____ City _____

State _____ Zip _____

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

EQUIPMENT REPORTS

continued from page 26

unit of difference in measurement may be the difference between proper and improper operation. With ordinary analog meters, even if extremely accurate, it would be quite difficult to tell the difference between values that may be only 0.1 volt apart.

We recently tested the *model 3400* digital VOM by Triplett. It is called a digital VOM because it contains current, as well as the usual voltage and resistance scales. It has a 3½-digit LCD readout, featuring 0.5-inch-high characters. The overall size of the unit is 3 × 5¼ × 1½ inches and it is housed in a brown two-tone case.

As with any other instrument, it's a good idea to read the instructions before doing anything else. For example the *model 3400* comes complete with a 9-volt battery, but how to install that battery is anything but obvious. It is not a difficult procedure, but a few moments of reading can save quite a bit of time.

Triplett has designed the *model 3400* for long battery life by using an LCD readout, and the instruction book anticipates a minimum life of 200 hours when using an alkaline battery as supplied. One common complaint about LCD readouts is that they are impossible to see in dark areas. It is true that LED's would overcome the problem, but they would also consume batteries much more quickly. There is an indicator that signals the user when there are 50 hours of battery life remaining.

Ranges and functions are selected by a front-panel rotary switch. DC volts are measured in five ranges from 200 mV to 600 V full-scale, with an accuracy of ±0.75% of reading, ±1 digit. The AC-voltage ranges are the same but the accuracy is ±1.5% of reading, ±2 digits on the 600-V range and ±1% on the lower voltage ranges.

The AC and DC current ranges are 2 mA, 20 mA, 200 mA, and 2 amps full-scale. Accuracy in those ranges is dependent upon the range and whether it is AC or DC, but it is no less than 1.5%, ±1 digit on the highest DC range and ±2%, ±2 digits on the highest AC range. Seldom is a measurement of current required that needs to be closer than those tolerances provide.

The resistance ranges are quite unusual in that alternate scales are of the "low-power" variety. Those are useful for testing semiconductor devices. Resistance is measured in five ranges, 200 ohms, 2000 ohms, 20 K ohms, 2 megohms and 20 megohms full-scale. The accuracy of those ranges is no less than ±1% of reading, ±1 digit, and again, the lower scales are even more accurate.

As mentioned, there are resistance ranges that will be useful in testing transistors and other semiconductor devices. The rotary range-selector switch is color-coded so that the low-power ranges appear in green and the high-power ranges appear in black. The low-power ranges will not turn on a semiconductor device while checking it, which means that there is no reason to switch the polarity of the leads when checking for a short. The black ranges will cause a semiconductor to be forward-biased and are therefore useful for checking the operation of the junction in the normal manner.

Among its features, the *model 3400* boasts auto-zeroing and auto-polarity as well as an over-range indicator. When the range has been exceeded, a figure "1" will be displayed in the leftmost position of the readout along with a "+" or "−". In addition, the front-panel test-lead jacks are of a recessed type that makes it virtually impossible to come in contact with a live wire at the point of connection to the meter. Triplett emphasizes safety and uses the first two pages of the *model 3400* instruction manual to deal with the importance of that subject as regards taking measurements in electrical circuits.

In operation, it was found that the readings obtained on the *model 3400* were well within the manufacturer's specifications. The LCD readout was easy to read and the various automatic functions all performed as stated in the instructions. In addition, it was found that the size of the *model 3400* was ideal for bench use as well as small enough to allow it to be carried conveniently. The case has small rubber bumpers at the corners of the bottom that prevent the unit from sliding around on your work surface. There is also a small wire stand included that holds the *model 3400* at a 45-degree angle on your work surface.

The instruction manual is quite small but there is an abundance of material packed within the pages. One section describes the theory of operation while another contains application notes. Another section explains transistor testing using the *model 3400*. The manual also provides a complete parts list as well as a schematic diagram.

The Triplett *3400* is covered by a one-year limited warranty for parts and service. It comes complete with a spare fuse and insulated alligator clips. A carrying case is optionally available.

continued on page 34

EQUIPMENT REPORTS

continued from page 32

The *model 3400* digital VOM sells for $125 from Triplett Corp., One Triplett Dr., Bluffton, OH 45817. **R-E**

Data Precision Model 938 Capacitance Meter

CIRCLE 103 ON FREE INFORMATION CARD

DATA PRECISION, A DIVSION OF THE ANALOGIC Corp. (Electronics Ave., Danvers Industrial Park, Danvers, MA 09123) has made quite a few very compact but accurate instruments. Now they are out with a new one, the *model 938 capacitance meter*. It mesures capacitances from 1 pF to 2000 μF in eight ranges, and displays the value on a 3½″ digit LCD.

The circuitry is based on dual-slope integration. The capacitor under test is charged by a precise voltage and then discharged. The charge and discharge times are integrated over several cycles. The result is a measure of the unknown capacitance and it is displayed on the readout. All of that is done with CMOS IC's including one LSI unit.

The unusual thing about the *model 938* is that, despite its accuracy and wide coverage, it's not so big that it has to be wheeled around on a cart. In fact, it fits into your shirt pocket. The unit is powered by a 9-volt battery and the expected battery life is 100 hours (200 hours with alkaline batteries). An AC adaptor (*model BE9*) may be used for bench work.

To operate the tester, connect it to a capacitor and turn the switch on. If you see only the "1" digit and the decimal point, switch to one of the other ranges until you finally obtain a reading. The capacitance will be displayed in pF, nF, or μF, depending on the range chosen. If the capacitor is shorted, the *model 938* will display the overrange indication on all ranges and the minus sign is also displayed. The voltage applied across all capacitors is 2.8 volts. Leakage in a capacitor can be detected by switching to the next range. That should only move the decimal point. If the reading changes, however, there is leakage. That is because the lower the range used, the higher the resistance seen by the capacitor.

The short test leads have banana plugs and clips. Special sockets are provided just above the test-lead jacks, for inserting the leads of very small capacitors. Those have spring contacts. The small amount of capacitance of the test leads can be neutralized by using the ZERO ADJUST control on the front panel. You can then hook up the capacitor, without moving the leads, and the reading will be very accurate. (Also, keep your hands off the test leads and the capacitor leads under test.)

The input to the *model 938* is fuse-protected against accidental overloads. The battery and a spare fuse are located inside the back cover. A warranty certificate, a certificate of conformance, and a final test-calibration certificate card are included with each instrument. The instruction manual gives full data on the operation and calibration of the *model 938* and also includes an explanation of how it works.

Here is a handy instrument, and one that should find many uses among technicians and experimenters. The *model 938* has a suggested retail price of $179. **R-E**

Exatron Stringy Floppy Data-Storage Device

CIRCLE 104 ON FREE INFORMATION CARD

THE TWO MOST COMMON METHODS OF EXTERnal memory storage used with microcomputers are cassette recorders and floppy disks. Since they are generally only regular audio recorders, the recorders used for that purpose are relatively slow. The disk systems are fast, but expensive—often over $1000 with the additional memory and interfaces involved.

The Exatron Corporation now offers a third alternative—a relatively fast digital-recording

continued on page 36

ALBIA ELECTRONICS

NEW...

LOW COST CAPACITANCE METER MODULE!!

NOT A KIT

Completely assembled and tested . . . for only

$49.95 Includes Albia's Satisfaction Warranty

Connect this high-quality Albia Capacitance Meter Module Model DM-8 to your digital multimeter and turn it into a Digital Capacitance Meter — the low cost way!
- Push to read range (button) from 1 pf to 20,000 Mf.
- Zero calibration control
- In one easy to use, self-contained package
- Battery powered (with "push to read" battery saver)

INSTANT ORDER INFORMATION BELOW!

IN STOCK! IMMEDIATE DELIVERY!

LOW COST HIGH FREQUENCY COUNTER

NOT A KIT

The Albia Model DM-7, 8 Digit High Frequency Counter is easy to use, switch selectable time base input by a single BNC, nothing to build — nothing more to buy!
- 5 Hz to 550 MHz
- 8 big easy-to-read .43" High Intensity LED display
- Crystal (±3 ppm @ 25°C) Controlled 0.1 or 1.0 sec. gate times
- Convenient bench top size (7"x10"x3")
- durable attractive case

NEVER BEFORE AT THIS LOW PRICE . . . . . $119.95 Includes Albia's Satisfaction Warranty

COMPLETELY ASSEMBLED • PRE-CALIBRATED • PRE-TESTED

NOT A KIT

NEW ALBIA DESIGN-MATE CIRCUIT DESIGNER

Albia Quality Hardware — Your Ideas — not a kit — pre-wired pre-tested — don't let this price fool you, this is a high quality, high IC capacity, portable self-contained circuit designer — includes:
- Control switches and buffered LED logic indicators.
- Plug-in your IC's into solderless breadboards, tie-in power and ground, connect your logic switches and LED indicators — FAST, EASY TO USE!
- All interconnections between LED's, switches, and circuits via 22-26 solid wire.
- Self-powered, in one compact, good looking and durable carrying case.
- Ideal for home experiments, the laboratory and students.
- Battery (4 1½ Volt C cells*) or AC powered provides economical bench use or convenient portable use. Available in two models.

Albia Model DM-5A containing 4 LED's and 4 logic switches **$49.95** Includes Albia's Satisfaction Warranty

Albia Model DM-5 contains 8 LED's and 8 logic switches **$64.95** Includes Albia's Satisfaction Warranty

*Batteries not included.

INSTANT ORDER INFORMATION BELOW!

ALBIA'S ECONOMY DIGITAL DM-9 MULTI-LOGIC COMPATIBLE 5-15VDC PROBE

The features are many on this quality Albia's test instrument; will detect low repeat rate pulses (up to 1.5 MHz); detects low, high or pulsed logic levels with a minimum detectable pulse width of 300 nsec. Easy-to-interpret 3 LED readout. Built-in over-voltage and reverse polarity protection. **$26.95** Includes Albia's Satisfaction Warranty

IMMEDIATE DELIVERY . . . NOT A KIT

ALBIA EXTERNAL REGULATED, SHORT PROOF ADAPTER

Model DM-5B, supplies up to 300 MilliAmps at 5V, saves batteries . . . ONLY **$19.95** Includes Albia's Satisfaction Warranty

REGULATED TRIPLE POWER SUPPLY BARGAIN PRICED ALBIA MODEL DM-6

A fully assembled and tested power supply that provides a solid, fully wired triple power supply including fixed 5V @ 1 Amp, 5V to 15V @ 0.5 Amp, and −5V to −15V @ 0.5 Amp — all supplies regulated, short proof. Each supply has short indicator LED. Complete and ready for use in a durable (8"x6"x3½") metal case.

$79.95 Includes Albia's Satisfaction Warranty

ALBIA SATISFACTION WARRANTY: If for any reason, whatsoever, you are not completely satisfied with your purchase, return it within 30 days of purchase date for a full refund — it's as simple as that!

POSTAGE & HANDLING	
ORDERS	ADD
UP TO $10.00	$1.75
$10.01 - $25.00	2.25
$25.01 - $50.00	2.75
$50.01 - $100.00	3.25
ORDERS OVER $100.00 WITHIN UNITED STATES	N/C

FREE!! BIG 1981 SALE CATALOG

42 pages of exciting bargains! Send today!!

FOR FAST AND DEPENDABLE DELIVERY SERVICE

CALL COLLECT: 1-203-467-5590 9 A.M. to 5 P.M. E.S.T.

WE ACCEPT MASTER CHARGE, VISA AND AMEX CREDIT CARDS

Connecticut Residents add 7½% Sales Tax • Prices shown in U.S. currency only. Foreign orders add 15%.

FREE ALBIA "SURPRISE PACKAGE" WITH EVERY ORDER RECEIVED by February 25, 1981

ALBIA ELECTRONICS INC

24 Albia St. • New Haven, CT 06512

EQUIPMENT REPORTS

continued from page 34

device designed for that specific purpose. The *Stringy Floppy* is a 4×6×2½ inch self-contained unit. The circuitry, which also acts as a keyboard debouncer for the *TRS-80*, uses an EPROM (*E*rasable *P*rogrammable *R*ead-*O*nly *M*emory), so no memory from the host computer is used and no special software is needed. The simplicity and speed of operation make the *Stringy Floppy* a considerable improvement over the cassette recorder.

While the *Stringy Floppy* does not match the speed of a disk system, it is over 14 times faster, easier to use, and more reliable than a typical cassette-based system.

Connecting the *TRS-80* version of the *Stringy Floppy* to a *Level II* system takes about a minute. It just plugs into the wall, and the ribbon-cable connector pushes on to the PC board bus at the left rear keyboard-unit slot. First, type SYSTEM, thru press ENTER, type "/12345", press ENTER, and a confirming message on your display will tell you that the *Stringy Floppy* is on line. If you check the *TRS-80* memory you'll find it's still all available.

You can leave your cassette recorder attached—the *Stringy Floppy* does not interfere with the recorder in any way. But you'll find that you'll only be using the cassette recorder for transfering old programs to *Stringy Floppy* wafers. Wafers? Yes, the *Stringy Floppy* uses 2¾×1½×3/16 inch wafers (smaller than a business card) containing continuous-loop 1/16-inch wide data tape. Wafers are $2 each and are available with 5-, 10-, 20- and 50-foot tape lengths—you simply use the shortest length for your program requirements.

A 4K program will fit on a 5-foot wafer, and the transfer takes approximately six seconds! The *Stringy Floppy* processes signals at 7200 baud, as compared to 500 baud for a *Level II* cassette recorder. That's about 62½ characters-per-second for the cassette, and 900 characters-per-second for the *Stringy Floppy*. A 15-K byte program, which takes four minutes to load from a *Level II* cassette, takes under seventeen seconds to load from a *Stringy Floppy* wafer. The wafer tape runs at about ten inches per second.

You only need to remember three new commands: @NEW, @SAVE and @LOAD. The @NEW command locates the beginning of the silver-foil wafer tape and writes (records) a digital signal on the entire tape length. It then goes through the continous loop tape again verifying every bit before it stops, displaying a total byte count on the screen. That is far better than just erasing a tape, as it validates the ability of the entire tape to hold data bits.

When you use the @SAVE command, you also assign a program number from 1 to 99, in sequence. The *Stringy Floppy* writes the program on the wafer tape, then continues around the tape loop, locates the just-written program by number, and verifies every bit before displaying a DONE message. No more rewinding and typing CLOAD? to verify—fine!

The @LOAD command loads the contents of the wafer's next program into computer memory. If you want a specific program number, just add that number to the end of @LOAD, such as @LOAD 3. You can store up to 99 separate programs on a single wafer.

There are no controls on the *Stringy Floppy*, but there are two red LED's. One lights whenever the motor is running, and the other lights whenever the *Stringy Floppy* is writing onto the wafer tape.

The speed of the *Stringy Floppy* makes it practical to handle DATA. A special DATA I/O (input/output) tape is provided. It takes less than one second to @LOAD and provides several additional commands. Incidentally, all *Stringy Floppy* commands can be imbedded into BASIC programs, as well as keyboard-entered.

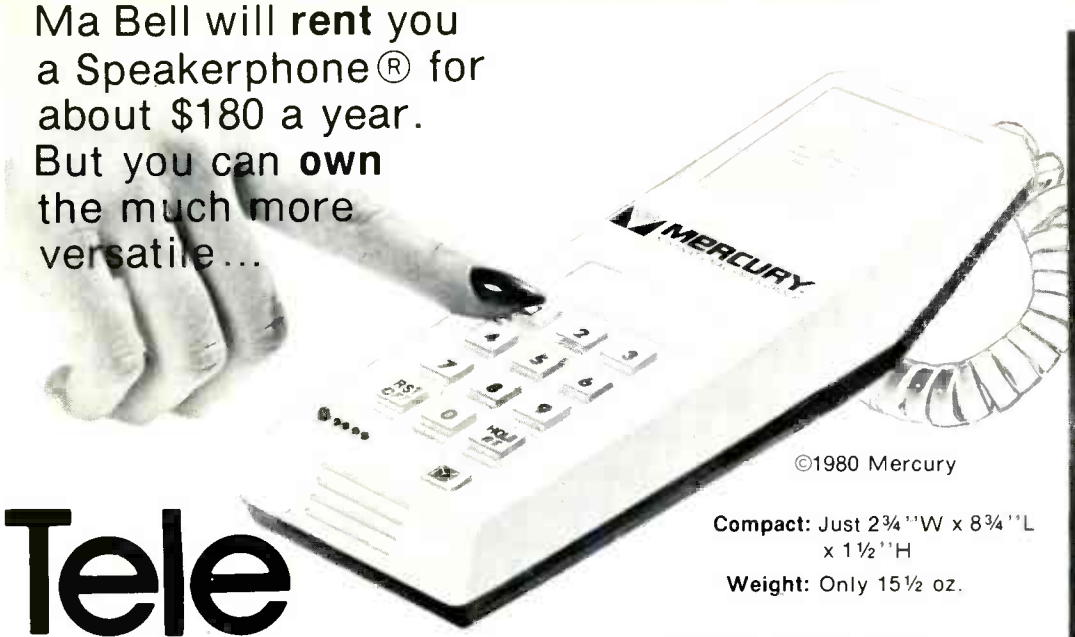
For machine-language buffs an *ESF Machine Language Monitor* is available. However, even without the monitor, machine language programs can be saved. If you know the starting address and length, they can be loaded with @LOAD in the regular way.

The *Stringy Floppy* EPROM contains various error messages. But since the system is so reliable, you may never see many of them. The PARITY or CHECKSUM errors appear on the screen on a bad @NEW or @LOAD, if one or more bits don't load or verify properly. During @SAVE and @NEW, a small silver, removable disk must be in position to write on the tape. If that disk is missing, a WRITE-PROTECTED error will be displayed. That allows you to be sure a tape you want to save cannot be recorded over. Also, during @SAVE, a TAPE TOO SHORT error message tells you to use a different wafer for that program.

The users manual is very complete, and guides you though each operation with clear instructions and examples. Up to seven *Stringy Floppies* can be daisy-chained onto one system and individually addressed, to allow transfer of data between each. That is much more practical than a dual-cassette system, since no rewinding of tapes is required, and data is transferred 14 times faster.

continued on page 42

Ma Bell will **rent** you a Speakerphone® for about $180 a year. But you can **own** the much more versatile...



©1980 Mercury

Compact: Just 2¾''W x 8¾''L x 1½''H

Weight: Only 15½ oz.

Tele Speaker™

for half that price!

It's the hands-free telephone for office, home, lab, studio, warehouse or farm building. Plus, it's an automatic redialer, too! And, no installation—just plug it in!

If you've ever watched "Charlie's Angels" on TV, you've seen how useful a Speakerphone can be. It allows all the Angels and Bosley to listen to, and talk to, the distant Charlie at the same time. Even when Bosley is alone in the office, the hands-free Speakerphone lets him write, check his files or do other work while carrying on a telephone conversation.

For conference calls or private calls, in the office or in the home, the Speakerphone is **almost** ideal.

But...

AT&T won't sell you one. You've got to rent it—month after month after month. And the rates vary from state to state. In Illinois, for example, it's $10 a month. In New Jersey, it's $15 a month —$180 a year. There's also an installation charge (**e.g.**, $57.50 in Illinois). Plus, it has to be hooked up to a conventional telephone, on which you **also** pay rent.

Because of the installation, you can't move the Speakerphone from room to room, as needed. And, as often as not, the cord that's installed is too short to permit you to place the unit exactly where you want it on a desk or conference table.

For all these reasons, and others...

YOU'RE BETTER OFF WITH THE TELE SPEAKER

The Tele Speaker is smaller, lighter and much more versatile than the Speakerphone/telephone combination. And much less expensive.

Exceedingly compact, the all-in-one-unit Tele Speaker can be placed on a desk, table or counter, or even hung on a wall. There's no installation needed. You don't even need an AC cord, or batteries. Just snap the modular plug into your regular phone jack in the wall. The coil cord can be stretched to 12 feet. If you need a longer cord, extension cords are available. (For use with multiple-phone lines, adapters are available.)

And the Tele Speaker is complete in itself. No extra phone is needed.

EVERYTHING'S BUILT IN

A built-in omnidirectional microphone and speaker let you talk and listen hands-free. It lets others in the room participate in the conversation, too. But you can also hold the Tele Speaker to your ear for private conversations.

There's a four-level volume control with LED indicator lamps, so you can adjust the speaker just the way you want it. Plus a "Power On" indicator. And a "Hold" key lets you hear the other party without them hearing you.

AUTOMATIC REDIALER, TOO

Here's another time- and money-saving feature. Press the "Redialer" key, and the last number you called—up to 21 digits long—is redialed automatically. It's great for coping with busy signals.

And whether you're in a push-button or rotary-dialing area, the Tele Speaker's push-button keys make calling fast and easy.

PRICED LOW ENOUGH EVEN FOR THE HOME

You can own a Tele Speaker for the incredibly low price of **$89.95**...or two of them for just **$84.95** each. Plus just $2.50 per order (not per unit) for shipping and insurance.

MONEY-BACK GUARANTEE

Enjoy using a Tele Speaker in your office and/or home for 30 days. If not completely satisfied, return the unit(s) —insured—for a full refund. But chances are you'll keep the Tele Speaker(s) for years of hands-free telephoning ease.

The Tele Speaker is also covered by a one-year limited warranty on parts and labor. Service (if ever needed) is readily available.

So send for one or more Tele Speakers today. Mail your check or money order to our address below. Or charge it to your Visa, Master Card, American Express, Diners Club or Carte Blanche credit card. If using your charge card, you can order via our toll-free phone number:

800-526-2801

If busy or no answer, call toll-free:

800-257-7850

In New Jersey, call: **800-322-8650.**
N.J. residents, please add 5% sales tax.

MERCURY®
INTERNATIONAL SALES GROUP

404 Madison Avenue,
Lakewood, New Jersey, 08701

CIRCLE 5 ON FREE INFORMATION CARD

GO WITH McGRAW-

Join the Electronics and Control Engineers' club that saves you BIG money on the

ELECTRONICS DESIGNERS' HANDBOOK. Edited by L. J. Giacoletto. 2nd Ed. *2,344 pp., 1,686 illus.* Now doubled in size and with 90% of its material new, this famous classic (first edition by Landee, Davis, Albrecht) has been thoroughly revised and updated to give you not only the *how* and the *why* of all your design work but also the *how much* of every design step you take!
231/494 Pub. Pr., $62.50 Club Pr., $47.50

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, 11/e. By D. G. Fink and H. W. Beaty. *448 pp., 1,414 illus.* A giant in every sense of the word, today's most widely used source of electrical engineering information and data serves you as no other single work available anywhere when you need detailed, accurate, timely, and reliable facts and how-to on the generation, transmission, distribution, control, conversion, and application of electric power.
209/74X Pub. Pr., $54.50 Club Pr., $41.95

PHASELOCK TECHNIQUES. By F. M. Gardner. *2nd Ed., 285 pp., illus.* This edition of the standard working reference shows you not only better methods of analysis and better procedures for deciding on loop parameters, but also the circuits and the results.
582029-3 Pub. Pr., $21.50 Club Pr., $16.95

INTRODUCTION TO THE THEORY AND DESIGN OF ACTIVE FILTERS. By L. P. Huelsman and P. E. Allen. *430 pp., illus.* Once you add active filter design to your repertory of specialties, you'll possess a skill that's in great demand today. Here's one of the best texts we know on the theory, design, application, and evaluation of modern active filters and the various techniques used today.
308/543 Pub. Pr., $28.50 Club Pr., $21.50

HANDBOOK OF OPERATIONAL AMPLIFIER CIRCUIT DESIGN. By D. F. Stout. Edited by M. Kaufman. *434 pp., 223 illus.* Compact, concise, highly concentrated, and containing a storehouse of information, this one-stop volume will help you solve any op amp circuit problem!
617/97X Pub. Pr., $31.50 Club Pr., $23.50

ELECTRONIC DISPLAYS. By E. G. Bylander, Texas Instruments Incorporated. *172 pp., illus.* The book describes current electronic displays by family types, discussing all aspects of their operation, application, and circuit requirements. You cover photometry and contrast enhancement, together with the fundamentals of such critical components as mounts and drives, interface requirements, and other necessary engineering information.
095/108 Pub. Pr., $24.50 Club Pr., $18.50

BIT-SLICE MICROPROCESSOR DESIGN. By J. Mick and J. Brick. *320 pp., 230 illus.* All in one place—the crucial information you've been needing about the 2900 family of bit-slice microprocessor components! A remarkable "first," this book designs right before your eyes not just one, but two complete 16-bit machines!
417/814 Pub. Pr., $18.50 Club Pr., $14.50

ELECTRONIC FILTER DESIGN HANDBOOK. By A. B. Williams. *576 pp., 408 illus.* The book is organized so that you can start from practically any set of requirements and follow a sequence of clearly outlined steps and design filters ranging from simple networks to very complex configurations. Each design technique is illustrated with step-by-step examples and is accompanied by a wealth of applicable schematics, graphs, and tables of normalized numerical values.
704/309 Pub. Pr., $32.50 Club Pr., $25.50

MODERN ELECTRONIC CIRCUITS REFERENCE MANUAL. By J. Markus. *1,264 pp., 3,666 circuit diagrams.* This 103-chapter guide means you can speed up the production of new electronic devices with ease and thereby lower your production costs. Complete with values of components and suggestions for revisions, plus the original source of each circuit in case you want additional performance or construction details.
404/461 Pub. Pr., $44.50 Club Pr., $34.50

DIGITAL HARDWARE DESIGN By J. B. Peatman. *428 pp., over 400 illus.* Taking you beyond the microcomputer, this guide re-examines traditional techniques and focuses maintainability as a key goal, on the design of circuitry too fast for the microcomputer alone, and on designing for usefulness. It covers everything from algorithmic state machines to separately clocked circuits—with scores of examples.
491/321 Pub. Pr., $26.95 Club Pr., $20.00

BE SURE TO CONSIDER THESE IMPORTANT TITLES AS WELL:

DIGITAL FILTERS. By A. Antoniou
021/171 Pub. Pr., $29.95 Club Pr., $21.95

MICROCOMPUTER INTERFACING. By B. Artwick
789/436 Pub. Pr, $21.95 Club Pr., $16.95

ELECTRONICS DICTIONARY, 4/e. By J. Markus.
404/313 Pub. Pr., $24.50 Club Pr., $19.50

SEMICONDUCTOR DEVICES AND INTEGRATED ELECTRONICS. By A. G. Milnes
789/487 Pub. Pr, $26.50 Club Pr., $20.95

ENGINEERING MATHEMATICS HANDBOOK, 2/e. By J. J. Tuma.
654/298 Pub. Pr., $24.95 Club Pr., $19.95

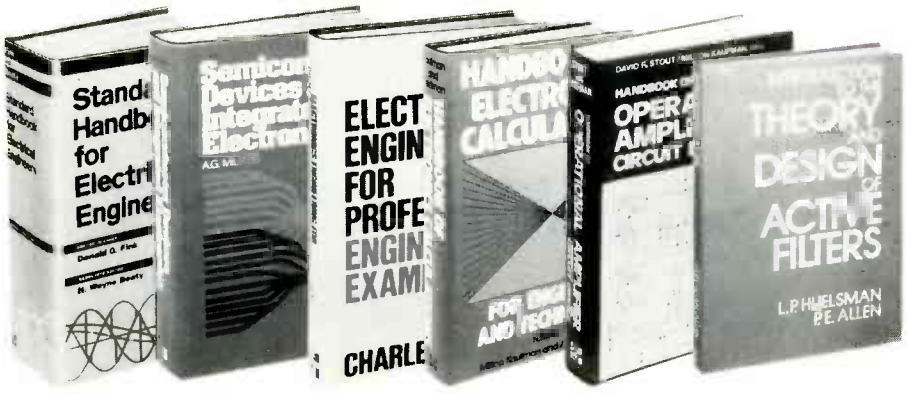
RADIO HANDBOOK, 21/e. By W. Orr.
772/630 Pub. Pr., $21.50 Club Pr., $16.60

TRANSFORMER AND INDUCTOR DESIGN HANDBOOK. By W. T. McLyman.
786/755 Pub. Pr., $35.00 Club Pr., $26.50

CRYSTAL OSCILLATOR DESIGN AND TEMPERATURE COMPENSATION. By M. E. Frerking.
784/973 Pub. Pr., $18.95 Club Pr., $14.95

NATIONAL ELECTRICAL CODE HANDBOOK, 16/e. By J. F. McPartland.
456/909 Pub. Pr., $21.50 Club Pr., $16.50

TRANSISTOR CIRCUIT APPROXIMATIONS, 3/e. By A. P. Malvino
398/78X Pub. Pr, $17.25 Club Pr., $12.95



HILL'S EXPERIENCE!

Book Club — McGraw-Hill's long-established important new books of all publishers!

HANDBOOK OF ELECTRONICS CALCULATIONS FOR ENGINEERS AND TECHNICIANS. Edited by M. Kaufman and A. H. Seidman. *653 pp., 725 illus.* This first comprehensive tool of its kind includes *hundreds of worked-out problems* in analog and digital circuits. Includes more than 700 diagrams, curves, tables, and graphs.
333/920 Pub. Pr., $27.50 Club Pr., $21.00

MICROCOMPUTER-BASED DESIGN By J. B. Peatman. *Expanded 4th printing, 604 pp., over 400 photos and other illustrations* Do all your best day-to-day designs, as well as your supercreative and special designs, around the new microcomputers and the specific "how-to" help you get here!
491/380 Pub. Pr., $29.95 Club Pr., $22.50

MICROELECTRONICS Digital and Analog Circuits and Systems By J. Millman. *881 pp., 700 illus.* This giant book takes you step by step from a qualitative knowledge of a semi-conductor, to an understanding of the operation of devices, and finally, to an appreciation of how these are combined to form micro-electronic chips.
423/27X Pub. Pr., $29.95 Club Pr., $23.50

ELECTRONIC COMMUNICATION. By Robert L. Shrader. *4th Ed., 801 pp., 870 illus.* This thoroughly updated edition offers all the theory and fundamentals you need to prepare yourself for the FCC commercial and amateur grade license examinations—and pass them the first time!
571/503 Pub. Pr., $21.95 Club Pr., $16.95

ELECTRONICS ENGINEERING FOR PROFESSIONAL ENGINEERS' EXAMINATIONS. By Charles R. Hafer. *336 pp., illus.* Actually two books in one—a quick preparation manual to help you pass your P.E. exams on the first try *and* a rich source of practical electronics engineering information and know-how.
254/303 Pub. Pr., $19.50 Club Pr., $15.50

INTRODUCTION TO RADAR SYSTEMS, 2/e. By M. I. Skolnik. *698 pp., 244 illus.* This new edition of a widely used text on radar from the systems engineer's point of view brings you full discussions of the many major changes that have occurred in the field recently.
579/091 Pub. Pr., $34.95 Club Pr., $27.95

MICROPROCESSORS/MICROCOMPUTERS/SYSTEM DESIGN. By Texas Instruments Learning Center and the Engineering Staff of Texas Instruments Inc. *634 pp., illus., outsized 7½ x 10¼ format.* This practical, authoritative guide details the versatile, proved-in-action methods and technical features of the 9900 minicomputer architecture that can be employed to create outstanding products and systems.
637/58X Pub. Pr., $24.50 Club Pr., $19.50

ELECTRONICS ENGINEER'S HANDBOOK. Editor-in-Chief, D. G. Fink. *2,104 pp., 2,026 illus.* Huge in every sense, this instant-reference volume gives you every latest essential in the field, 2,100 formulas and equations, a 2,500-item bibliography, and every illustration you need to clarify all of modern electronics!
209/804 Pub. Pr., $57.50 Club Pr., $42.50

PRINTED CIRCUITS HANDBOOK, 2/e. By C. F. Coombs, Jr. *256 pp., 327 illus.* Blueprints every important phase of printed circuitry. Provides the information you need to establish a production facility and control the processes. A virtual encyclopedia in the field, five major sections cover engineering, fabrication, assembly, soldering, and testing.
126/089 Pub. Pr., $35.00 Club Pr., $26.50

DESIGN OF SOLID-STATE POWER SUPPLIES. By Eugene R. Hnatek. *2nd Ed., 640 pp., illus.* A total revision and expansion of an essential, ready-to-use sourcebook on the design of power supplies, particularly of the switching variety. Incorporates the latest developments in the field while emphasizing the practical, how-to help designers want.
582054-4 Pub. Pr., $27.50 Club Pr., $21.50

any one of these great professional books for only $1.89

values up to $62.50

Special $1.89 premium book comes to you with your first club selection

Why YOU should join now!

• BEST BOOKS IN YOUR FIELD—Books are selected from a wide range of publishers by expert editors and consultants to give you continuing access to the latest books in your field.

• BIG SAVINGS—Build your library and save money too! We guarantee savings of at least 15% off publishers' list prices on every book. Usually 20%, 25% or even higher!

• BONUS BOOKS—You will *immediately* begin to participate in our Bonus Book Plan that allows you savings between 70-80% off the publisher's price of many books.

• CONVENIENCE—14 times a year you receive the Club Bulletin FREE, fully describing the Main Selection and alternate selections, together with a dated reply card. If you want the Main Selection, you simply do nothing—it will be shipped automatically. If you want an alternate selection—or no book at all—you simply indicate it on the regular reply card and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the Bulletin you should receive a book you do not want, just return it at the Club's expense.

As a member, you agree only to the purchase of four books (including your first selection) over a two-year period.

MAIL THIS COUPON TODAY

McGraw-Hill Book Clubs
Electronics and Control Engineers' Book Club
P.O. Box 582, Hightstown, New Jersey 08520

Please enroll me as a member and send me the two books indicated, billing me for my first selection only at the discounted member's price, plus local tax, postage and handling. If not satisfied, I may return the books within 10 days and my membership will be canceled. I agree to purchase a minimum of 3 additional books during the next 2 years as outlined under the club plan described in this ad. Membership in the club is continuous but cancelable by me at any time after the four book purchase requirement has been fulfilled.

Write Code # of PREMIUM selection here _____

Write Code # of FIRST selection here _____

Orders from outside the U.S. must be prepaid with international money orders in U.S. dollars.

Signature _____

Name _____

Address _____

City _____

State _____ Zip _____

This order subject to acceptance by McGraw-Hill. All prices subject to change without notice. Offer good only to new members. A postage and handling charge is added to all shipments. E33474

EQUIPMENT REPORTS

continued from page 36

Although the *Stringy Floppy* does not have the speed or versatility or a floppy-disk system, it offers many advantages in speed and reliability over a cassette-based system. The *Stringy Floppy* for the TRS-80 sells for $249.50. Versions for the S-100 and SS-50 busses are $289.50 and $250.00, respectively. From Exatron Corporation, 3559 Ryder Street, Santa Clara, CA 95051. **R-E**

Eico Model 330 Signal Generator

IT HAS BEEN SAID THAT THERE ARE THREE pieces of test equipment that every home radio and electronics experimenter should have: a multimeter, an oscilloscope, and a signal generator. EICO's *model 330* RF signal generator is an inexpensive complement to the hobbyist's workshop. For kit builders, that handy accessory may be constructed for under $100.

The small size (7½ × 8½ × 5 inches) allows it to fit comfortably on any workbench, and its weight of five pounds makes it very portable. It must be pointed out, however, that the *model 330* is not a lab-quality instrument. But it is suitable for peaking-up ham gear, CB receivers, and other entertainment-class electronics.

The signal generator features continuous coverage from 100 kHz to 54 MHz on the fundamental frequencies. Tuning-dial accuracy is advertised as within 1.5 percent. In fact, our sample's accuracy was better than one percent worst case (highest frequency range). The stability is fair. A constant wavering of the RF signal was observed when the output of our sample unit was measured on a frequency counter and monitored on a receiver. We felt, however, that that slight instability would not degrade the effectiveness of the signal generator in most consumer-alignment procedures.

Output level is continuously variable up to 300,000 microvolts into a 50-ohm load. Coarse attenuation is provided by a three-position rotary switch, approximately 20 dB per step. The RF output is provided through a front-panel BNC connector.

Frequency tuning is accomplished by a two-section variable capacitor. The variable capacitor features vernier drive and gear reduction to help smooth out the adjustment procedure.

Output from the internal audio oscillator is provided through a pair of front-panel binding posts, or is switch-selected to modulate the RF generator. The frequency of the audio oscillator is nominally 400 Hz (ours measured 260 Hz). When used alone, the output level of the audio oscillator is approximately two volts into a 100,000-ohm load (one volt at 10,000 ohms).

The unit is housed in a metal cabinet, smooth-finished in black and silver/gray. The power required is 117 volts AC. A neon pilot lamp signals the ON status of the *model 330*.

Kit builders will find the solid-state generator a snap to assemble. The printed-circuit board is well marked for parts placement, and there are no cramped quarters to contend with. All RF coils are prewound and slug-adjustable for final alignment.

There is nothing unorthodox about the circuit or its assembly. There are four transistors and they are used as an audio-frequency oscillator, an RF oscillator, a modulator, and a buffer. Two rectifier diodes complete the semiconductor count.

As is traditional with EICO, a well-illustrated manual is provided, complete with a large, bold circuit diagram. All parts are thoroughly described, and a parts list is included. The complete manual assists with the wiring task and provides final alignment hints. A section on typical applications for the *model 330* in receiver alignment is included, and the manual also illustrates a number of test-jig circuits such as the standard IEEE dummy antenna.

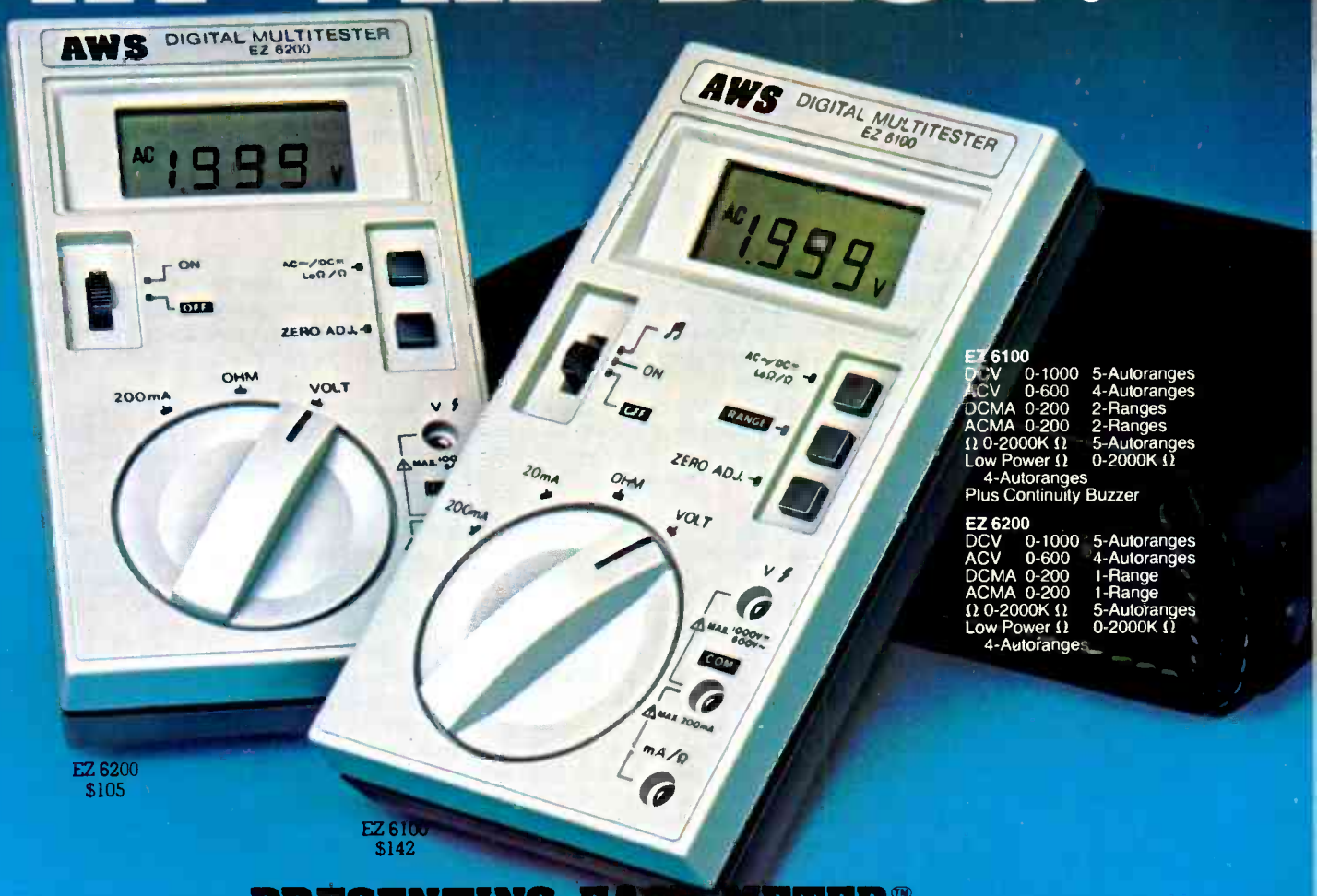
The EICO *model 330* is a very useful piece of home test equipment for less demanding hobby requirements. Its low cost and its straightforward design and assembly are reassuring to the less experienced builder.

The *model 330* RF signal generator sells for $119.95 in kit form, and $164.95 factory wired. It is manufactured by EICO, 108 New South Road, Hicksville, NY 11801. **R-E**

CIRCLE 105 ON FREE INFORMATION CARD

YOU'VE SEEN THE REST...

NOW LOOK AT THE BEST!



EZ 6200
$105

EZ 6100
$142

EZ 6100

DCV	0-1000	5-Autoranges
ACV	0-600	4-Autoranges
DCMA	0-200	2-Ranges
ACMA	0-200	2-Ranges
Ω	0-2000K Ω	5-Autoranges
Low Power Ω		0-2000K Ω 4-Autoranges

Plus Continuity Buzzer

EZ 6200

DCV	0-1000	5-Autoranges
ACV	0-600	4-Autoranges
DCMA	0-200	1-Range
ACMA	0-200	1-Range
Ω	0-2000K Ω	5-Autoranges
Low Power Ω		0-2000K Ω 4-Autoranges

PRESENTING EASY-METER™ UNPRECEDENTED FIVE-YEAR WARRANTY.

- Autoranging on Volts and Ohms
- Easy reading 3½ digit display
- CMOS–LSI advanced circuitry
- Autopolarity
- Automatic indication, unit and signs
- Easy to operate
- Economically powered with two "AA" 1.5V batteries
- Low battery drain, 300 hours continuous operation
- Low battery warning sign
- Lo Power and Normal Ohm ranges
- Range hold
- Buzzer continuity check
- Zero adjust feather-touch button
- AC/DC Lo Ω/Ω function selection by feather-touch button
- Safety fused
- Pocket-size, compact, lightweight, nicely balanced
- Shock resistant ABS housing
- Reliable, accurate, and rugged

For ordering information write A.W. Sperry Instruments Inc., 245 Marcus Blvd., Hauppauge, N.Y. 11787 or call toll-free 800-645-5398.

A.W. SPERRY INSTRUMENTS INC.

The Measurable Advantage.

CIRCLE 44 ON FREE INFORMATION CARD

satellite tv news

DIRECT-TO-HOME SATELLITES

Direct Broadcasting Satellites (DBS)—which could put inexpensive one-meter dishes on rooftops across America—got a boost recently when the FCC said it would formally consider any such plans. That preliminary ruling was seen as a green light, giving Comsat the go-ahead to submit its extensive and much-discussed DBS proposal. The FCC staff urged that the DBS plan be considered—so the next step is to permit public comments on various ways in which DBS should be regulated or developed. Although Comsat still says it wants to have its DBS system in place by 1985, most observers think that such a timetable may be too ambitious.

As we went to press, Comsat still had not submitted its formal proposals for such a system—although it is expected to include $300 home terminals, and a six-channel, high-powered satellite offering pay-TV movies and other entertainment and educational services. Monthly program fees would probably be about $15 to $40 per home.

LOWER COSTS FOR HOME SATELLITE STATIONS

As we await the arrival of DBS technology, the prices and opportunities in the current satellite reception market continue to look better. Meanwhile, a host of new low-price-equipment continues to arrive on the marketplace, although much of it is oriented toward cable-TV systems and other professional users. For example, Hughes has spun off an outdoor downconverter for $1,050; among other things, the unit permits a user to run cable up to 1000 feet without amplification.

Microdyne has introduced a new integrated terminal for $9,200 complete. The unit includes dual polarized feeds, an LNA, 24-channel receiver, VHF modulator, and remote-control box. It also features a novel repair setup: Most components are in a modular canister—which can be unscrewed and replaced.

MORE PROGRAMMING

Time may become the only impediment in choosing what to do with your home satellite receiver. By midyear there will be a constant barrage of video programming floating around the skies. Among the newest plans are Rainbow Programming Service, which was due to go on the air in December 1980. The channel, carried on Comstar D2, will combine a "Bravo" series of cultural programming with an "Escapade" series of action-adventure movies.

Meanwhile, CBS Cable, the new division of CBS-TV, plans to begin its programming by spring or early summer. The channel, aboard Westar, will also concentrate on cultural programs—including some newly created shows made especially for the cable-only network.

The latest trend in cable programming via satellite appears to be new shows made by the cable-TV companies themselves. In that regard, some media moguls who are now entering the CATV business pose the most interesting prospects. For example, Teleprompter, the nation's largest cable-TV company, was recently acquired by Westinghouse Electric Corp. Westinghouse, of course, also owns Group W Broadcasting—one of the major suppliers of independent programming, including "P.M. Magazine." Industry experts foresee a new boom in made-for-cable TV programming, which will be beamed via satellite. In the same vein, Times Mirror Company and the Chicago Tribune Co., which both own TV stations and newspapers, are also stepping up their cable-TV ownership—which will also lead to more new program services.

AROUND THE SATELLITE CIRCUIT

- Playboy Enterprises may build its own satellite network, mainly to be used for teleconferences between its major resort hotel complexes. But the Bunny network could also be used for sending live entertainment to hotel guests. Playboy's plans are at a very early stage of development, so it could be a year or more before any programming is offered.
- Here's another indicator of how big the satellite business will grow: Sid Topol, president of Scientific-Atlanta, one of the major manufacturers of professional satellite equipment, recently predicted that by 1990 there will be more than 100,000 earth stations in use in the United States. Most of them will be at business locations, to be used for data transmission and other corporate needs (including teleconferencing). Topol also predicts that within five years almost every TV station will have an earth terminal—and that could mean that most broadcast-TV programming will take to the skies by then.
- Independent News Network is now beaming a half-hour nightly news program to broadcast-TV stations around the country. About three dozen non-network TV stations (mostly in major cities) carry the newscast, which is sent via Westar II Transponder 2. The satellite feed begins at 9:30 p.m. eastern time each day.
- LNR Communications (180 Marcus Blvd., Hauppauge, NY 11787) is now offering a 20-to 40-GHz series of components for earth stations, including S-to Q-band power up-converters, 33-36 GHz low noise amplifiers, and other products.

GARY H. ARLEN
CONTRIBUTING EDITOR

Brainchild

Yesterday — Remember the first Heathkit Analog Computer (1957)? Or the Heathkit Single-Sideband Transmitter (1958)? How about the Heathkit Multiplex Adapter for FM stereo reception (1960)?

Each was a ground-breaking innovation for its day. Each was a Heathkit brainchild.

Today — Today's brainchildren include the popular Heathkit All-In-One Computer, a complete computer system with disk storage, smart terminal, two Z80 microprocessors — all in one compact unit.

Also rising fast, the Heathkit Screen Star a new projection TV that brings together the best in video technology to create the sharpest color picture ever on a six-foot diagonal screen.

Heath imagination applied to microprocessor electronics created the Heathkit Weather Computer. It monitors current weather, tracks changes, stores data — and puts it all at your fingertips.

Tomorrow — Tomorrow's brainchild, like today's and yesterday's, will combine the newest and the best in electronics to create a new state-of-the-art.

On the drawing boards right now are new designs for amateur radios, audio components, computers, color TV's, test instruments and new educational programs — all in easy-to-build, money-saving kits. They'll be appearing soon in Heathkit Catalogs and at Heathkit Electronic Centers. It's one catalog you don't want to be without.

Heathkit®

SEND FOR *FREE* CATALOG

Write to Heath Co., Dept. 020-744, Benton Harbor, MI 49022.

VISIT YOUR HEATHKIT STORE

In the U.S. and Canada visit your nearby Heathkit Electronic Center where Heathkit products are displayed, sold and serviced. See the white pages of your phone book. In the U.S., Heathkit Electronic Centers are Units of Veritechnology Electronics Corp.

EX-379

CIRCLE 28 ON FREE INFORMATION CARD

Golf cart company gets back on the green

with MRO parts from Sylvania ECG.

A golf cart manufacturer found himself in trouble when his regular supplier couldn't come through with vitally needed battery-charger parts. MRO replacement parts from his local Sylvania ECG distributor, Menard Electronics of Baton Rouge, La. saved the day. Menard got the golf carts rolling off the assembly line again by supplying off-the-shelf semiconductors listed in the ECG Industrial MRO Replacement Guide.

But, you don't have to have that kind of emergency to get high-speed action from your Sylvania ECG distributor. He can give you fast service on replacements for linear and digital ICs, triacs, SCRs, transistors, zeners and more than 70,000 other semiconductor devices.

He can also help you avoid future emergencies by working with you to set up your own mini-stock inventory of key parts tailored to your particular needs. And since the electrical specifications of many ECG replacements actually exceed those of the original parts, he can help you upgrade the reliability of many types of equipment at minimum cost.

He also has the famous "Sylvania ECG Industrial MRO Replacement Guide and Catalog" which provides technical information, and cross-references more than 70,000 industrial part numbers.

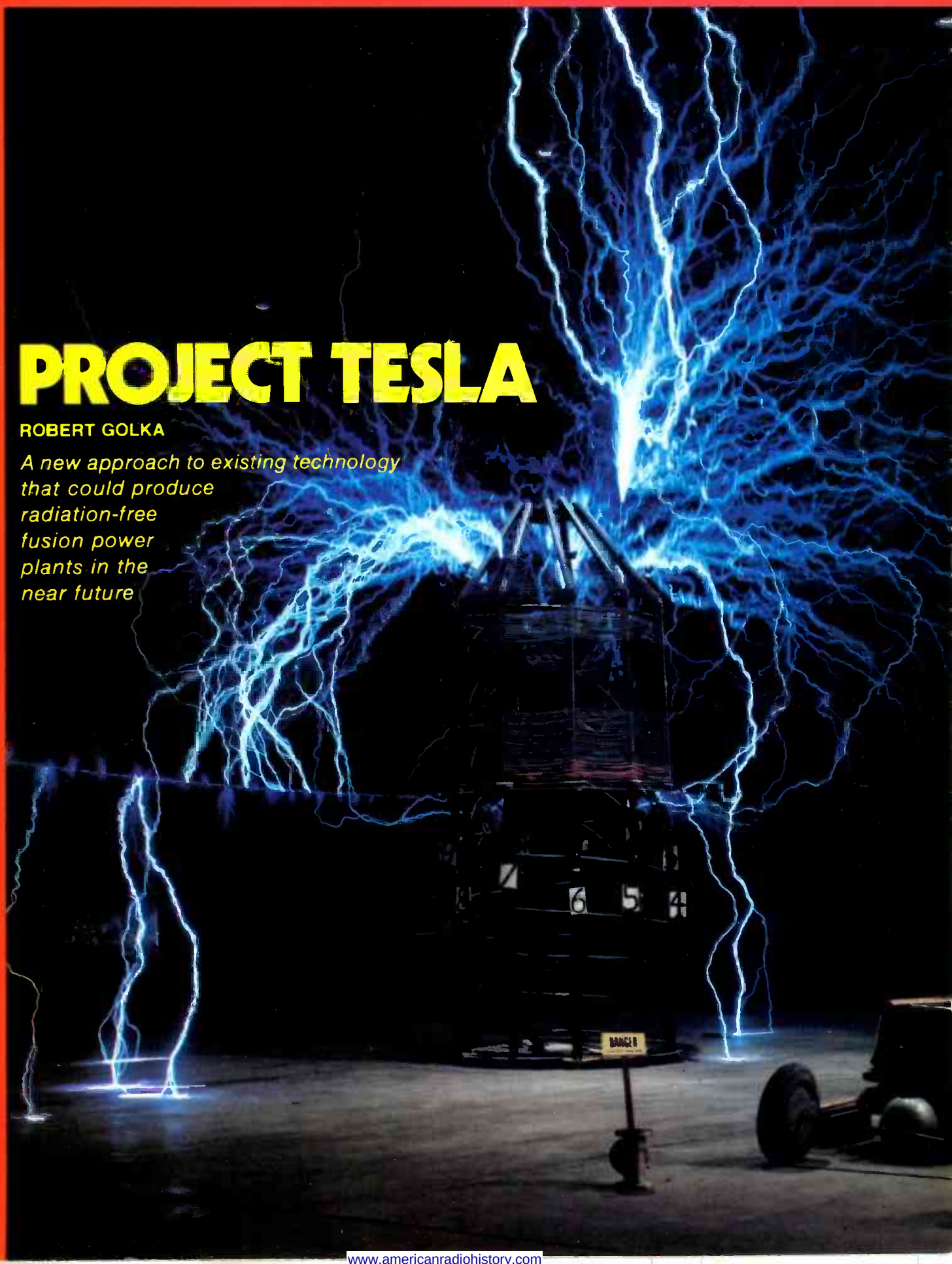
Get your copy where you get the parts—at your local Sylvania distributor. TO FIND OUT WHERE HE IS, CALL TOLL-FREE 800-233-8465.

SYLVANIA | GTE

PROJECT TESLA

ROBERT GOLKA

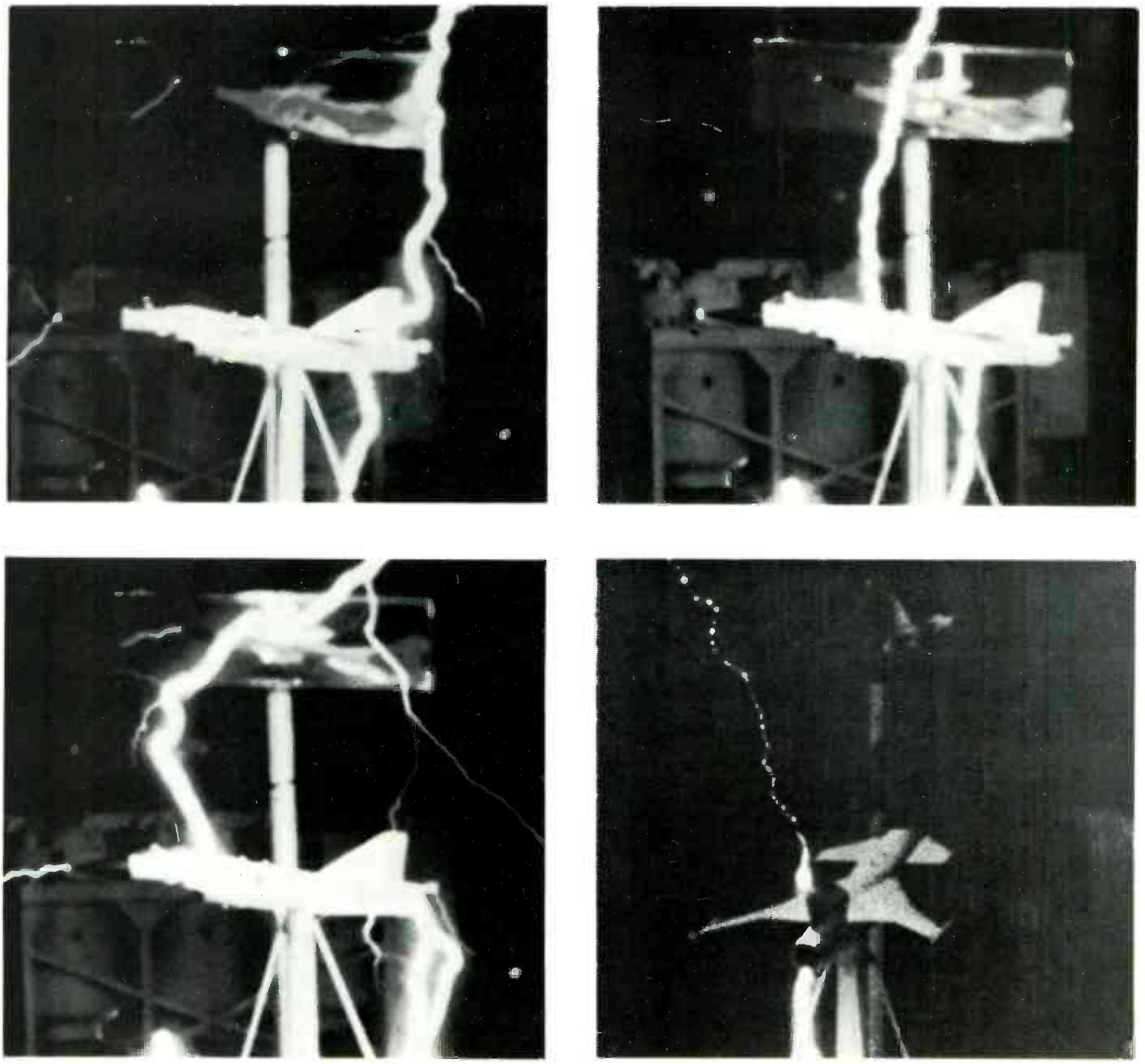
A new approach to existing technology that could produce radiation-free fusion power plants in the near future



FOR MANY YEARS WE HAVE LOOKED FOR A WAY OF holding very hot gases without the use of magnetic fields. About 11 years ago (1968), we here at Project Tesla began looking into some of the research of Nikola Tesla, who in 1899 was experimenting with an international power and communicating system. During his experiments he was repeatedly producing small fireballs that persisted for many seconds after his coil (which at that time was generating 12-million volts) was turned off. He then devoted eight pages of his diary to a crude hydrodynamic theoretical model of the fireballs and said that the investigation of these properties would be worthwhile. After Tesla's death, his experiments in this field were not repeated.

Then in 1970, I organized Project Tesla and tracked down Tesla's diary of 1899 to the Nikola Tesla Museum in Beograd, Yugoslavia. From Tesla's notes I was able to build the closest replica of Tesla's high voltage machine, recreating the fireballs, and even exceeding the power output of it. From that point, 10 years of research with limited out-of-pocket funding, has emerged a full-blown fireball thermonuclear fusion reactor concept.

The 1978 Nobel Prize winner, Peter Leonidovich Kapitsa, with support of the Soviet government, has developed very similar concepts in Nuclear fusion which he discusses at length in his Nobel prize lecture published in the September 7, 1979 issue of *Science*. Fusion creates heat by pushing hydrogen-deuterium atoms together. This is completely opposite to the method used in fission reactors that generate heat by splitting heavy atoms apart. Aside from which this process is potentially very messy to our environment. The problem is simply that some of the nuclear frag-



WITH THE TESLA COIL operating at 20 million volts, the above photos show the various discharge paths that occur when an airplane is struck by lightning. These photos were taken while Project Tesla was under contract by the USAF for the investigation. During this investigation using a scale model, a 16-mm movie camera captured the frame in the lower right, which shows actual beads of ball lightning.

ments are unstable and thus radioactive for periods of time that range from days to hundreds of thousands of years, depending on which radioactive elements we are talking about. In the "Fireball Fusion Reactor" only Helium is created and this is not a radioactive substance. Mathematical models of the fireball fusion process, indicate it can achieve and hold temperatures over a billion degrees, more than enough for the fusion process to take hold and be sustained.

The fireball fusion reactor works by focusing a carbon dioxide laser beam down to a tiny pin point in a spherical tank filled with hydrogen-deuterium. The high concentration of light energy heats the gases so fast that an explosion occurs, just as sunlight through a magnifying glass will ignite a piece of paper because the magnifying glass concentrates the sun's light which produces heat. This makes a small firecracker-size explosion.

This explosion is designed to occur at the focal points of four other far-infrared tetrahedrally spaced lasers. These lasers are chosen to be of a particular color of light (wave length) so that the plasma (hot gases) in the explosion resonates and absorbs energy from the laser light. As this happens the plasma explosion becomes stable and forms a fireball, because light energy (photons) is being put in and absorbed in an orderly and slow manner. This is a very much different method than that of inertia pellet laser fusion now being experimented with at Lawrence Livermore Laboratories in California. That process involves ganging up yet to be developed costly giant lasers to develop a tremendous pulse of light energy that is slammed into a tiny pellet in a trillionth of a second to make an implosion which produces heat because of the extreme rapid compression of the vaporized pellet. Thus the plasma fireball heats up and expands gradually which is unwanted. This expansion is reversed by gradually increasing the deuterium gas pressure in the spherical tank causing the fireball to remain the same size and density and to reach a billion and a half degrees in 30 minutes.

Once a billion and a half degrees have been reached, the fusion process starts and the laser can be extinguished. Each pair of hydrogen-deuterium atoms that fuse together make a helium atom and shoot off 2 neutron particles at high speeds. These neutron particles have no electrical charge at all, therefore, they travel effortlessly through the onion-like layers of positive ions and negative electrons of the fireball.

The spherical tank is equipped with an inside water jacket. Where the high speed neutrons reach the water, they are slowed down and convert a little of the water to deuterium. (They also heat the water just as a brake on an automobile heats the wheel cylinders.) The heat can make the water turn to steam and the steam can be used to turn a turbine-driven generator to produce electric power. It can also be used to break down water into hydrogen to supply hydrogen-powered automobiles.

We mention hydrogen powered automobiles, only because the offshots of this technology are many. In comparison to current time scales of Fusion Development, the "Fireball Fusion Reactor Prototype" could be built with proper funding in two to five years, bringing it well ahead of other fusion research. R-E

U. S. Project Tesla

Nikola Tesla, enigmatic inventor and holder of numerous patents on electric devices including the AC electric motor, and the tuned circuit used in all radio and television sets, designed and built the largest high-voltage device (12.5 million volts!) ever constructed. The year was 1899. The place, Colorado Springs, USA. His purpose was to send electric power and communications around the world, three years before Marconi demonstrated radio transmission by sending the code pulses for the letter "S" across the Atlantic Ocean in 1902.

Tesla's experiment lasted nine months and cost $200,000 (in 1899 dollars), kindly supplied by J. Pierpoint Morgan and others. During these experiments he noted in his diary the accidental but repeatable production of little "fireballs", about 1½ inches in diameter, that persisted for many seconds after his device was turned off. He then devoted eight pages of his diary to a crude hydrodynamic theoretical model of the fireballs and said that investigating their properties would be worthwhile. For the next 70 years his experiments were never repeated nor verified.

In 1968, Robert K. Golka became interested in Tesla's fireballs since they represented a confined plasma, something that may be useful for controlled thermonuclear fusion research. Natural ball lightning was similar in many respects. Could the key to both phenomena be found by duplicating Tesla's experiments? Mr. Golka decided to find out. In 1970 he finally tracked down the Colorado Springs Tesla Diary of 1899 in the Nikola Tesla Museum in Beograd, Yugoslavia. Mr. Golka built the present apparatus at the Wendover Air Force Base in Utah, the closest replica of Tesla's high-voltage machine since the original. Since then the machine has been modified many times, always in an attempt to get closer to the original to verify the little fireballs of confined, hot plasma reported by Tesla (see **Radio-Electronics,** June 1976 issue).

The past 10 years of work has lead to a $4-million plasma fusion device that has recently been presented to the Department of Energy for funding. Instead of making the fireball by a lightning discharge, the proposed device uses five high-power CO_2 lasers that are focused inside a 1-foot diameter spherical tank under high pressure. If this device is successful it may completely change present attempts to thermonuclear fusion, in that confining magnetic fields will no longer be necessary to confine a plasma in a donut-shaped device, such as the Tokamak. Instead, the plasma will be in the form of a sphere, held together by an electron-ion layer effect that is analogous in some respects to the surface tension in a water droplet.

In this case there are alternating concentric spherical layers of trapped particles of alternating signs, a phenomenon first envisaged by the late inventor of electronic TV, Philo Farnsworth, who called the layers "virtual anodes" and "virtual cathodes." It is believed by Golka that a 1971 experiment by Bekefi at MIT may have demonstrated the Farnsworth effect as arising spontaneously at the boundary of a hot plasma immersed within a cold gas.

TELEVISION

NEW DIMENSION IN TV SOUND

KARL SAVON
SEMICONDUCTOR EDITOR

Stereo television may not be here, but this stereo synthesis system from RCA is the next best thing.

STEREO TELEVISION SOUND IS NOT HERE yet. Several systems have been suggested by various organizations, but apparently there has not been sufficient public demand to justify the development and implementation of a practical system. Perhaps we are waiting for improvements in monaural sound quality before the possibility of stereo seems real. RCA's CTC 101 color television chassis introduces a stereo-synthesis system called dual-dimension sound. Although it is not true stereo, the system produces a "stereo" effect from the transmitted monaural sound signal.

One of the most basic stereo-synthesis systems that has been proposed in the past is the simple division of the audio spectrum into two distinct bands —high and low frequency bands defined by high and low pass filters respectively. That method is far from satisfactory because of the obvious demarcation between the two sound channels. The new RCA system disguises the synthesis by intermixing the spectral sound ranges so they are not nearly as distinguishable.

Figure 1 shows the system schematic. The key components are a dual-section filter and two operational amplifiers, plus the two speakers necessary to produce the effect. A double-pole double-throw switch is used to disable the system when desired.

The audio signal from the sound detector feeds a 12-element R-C filter. The configuration may seem familiar to you—in fact it's dual-section twin-T filter. The two cascaded filter sections have been designed to have nulled responses at two different frequencies, one around 160 Hz and the other about 5000 Hz. The filter output is coupled to the noninverting input of amplifier IC1-a. Negative feedback between the amplifier's output terminal and the inverting input establishes the closed-loop gain. The output of amplifier IC1-a is coupled through a 100-μF capacitor and the system mode selection switch to the channel A speaker.

Now that channel A has been set up with three peaked bands of energy due to the filter's two nulls, a complementary response must be generated for the second channel. The second operational amplifier section produces the required double-peaked response without using any additional filter components. Op-amp IC1-b is configured as a difference amplifier; the original unfiltered input signal is routed to its inverting input, while the output of the twin-T filter is fed to the amplifier's noninverting input. Subtracting the flat input spectrum from the triple-peaked filtered signal forms the double-peaked channel signal response shown in Fig. 2. A stereo balance control varies the level into the inverting input of the second amplifier and is used to optimize the stereo-synthesis effect.

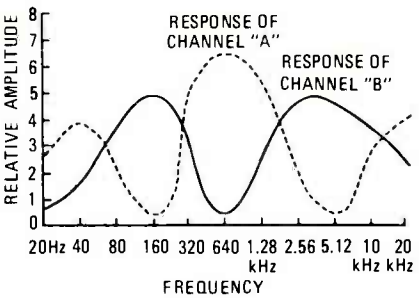


FIG. 2—FREQUENCY RESPONSE of synthesis sound circuit shows how the audio spectrum is split up to create a stereo effect.

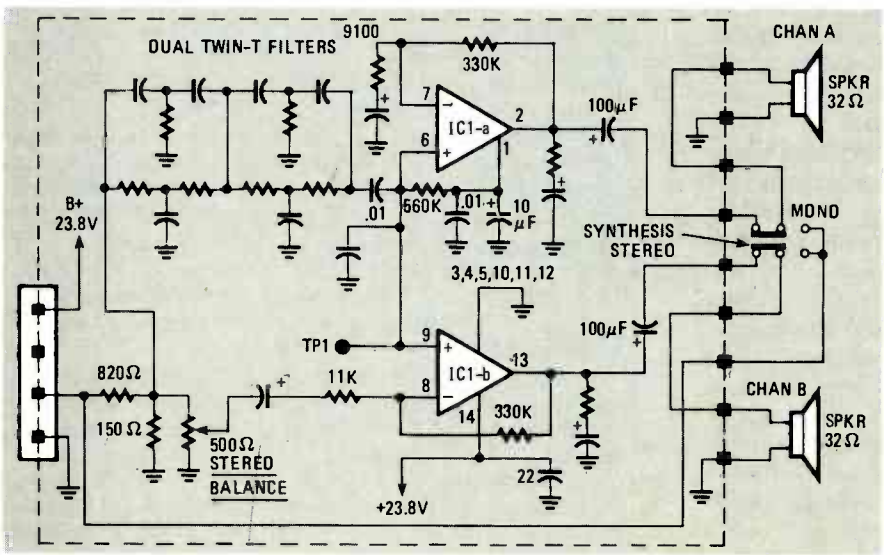


FIG. 1—SYNTHESIS SOUND CIRCUIT found in RCA's CTC-101 TV chassis produces a simulated stereo effect.

The output of the second amplifier section drives the channel-B speaker. The spectrum in both channels is now distributed throughout the frequency range to give a pseudo-balanced effect. When the stereo balance control is properly adjusted, the total energy distribution in the two channels is the same as the energy content in the original input signal.

Negative feedback is also used around the second amplifier so that its gain matches the channel-A gain. Since the same filtered signal is applied to the inputs of both amplifiers and since the feedback is similar for the two channels, the output-signal levels are the same for both channels. The stereo balance potentiometer makes up for any tolerance imbalances that could disturb the important relationship between the A and B channel energy distributions.

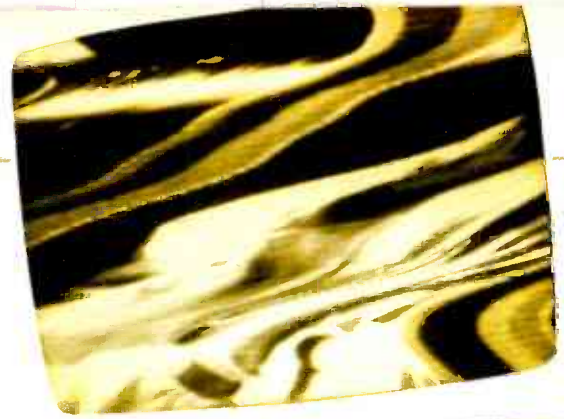
When the mode switch is in the MONO position the system is bypassed, feeding the audio-input signal directly to the two speakers. **R-E**

BUILD THIS

PAY-TV DECODER

Pay-TV puts cable-quality programming on the air. This is the inside story of the methods used by broadcasters to insure privacy.

D. LANDFEAR



ONE OF THE FASTEST GROWING TV MARkets today is the subscription-TV, or pay-TV, business. Most pay-TV broadcasters use one of the standard UHF or VHF channels but transmit an encoded, or scrambled, picture. In order to watch those scrambled signals, a subscriber needs to have a decoder attached to his set. Subscription TV is much like cable TV...without the cable.

New pay-TV stations are coming on the air every month; and with over a million subscribers already watching, the prospects for still more stations are indeed good. All of those stations offer approximately the same fare: During prime time they show full-length movies and special-event features, such as night-club acts and sporting events. A special bonus for their monthly subscription fees is that the subscribers are never subjected to commercials.

Pay TV isn't based on any new technology; indeed, the technique of scrambling TV pictures is almost as old as TV itself. In the past there have been at least a dozen different pay-TV schemes that have come and gone because of cost, complexity, or market conditions. However, current technology has played a part in the recent success of those systems: Decoders in use today are a complete receiver which merely attaches to the antenna terminals of the subscriber's set. Contrast that to earlier designs which require connections *inside* the set to the sync, video, audio, and other signals.

Presently, five different encoding schemes have been authorized by the FCC; at least three of them are in use now. All of those systems use essentially the same approach to encoding the signal. Either the audio channel is taken off the main channel and put on a subcarrier, or another audio channel is added somewhere in the composite signal, usually below the video carrier. The video is encoded by removing, suppressing, or masking the sync pulses; that disables the receiver's sync-separator circuit. A viewer who received such a scrambled signal on a normal receiver would see no coherent picture and would probably hear a "barker" or announcer telling him how much he was missing by not being a subscriber!

NOTE:

The legality of the use of privately-owned devices to decode subscription TV broadcasts is currently the subject of much debate and pending litigation. The subscription companies have taken the position that decoding of broadcasts without payment is "theft of service" and the FCC has issued a notice to the effect that subscription-TV decoders are subject to FCC approval.

This article merely explains how such decoding devices are built and used, and you should obtain independent advice as to the propriety of its use depending upon your individual circumstances.

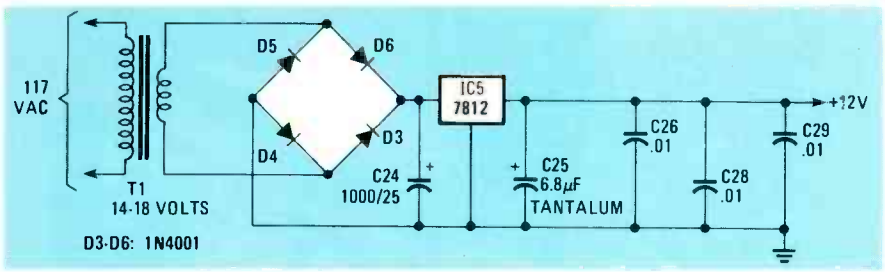


FIG. 4—THIS POWER SUPPLY (included on PC board) allows the decoder to operate from 117 VAC.

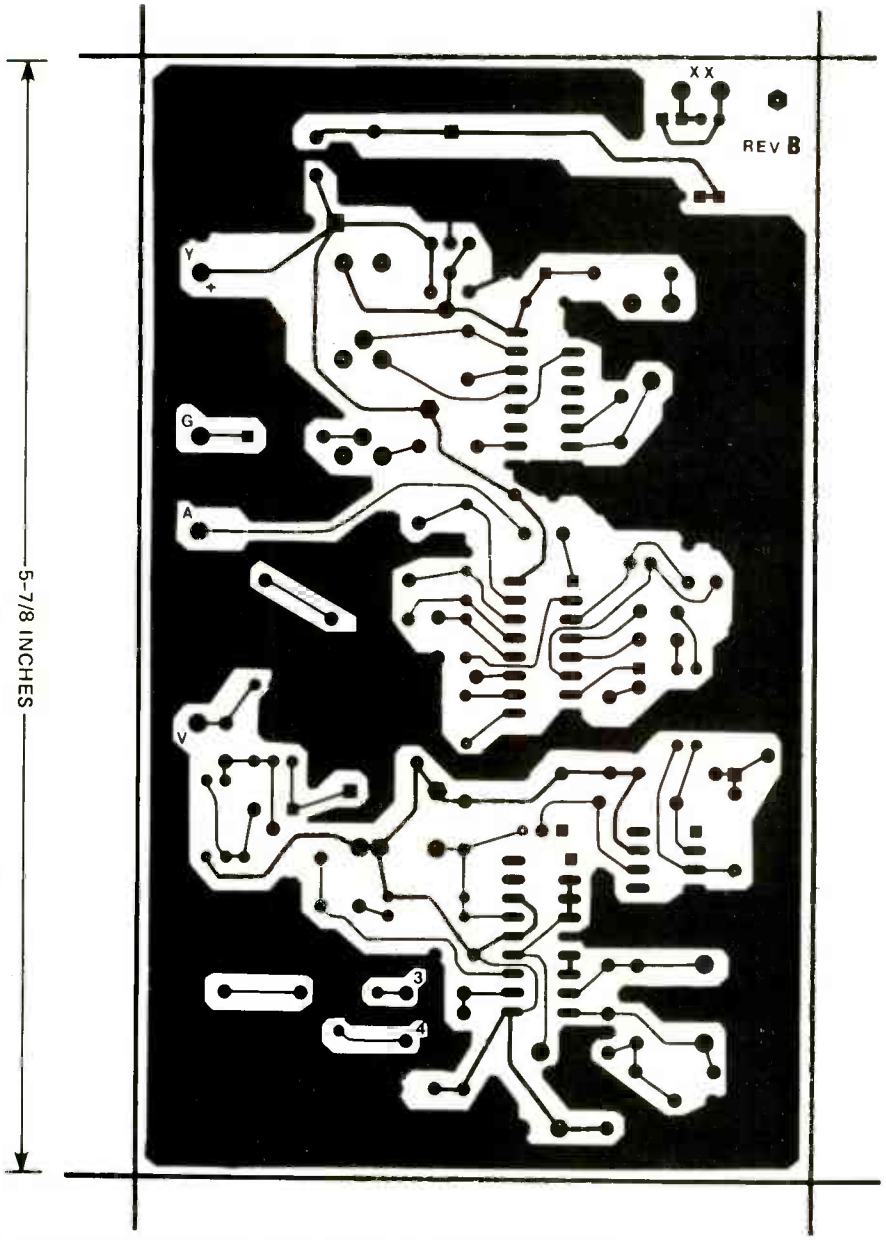


FIG. 5—HOLE MUST BE DRILLED at lower left of board for J1, if used.

(Q2) as a variable-capacitance diode from IC3 to the 4.5-MHz oscillator tank-circuit L2-C22. The output of that circuit is coupled through C18 and R20 to the video input of the modulator to produce the required sound-carrier 4.5 MHz above the video carrier at the output.

The RF output is developed across R22 and is attenuated by R29. The output is a 75-ohm unbalanced signal that can be connected directly to a 75-ohm antenna connector or, via a balun transformer, to 300-ohm antenna terminals.

The remaining circuitry on the board (see Fig. 4) consists of power supply and regulator circuits. Four diodes (D3-D6) make up a full-wave bridge to produce approximately 16 volts DC, which is filtered, and then regulated by IC5 to produce 12 volts. A second regulator, IC6, provides the regulated 5 volts required by IC2 (see Fig. 3).

Construction and alignment of the PC board is relatively straightforward

PARTS LIST

Resistors ½ watt, 5%
R1, R28—470 ohms
R2—10000 ohms, potentiometer
R3—22000 ohms
R4, R5—3900 ohms
R6, R7—100,000 ohms, potentiometer
R8, R21—1000 ohms, potentiometer
R9, R10, R26—15000 ohms
R11, R27—100,000 ohms
R12, R13, R20—10000 ohms
R14-R16—not used
R17—2200 ohms
R18, R19—not used
R22—75 ohms
R23—100 ohms
R24, R25—240 ohms
R29—1000 ohms

Capacitors
C1, C15—10 μF, electrolytic
C2, C8—1.0 μF electrolytic
C3—0.033 μF ceramic disc
C4—0.003 μF ceramic disc
C5—470 pF, mica
C6, C7—0.022 μF ceramic disc
C9—0.0047 μF polystyrene or mylar
C10—0.0047 μF polystyrene or mylar
C11—100 pF ceramic disc
C12-C14, C27—0.1 μF ceramic disc
C16, C17—not used
C18—22 pF ceramic disc
C19, C20—0.001 μF ceramic disc
C21—56 pF mica
C22—82 pF mica
C23, C26, C28-C30—0.01 μF ceramic disc
C24—1000 μF electrolytic
C25—6.8 μF tantalum electrolytic

Semiconductors
D1—1N914
D2—not used
D3-D6—1N4001
LED1—jumbo red LED
IC1—LM1800 PLL FM stereo demodulator
IC2—74123 dual retriggerable monostable multivibrator
IC3—LM741 op amp
IC4—LM1889 TV video modulator
IC5—7812 12-volt positive regulator
IC6—78L05 five-volt positive regulator
Q1—not used
Q2—MPSA05
L1—0.068 μH slug-tuned coil (2½ turns #18 wire on ½-inch form) (J.W. Miller 48A77MPC or equivalent)
L2—7-12 μH slug-tuned coil (J.W. Miller 23A105RPC or equivalent)
S1—SPST switch
S2—SPST or DPST switch
T1—14-18-volt, one-amp transformer (optional)

Miscellaneous: PC board, phono jack, vestigial sideband filter FL-1 (Plessey SW300 or equivalent—optional), solder, IC sockets, etc.

NOTE: The following are available from Micro-Mart, 552 Summit Avenue, Westfield, NJ 07090 (Tel. 201-654-6008) or Sterling Technology, POB 5929, Incline Village, NV 89450 (Tel. 800-538-9787 except CA. CA residents call 800-662-9238): Etched & drilled, solder-plated PC board with instruction manual, $20.00; PC board only, $15.00; kit of all parts with manual, $69.00. Visa and Mastercard accepted, please add tax where applicable. All prices postpaid within contiguous 48 states.

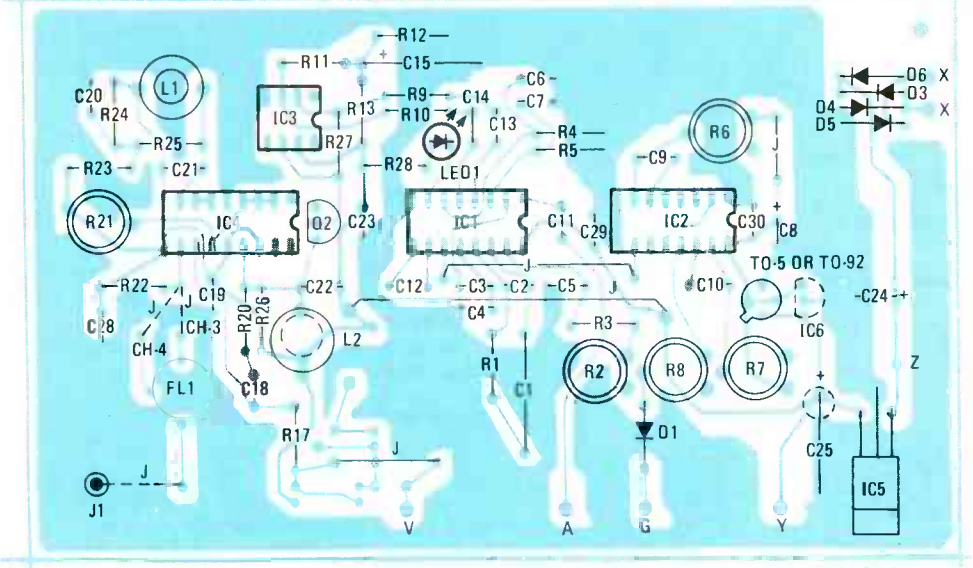


FIG. 6—PROVISION HAS BEEN MADE for use of different sized components (e.g., IC6, C22).

and only an oscilloscope is required for final adjustment.

A foil pattern for the PC board is given in Fig. 5 and parts placement is shown in Fig. 6. You should note that while that board is intended to unscramble the signal received by one TV set and generate a signal to be received by another, it can also be modified for single-receiver operation That will be described in the sections that follow.

Power

The adapter board requires 12-volts DC at approximately 100 mA to operate it. That power may be derived in several ways.

A rectifier, filter, and regulator are provided on the board. An AC source of 14 to 18 volts may be connected to terminals "x-x" (see Fig. 6), using a filament transformer.

Power can also be taken from the TV-receiver power supply, if the voltage available is 12 volts or greater. If the TV supply-voltage is in the range of 12 to 14 volts, IC5 may be removed from the board, and power connected directly to point "Y" (Fig. 6). If the supply voltage is 14 to 20 volts, C24 should be removed, and power connected directly to point "Z". If the voltage is greater than 20 volts, a resistor will be required between the set and point "Z". The resistance, R, is calculated as follows:

$$R = 10\,(E - 15)$$

where E is the supply voltage of the set.

The wattage rating, P, of the resistor is determined by the formula:

$$P = 0.01 \times R$$

Thus, if the set's supply voltage were 24 volts, R would be 10 (24 − 15), or 10 × 9, giving a value of 90 ohms and a wattage rating of 0.9 watt; A 91-ohm, one-watt resistor would be the closest standard value.

Audio detector output

The output from the TV receiver's audio detector is connected to terminal "A" of the adapter board, using a short length of shielded cable. The signal must be connected directly to the output of the detector ahead of any de-emphasis network (usually an R-C circuit) in order that the high-frequency subcarrier and pilot carrier not be greatly attenuated. That point is usually right at the cathode(s) or output terminal of the detector device. An oscilloscope should be used to determine the presence of the pilot carrier if any doubt exists as to the correct takeoff point. The pilot-carrier signal amplitude should be approximately 100 mV or greater, peak-to-peak. In some receivers, it may be necessary to decrease the value of any decoupling or bypass capacitors in the detector circuit.

Video IF gain stage

This connection, from point "G" on the PC board, is made directly to the emitter of one of the set's IF-gain stages—usually the second. In some instances, though, it may be necessary to key more than one stage. That may be accomplished by adding another diode with its anode connected to the anode of D1 and its cathode to the emitter of the first IF amplifier. If the adapter is being connected to a TV receiver on which it is desired to preserve the capability of receiving standard TV signals as well, a SPST switch, S1, should be inserted into that line to allow selection of standard or nonstandard video reception.

(You might, instead, want to use a DPST switch, with the second set of contacts being used to turn the adaptor on or off. That will eliminate possible interference from the RF modulator when you are watching "normal" TV—Editor.)

If none of the IF gain stages are accessible (e.g., everything's on one LSI IC) an alternate approach to the gain-gating may be made by constructing a fast-switchable attenuator using a PIN diode or similar device, and placing it between the tuner- and video-IF stages. The design of such a device, however, must be left to the builder inasmuch as the requirements of each TV receiver will be different. Generally, a gain increase of about 8 db is required.

Video detector output

This connection is necessary only

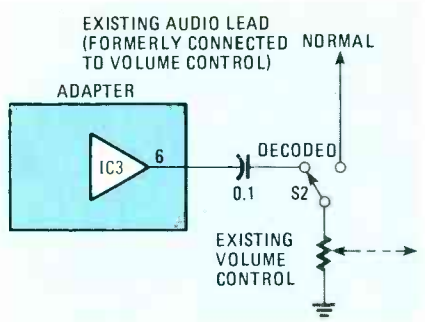


FIG. 7—SPDT SWITCH can be used to select "normal" or decoded audio signals.

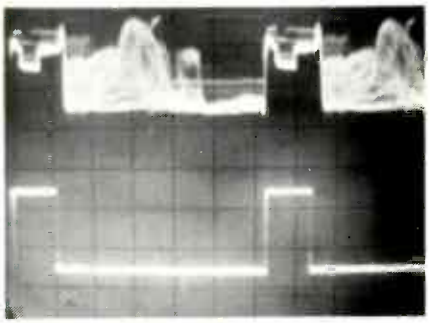


FIG. 8—UPPER TRACE shows scrambled signal; lower one shows gating pulse from decoder.

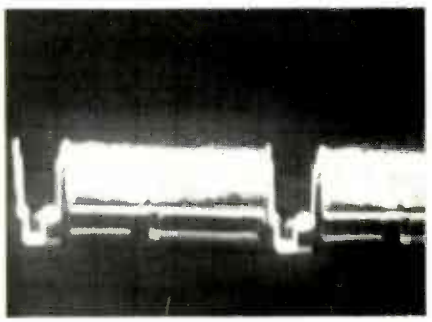


FIG. 9—A PROPERLY UNSCRAMBLED SIGNAL should look like this on your scope.

WARNING

Ideally, the TV set that the decoder will be connected to should have an isolated chassis. TV sets of this type use a power transformer to isolate the chassis from the 117-volt power line. Unless the TV set has an isolated chassis, a potential shock hazard can exist.

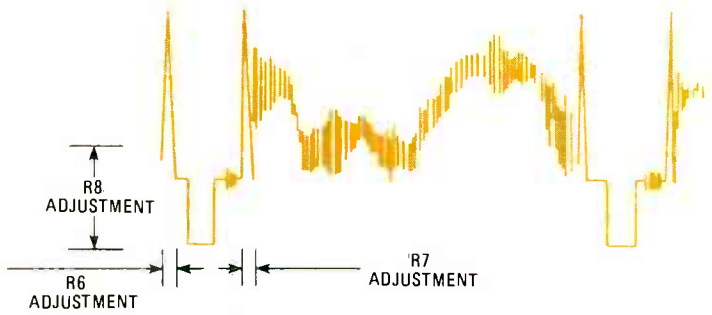


FIG. 10—IDEALIZED VERSION of signal in Fig. 9 shows critical decoder alignment points.

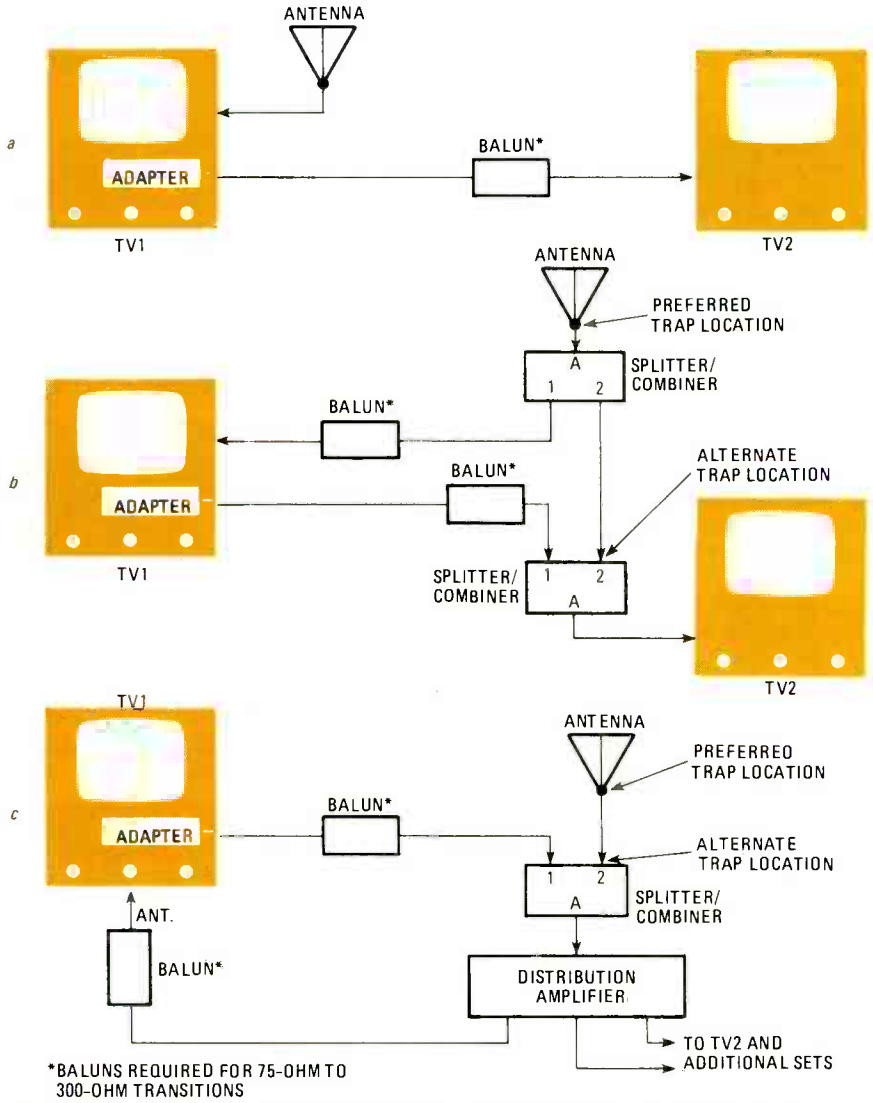


FIG. 11—SEVERAL METHODS for interconnecting a multi-set system. See text for details.

if the TV receiver to which the adapter is attached is *not* the TV receiver on which the program will be watched. Shielded cable should be used for the connection to point "V". The video signal is used to modulate the RF output. The signal should be taken directly from the video detector, or as close as possible following it. It is not recommended that it be taken from a video-amplifier stage because the color burst and chrominance signals may be trapped out before that point. The video modulator has a differential-input stage; the output signal will be the difference between the video-input signal at point "V" and the voltage on the reference input as determined by R21's setting to offset any DC component of the input signal.

Audio back to TV receiver

This connection is necessary only if the TV receiver to which the adapter is attached *is* the TV receiver on which the program will be watched. The semiconductor capacitor, Q2, is removed from the board and a piece of shielded cable connected to the output (pin 6) of IC3. The other end of that cable should be connected via a .1-μF capacitor to the top of the TV receiver's volume control after the existing lead is removed. Alternatively a SPDT switch can be used in the set to switch between the internal (normal) or external (adapter) source. See Fig. 7 for details.

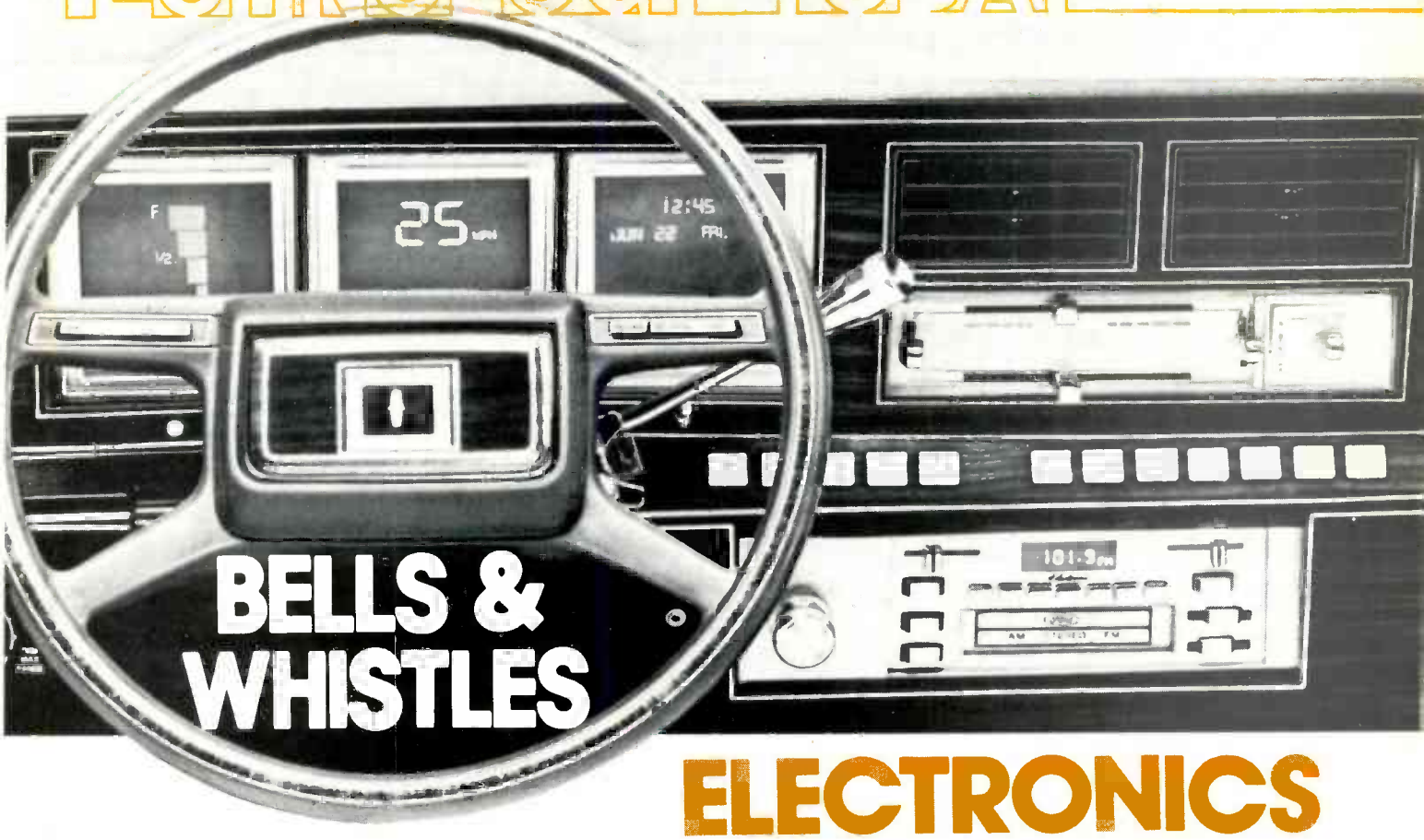
TABLE 1	
Channel 2	55.25 MHz
Channel 3	61.25 MHz
Channel 4	67.25 MHz
Channel 5	77.25 MHz
Channel 6	83.25 MHz

Alignment

After it has been attached to a TV receiver, the adapter can be aligned using an oscilloscope—preferably dual-trace—and another TV receiver. A frequency counter and TV field-strength meter, although not absolutely required, are also helpful in aligning the adapter. In order to eliminate any confusion in the following instructions, the terms TV1 and TV2 will be used. TV1 refers to the TV receiver on which the adapter is installed, and TV2 refers to the other receiver, on which the program will be viewed. Refer to Fig. 6 for the location of the components involved in the alignment procedure.

1. Before applying power, set all the potentiometers to the approximate center of their travel.
2. Apply power and tune TV1 to a channel known to be transmitting a scrambled signal. TV1 should be connected to a good antenna. Verify that TV1 is in fact tuned to the channel by monitoring point "V" for a video signal with the scope.
3. Very slowly adjust potentiometer R2 on the adapter board until the LED lights. Note the approximate position at which that happens and continue tuning until the LED goes off. Then turn the adjustment screw back approximately halfway between the points where the LED came on and where it went off.
4. Adjust R6, R7, and R8 to obtain the waveform shown in Figs. 8, 9 and 10. First adjust R6 and R7, then R8, to obtain the waveform shown in Fig. 10. Some slight readjustment of R6 and R7 may be necessary to eliminate spiking at the leading and trailing edges of the horizontal-blanking pulses.
5. Connect the VHF antenna terminal(s) of TV2 to the RF output of the adapter board (J1) and set the channel selector to an unused channel between 2 and 6. Adjust the fine-tuning control until only snow appears on the screen. (It may be necessary to disconnect the input to the antenna temporarily to do that.)
6. Adjust the slug of coil L1 for the

continued on page 112



BELLS & WHISTLES

PART 3

ELECTRONICS IN YOUR NEXT CAR

Electronics is appearing in just about every automotive application that you've ever imagined, and in some you may not have.

MARTIN BRADLEY WEINSTEIN

SO FAR, WE'VE LOOKED AT ELECTRONICS behind the dashboard and under the hood. Here we're going to take a look at some of the other places electronics is showing up. We're *not* going to cover entertainment systems—there are too many and the differences among them are too small. Instead, item by item, let's skim some cream from the top of the carmaker news.

Cadillac Memory Seat

It had to happen. First seats slid back and forth on a rail, then somebody put in a motor to do the work. Somewhere along the line, seats learned to tilt; again, somebody put in a motor to do the work.

Now Cadillac has turned the motors into servos with a *Memory Seat*. Cadillac power seats themselves involve a lot of hardware. The six-way power-seat adjustor moves them back and forth, up and down, and tilts them forward and backward. Once a driver chooses where he wants to float his designer jeans, he can store the seat setting by pressing a SET button, then either the 1 or 2 button.

The memory seat, according to Cadillac, "stores two personal seating positions, one for him, one for her... the two personalized settings remain in the unit's memory until you change it."

The seat position can be changed manually with the transmission in any gear, but the memory mode only works with the gear selector in park or neutral.

Your chauffeur may never know the comfort of a memory seat, since Cadillac does not make that option available on its limousines.

Perhaps one of our enterprising Cadillac-owning readers can come up with an add-on circuit to transform the memory seat circuitry into a highway vibra-massage.

Imperial visors

The 1981 Chrysler Imperial has added some electronics. Visor vanity mirrors are not new. Illuminated ones are more recent, but still not noteworthy. Finding illuminated visor vanity mirrors on both the driver and passenger sides can start raising an eyebrow or two—with two brightness levels no less. (One wonders about the occasional driver with flawed mascara not waiting for a traffic light.)

But the real cherry on top of that sundae is the garage-door opener switch they've built into the driver's side dual-intensity illuminated visor vanity mirror. (See Fig. 1.) Just don't hit any chuckholes—when your head bumps the visor you could open up a neighbor's garage door.

But things could be worse. Can you imagine a small flat video screen up there?

Bright lights from Germany

Now there are intelligent lights for cars, due to the work of West German

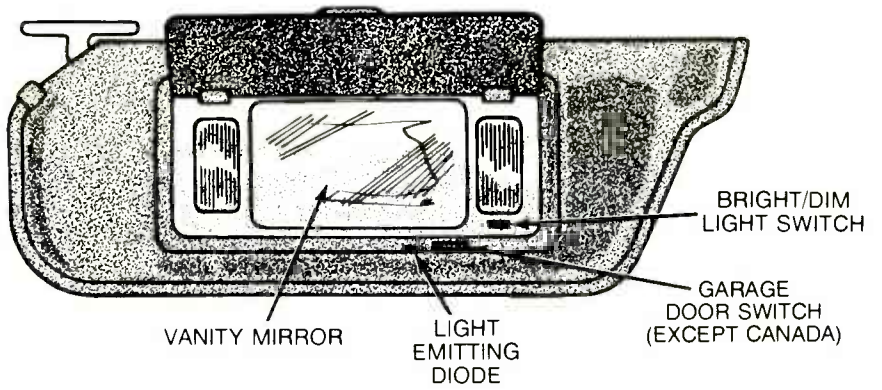


FIG. 1—GARAGE DOOR OPENER/visor mirror combination featured on the 1981 Imperial.

company Kabelwerke Reinshagen GmbH, an affiliate of NV Philips Gloeilampenfabrieken of the Netherlands. Their Automatic Check and Control System, which appears on development if not production vehicles, not only keeps an eye on parking, signal, and headlamp failure, it even acts as a self-resetting electronic fuse.

There's a microprocessor at the heart of the unit (of course) that handles all the housekeeping. A simplified schematic diagram is shown in Fig. 2. Control inputs to the microprocessor come from the various switches (headlight switch, brake lights, turn signals, flashers, etc.) on the dash. Control output from the microprocessor turns on a PNP transistor that provides +12 volts to the lamp. The sensing input to the microprocessor comes from the junction of the transistor and the lamp; there is also a 1-K resistor in parallel with the power transistor, another 1-K in parallel with the lamp.

If the lamp filament is open (the usual failure mode), the junction will be about 6 volts with the transistor off, 12 volts with the transistor on. A short across the lamp puts the junction at ground potential no matter what, and the microprocessor reacts by keeping the light off (switching within about 10 milliseconds—as fast as a good fuse) and alerting the driver. A good lamp, of course, puts 0 volts at the junction when it's off, 12 volts when it's on.

The 8-bit microprocessor can check up to 32 lamps or sensors within that 10-ms response time according to a sequence stored in memory. A two-digit dashboard indicator identifies which light or sensor presently is in need of attention.

The system keeps going through turn-on, turn-off and read sequences from the time the car ignition is turned on until about two minutes after it is turned off. Alternate states (in other words, turning a light on that should be off or off that should be on) are triggered for about a tenth of a millisecond each second of operation. By continuing to check after the car has been turned off, problems that occur while filaments are cooling are also detected.

There are other advantages to that approach, too. For one, since power transistors do the heavy-current switching, relatively inexpensive, light-duty switches can be used for controlling the lights through the microprocessor. Lockouts (for example, turning the low beam off when the high beams are on, or turning the headlights off when the ignition is off) can be accomplished in software. So can such niceties as opening and closing headlight doors, automatic dimming, and so on.

Interested readers can find a report on that system in the August 30, 1979 *Electronics*. One important statistic brought out in the article: when three million U.S. cars were checked in a survey, one in five had at least one defective light.

More inventive readers are invited to develop similar systems and present them to other **Radio-Electronics** readers as a construction project.

Diesel water watcher

One of the new engines available from General Motors is its 5.7 liter diesel. Those engines are designed to tolerate a certain level of water in their fuel tanks, and, in fact, are designed with a fuel tank water-separation system capable of holding substantial amounts of water. That water can be gradually passed through the fuel system in small quantities without harming the engine.

But if you buy fuel contaminated with more water than the fuel system can tolerate, the engine won't run and parts of the injector pump can be seriously damaged.

There are provisions for siphoning excess water out without removing the fuel tank, but you have to know the water's there.

So GM developed an electronic module to detect excess levels of water in diesel fuel. From an electronic point of view, the most interesting thing about it is that the probe in the gas tank is *capacitive*. A simplified schematic diagram is shown in Fig. 3.

To understand how it works, imagine two large conductive surfaces covered with an insulating coating, separated by an extremely small distance. An AC signal is passed through this capacitor, rectified, smoothed and used to drive (for the purpose of this example) a meter movement.

You probably know from basic theory that the amount of signal that gets through the capacitor is determined by its capacitive reactance (a simplified view, assuming the inductive reactance and resistive components of impedance are trivial at the signal frequency). Capacitance is determined by both the geometry of the capacitor and the dielectric constant of the material between its plates.

So, since water in diesel fuel changes its dielectric constant, a capacitive probe can be readily applied. There are a number of resulting benefits for the carmaker, including reliability, no

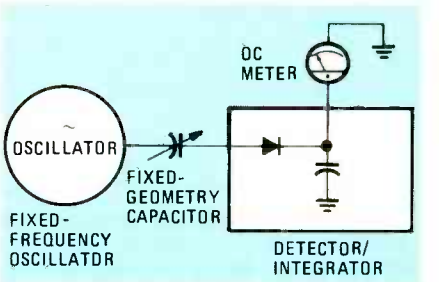


FIG. 3—DIESEL FUEL WATER monitor from GM uses a fixed geometry capacitive probe.

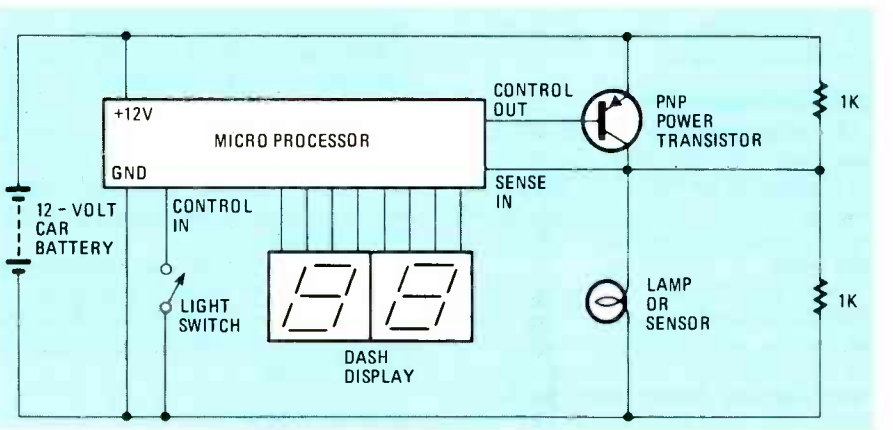


FIG. 2—A MICROPROCESSOR is at the heart of a unit that monitors all auto lamps.

moving parts to wear, easy calibration at the time of component manufacturing, and relatively simple electronics in the idiot-light-driver module.

The aftermarket

Aftermarket is a term used to describe add-on items people buy for their cars after the cars are theirs—everything from litter baskets to chrome engine parts to oil-change kits to little football heroes with heads that bob up and down in the back window.

One of the familiar companies with some small success in the automotive aftermarket is Sears, Roebuck and Company. Here's some of what they're offering.

Electronic speed controls or cruise controls are getting more sophisticated than ever. All involve some sort of servo system using speed information and controlling throttle position, but some additional uses have been added.

Those new units mount on dashboards or on the turn-signal lever. They're small boxes—at the control end—and now they feature illuminated legends. One recent model, shown in Fig. 4, incorporates the following controls:

ON/OFF. Engages or disengages the control. Any braking-action also disengages the control.

SET. Push that button when you've reached the speed you want to stay at. These new units take their speed information from the drive shaft, so you really are programming vehicle speed, not engine speed.

RESUME. Push that after you've braked and it will bring your car steadily back up to the last speed you set.

COAST. That is new—push it and the electronics keep their "feet off the gas" as long as you hold it in to allow gradual temporary slowing.

ACCEL. Another new one—here the electronics "push the pedal" a little harder as long as you hold it in, causing steady acceleration. Both COAST and ACCEL return you to your set speed when the button is released.

There are also units available that provide a speed alert. Set in the speed you don't want to exceed, and when you do, it buzzes. You can find circuits

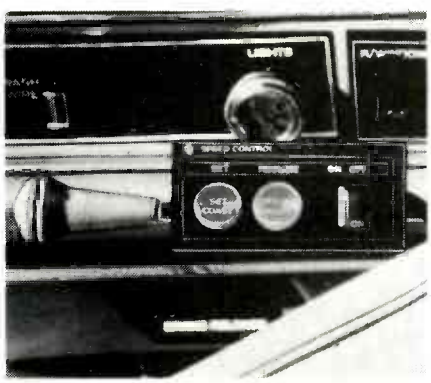


FIG. 4—CRUISE CONTROL from Sears mounts on the dash or on the turn signal stalk.

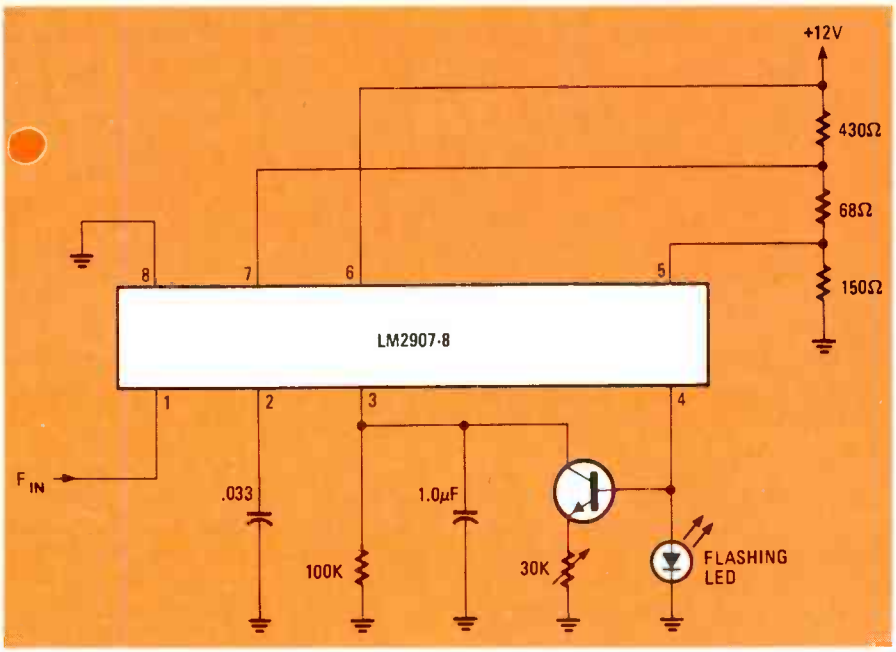


FIG. 5—SPEED ALERT circuits are easy to find. These devices can be put together for less than most cruise controls and are simple to install.

for that kind of device in the application literature for the National Semiconductor LM2907 and LM2917 tachometer IC's. (See Fig. 5.) Those gadgets are about a hundred dollars less than top-of-the-line aftermarket cruise controls, fifty dollars less than the cheapies, and easier to install. But they replace reliable electronics with unreliable you.

If you're buying a new car, by the way, strongly consider an electronic cruise control—they are one of the few legitimate devices that can really save you fuel—they drive with a steadier foot than even the best human drivers.

There are a number of add-on interval-delay wipers. And that is more significant than it seems.

It used to be fairly simple to induce a wipe-wait-wipe sequence, but that was before wipers learned to park themselves. In order to park, you see, the DC wiper motor has to be reversed by reversing connections, and an end-of-travel switch keeps it from grinding into a burnout or through to the firewall. That makes the wiper switch fairly complicated, and complications increase with additional wiper speeds and motor windings.

So, many of the newer units are designed to let the standard wiper control override them entirely, and work only with the wiper switch off. (See Fig. 6.)

Some units provide for both variable delay between wipes and a variable number of wipes between delays (for example, wipe twice—wait—wipe twice—wait—etc.).

Cadillac, by the way, has done something interesting on the plumbing side of the subject. They use what they call a fluidic reflow nozzle to set up a very

FIG. 6—WIPER CONTROL from Sears works only when the car's wiper switch is off.

rapidly oscillating stream of washer fluid. The frequency of oscillation is so high, the spray pattern looks like a solid fan of fluid.

Motors motors everywhere

There's hardly anything you've ever had to do to or with a car by hand that hasn't been motorized.

There are motorized side-view mirrors. Motorized jacks. Motorized windows and sun roofs. Motorized trunk lids. Motorized antennas. Motorized seats. Motorized (or solenoid) headlight covers. Motorized scanning searchlights. Motorized fans, blowers, and defoggers. Motorized oil-changing pumps. Motorized gas siphons. Motorized console covers. And more.

And things without motors sometimes use solenoids. Things like remote trunk releases. Electronic door locks. And more.

Yet electromechanical devices like motors and solenoids are among the least reliable items on cars. But carmakers and partsmakers are working together to improve the situation.

New magnetic materials are being used. New winding designs. New transistorized driver circuits—with the

ELECTRONIC CLIMATE CONTROL offered on the 1981 Cadillac provides heat and air conditioning automatically. It features a digital temperature readout.

potential for VMOS technology just around the automotive corner. And metal linkage is being replaced with plastics and synthetics for corrosion-proof, long-wearing mechanisms.

The result is a longer mean-time-between-failure statistic than ever. But one of the corollaries of Murphy's Law is that the more things there are, the better the chance that something will go wrong with one of them.

Even in 1981, power windows still jam. Headlights still shine behind closed covers. And automatic door locks still sometimes fail to unlock.

So the electromechanical automotive news is a story of progress, but no breakthroughs.

Tidbits

There are a few gadgets around cars—some new, some not—that tend to raise an eyebrow or the corner of a lip.

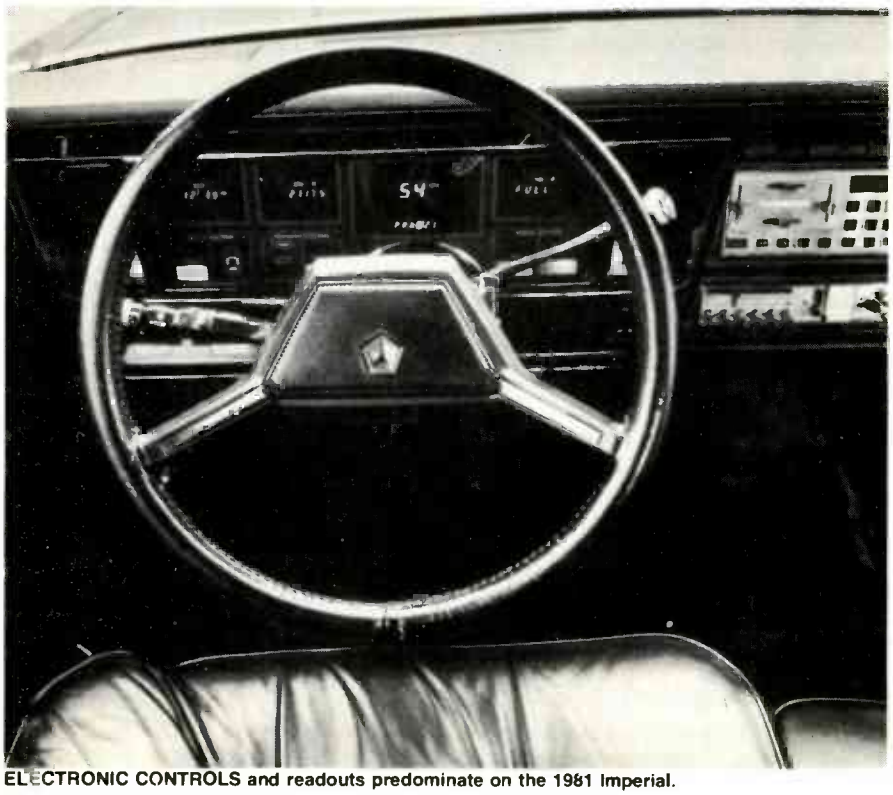
Some side-view mirrors feature built-in heaters that turn on with the car's defroster on cold winter mornings. Any number of heating elements have been used, from resistive wire to parking lamp bulbs to power resistors. The idea's a good one, and may show up more often in the models to come.

You've seen some new car models of the past few years with a second set of signal lamps atop the trunk lid, just below the back window. You may not know that a government-sponsored study showed those secondary signals to have a positive effect in reducing rear-end collisions. Apparently, they help reduce the oncoming driver's total reaction time.

Another government study has endorsed the use of demand-sensitive air-conditioner cutoffs as a proven fuel saver. Those devices disengage the air-conditioner compressor whenever a temporarily high load is put on an engine, such as accelerating to pass. Those devices have been on police cars for years (not to save fuel, but to maximize accelerating power), but have not always been available as an option to "civilian" buyers.

Electric cooling fans designed to work with fanbelt-driven fans having fewer blades (and thus less loading on the engine) or to replace fanbelt-driven fans altogether (or engine-driven fans where the fanbelt pulley is a take-off rather than a take-on power point) have been used successfully in foreign cars, and are expected to find their way into more American cars in the future. Because the electric fans can respond more quickly and accurately to engine cooling needs, they promise better overall efficiency. But remember, additional battery/alternator load shows up as additional engine loading because it makes the alternator harder for the engine to turn, in exactly the same way as dynamic motor braking works.

Police radar detectors are getting more sophisticated, both in terms of improved circuitry and human factors. The new trend is toward units mounted out of sight behind the grille with only a control and warning box on the dash, and toward better disguises. In the latter category, we've seen prototype or production models disguised as side-view mirrors, fog lights, tissue boxes, and even stuffed animals.



ELECTRONIC CONTROLS and readouts predominate on the 1981 Imperial.

The future

The word for the future is that fewer items will be available on the automotive aftermarket, since the business for products and companies in that field has been bad for several years now. Companies are trimming their lines down to solid sellers, doing less development, and fighting to stay in business.

Some companies have lost that fight. Tenna Corporation, for example, went bankrupt in September, 1980. They made radios, tape players, and other accessories. That company had been an industry leader for nearly thirty years, and its demise is a striking example of the ill health of the industry.

Similar problems face U.S. carmakers, but bells and whistles will help them sell against offshore competitors. Look for new ways to make driving easier and more relaxing and to give cars more sex appeal. **R-E**

BUILD THIS

UNICORN-1 ROBOT

JAMES A. GUPTON, JR.

Adding Remote Control

Part 7—The first of several parts on adding remote control to Unicorn-1. The first step is a relay board to drive the 12-volt system from a five-volt source. Also, there's a uniquely robotic arm.

WHILE THE COMMAND CONSOLE AND UMBILICAL cable are fine for getting the feel of controlling the robot, there comes a time when you're ready to break loose and operate the robot from a distance—by radio control, for example. In this section we'll begin the changeover—whether it's for radio or computer control—by constructing a relay board to operate the robot's 12-volt motors and solenoids from 5-volt (logic-level) signals.

We'll also describe another type of manipulator arm for the robot that does away with the elbow-bending action and substitutes for it an *extendable* arm.

Relay board

Both the radio-control decoder circuitry and the computer-interface generate logic-level signals—where the voltages are either close to zero for a logic "0", or close to five volts for a logic "1". Since the motors and solenoids in the robot are designed to operate from a 12-volt supply, we must devise some way of switching 12 volts from a 5-volt control signal. That is the purpose of the relay board.

The board is a standard 22/44 finger (44 fingers, with 22 on each side), 4 × 5-inch perforated IC prototyping board that fits into a mating edge-connector and is available from a number of sources. One side has a foil pad at each of the perforations and two sets of traces for power distribution, but the other is bare, except for the fingers at the card-edge.

Figures 57 and 58 show the same relay board from the foil side with an X-ray view of the relays that are mounted on the bare side of the board. All wiring, with a few exceptions that will be pointed out later, is done on the foil side of the board. Two diagrams will show exactly how the wires are connected.

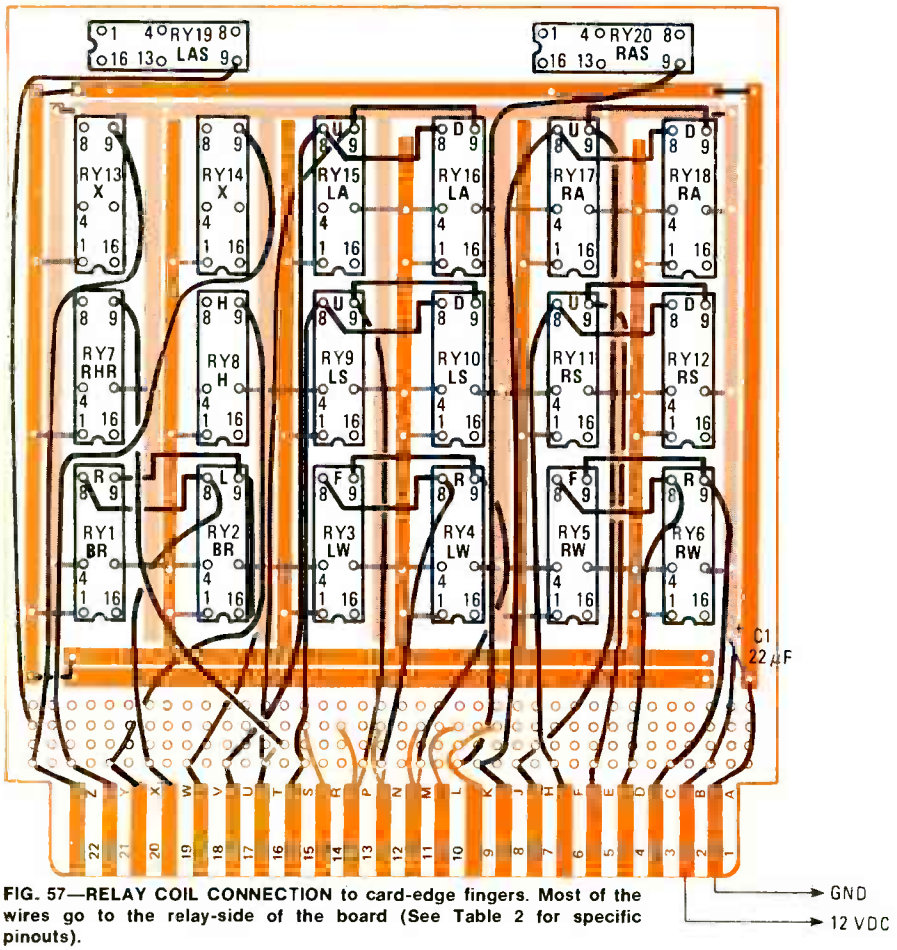


FIG. 57—RELAY COIL CONNECTION to card-edge fingers. Most of the wires go to the relay-side of the board (See Table 2 for specific pinouts).

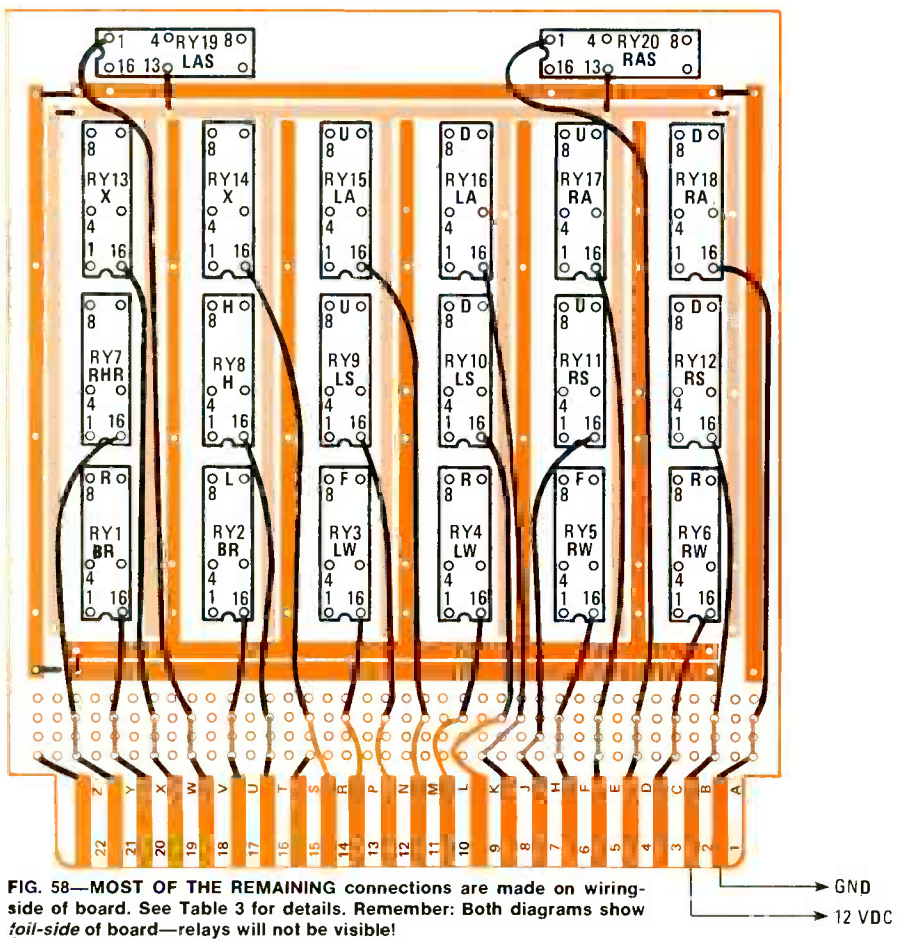


FIG. 58—MOST OF THE REMAINING connections are made on wiring-side of board. See Table 3 for details. Remember: Both diagrams show *foil-side* of board—relays will not be visible!

The DIP relays, capable of switching one amp, (see parts list) are mounted on the bare side of the board in 16-pin DIP sockets. Table 1 shows the function of each of those relays. The sockets can be secured to the board either by soldering their corner pins to the foil pads on the bottom of the board or by a bit of epoxy between the socket and the surface of the board. The first method is preferable. Sockets are used in case the relays have to be replaced.

All 20 relays are the same type, DPDT (see Fig. 59), even though, in some cases, only one section of a set of relay contacts may be used.

It is recommended that, whatever designations (if any) are given to the fingers on the prototyping board you use, you follow the ones given here, to reduce the possibility of confusion and miswiring.

Looking at the foil side and starting from the *right*, the fingers bear the letters "A" through "Z" (with four letters left out to give us 22). The fingers on the bare (relay) side of the board, but *still looking at the board from the foil side,* are numbered 1 through 22, from right to left. (Viewing the board from the bare side would show the numbers 1 through 22, but from *left to right.*) Finger "A" is opposite finger 1, finger "B" is opposite finger 2, etc.

Make sure you understand that system before you start wiring things up!

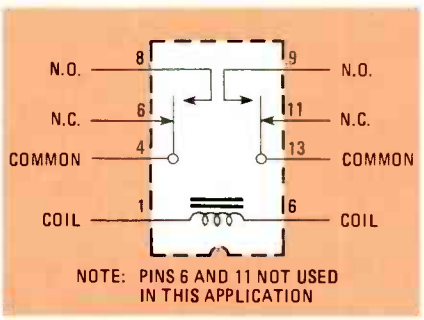


FIG. 59—PINOUT OF RELAYS used in this project by author. Relay contacts should be rated at one amp.

Wiring procedure

Refer frequently to Figs. 57 and 58, and to Figs. 60 and 61.

Begin by connecting pin 1—it feeds one end of the relay's coil—of each of the IC sockets to the ground rail of the board as shown in Fig. 58. The only exceptions to that are relays RY19 and RY20. In their case it is pin 16 that's connected to ground.

Use insulated wire throughout—there are going to be lots of wires, and the possibility of short circuits exists. You can use wire-wrap wire for connections to pins 1 and 16, but all the others will require at least 22-gauge wire to carry sufficient current for the motors and solenoids. Using a color-coding system will simplify signal tracing later.

Next, connect pin 16 (the other end of the coil) of each socket (pin 1 for RY19

TABLE 1
RELAY FUNCTIONS AND CALLOUTS

Relay No.	Function	Designation
RY1	Body rotate, right	BR (R)
RY2	Body rotate, left	BR (L)
RY3	Left wheel, forward	LW (F)
RY4	Left wheel, reverse	LW (R)
RY5	Right wheel, forward	RW (F)
RY6	Right wheel, reverse	RW (R)
RY7	Right hand rotate	RHR
RY8	Horn	H
RY9	Left shoulder, up	LS (U)
RY10	Left shoulder, down	LS (D)
RY11	Right shoulder, up	RS (U)
RY12	Right shoulder, down	RS (D)
RY13	Unassigned	X
RY14	Unassigned	X
RY15	Left arm, up	LA (U)
RY16	Left arm, down	LA (D)
RY17	Right arm, up	RA (U)
RY18	Right arm, down	RA (D)
RY19	Left arm solenoid	LAS
RY20	Right arm solenoid	RAS

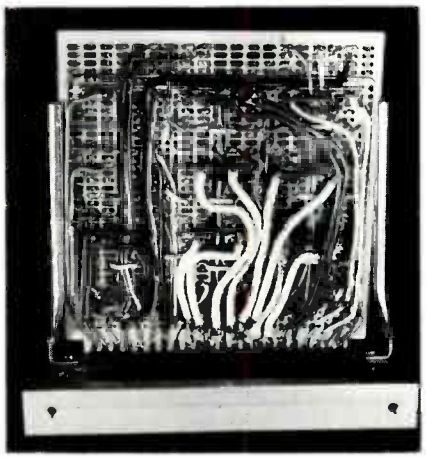


FIG. 60—BE VERY CAREFUL when wiring the relay board and check for shorts and solder bridges. Color coding wires helps.

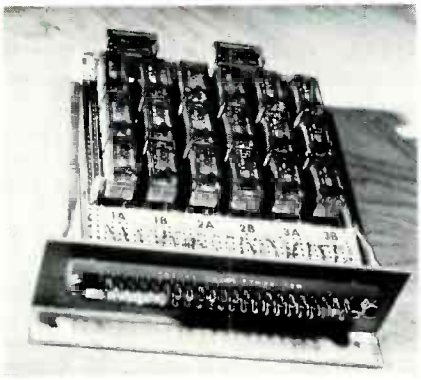


FIG. 61—RELAY BOARD plugs into 22/44 pin edge connector that will be wired to relay-driver board and to 12-volt systems.

and RY20) to the appropriate finger at the card-edge, as shown in Fig. 57 and Table 2. That is part of the exception mentioned earlier—15 of those wires are connected to the fingers on the bare side of the board by passing them through convenient holes. Fig. 61 gives an idea of what that will look like.

You should note that the wires may not run straight down, as is suggested in Fig. 57, but may zig or zag to one side or the other to mate with the pad that connects to the appropriate finger.

A 22 μF tantalum capacitor is mounted on the relay-side of the board and soldered to the 12-volt and ground-supply rails. Make sure that the "+" side of the capacitor goes to the 12-volt line.

The 12-volt rail is connected to finger "B", and the ground rail to finger "A", on the foil side of the board.

Figure 58 shows the connections for the normally-open relay contacts (pins 8 and 9), and those connections are also listed in Table 3. Before making connections to the card-edge fingers, wire the pin 8-to-pin 8, and pin 9-to-pin 9 jumpers shown for some of the relays.

Finally, still referring to Fig. 58, connect pins 4 and 13 to either 12-volts or ground, as indicated.

PARTS LIST—RELAY BOARD

Item	Quantity
22/44-finger, 4 x 5-inch prototyping board (Radio Shack 276-154 or equivalent)	1
DIP relay, 5-volt coil, 1-amp contacts (Radio Shack 275-215 or equivalent)	20
16-pin DIP socket	20
22 μF tantalum capacitor	1
Miscellaneous: wire, solder, etc.	

Finishing up

Inspect the entire board for solder bridges and shorts, and make certain that every wire goes where it's supposed to. The wires should be held close to the board. They can be secured with a drop of one of those very-fast-setting glues, with epoxy, or with silicone sealant.

The operation of the relays can be checked by applying 5 volts and ground to pins 1 and 16 of the sockets or, better still, to the appropriate fingers at the card-edge. You should be able to hear the contacts of the relays click quietly as they close.

The long arm of the . . . robot

A telescoping (or extendable, if you prefer) manipulator was designed to give the robot added versatility as well as an additional unique feature. It replaces the flexing action of the elbow joint (a human attribute) with the ability to "stretch" the arm—something which is definitely not a characteristic of people, or of most other animals.

Refer to Fig. 62 as the construction of this new arm is described.

First, the manipulator with the claw-type end effector (that can even be the one with the rotatable wrist) is removed from the robot at the shoulder, and the entire upper section—from the elbow hinge to the shoulder-attachment section—is disassembled. Only the two side rods, the elbow-hinge cross-bar rod, the ¼-20 threaded rod and limit switches are re-used. Hold onto the other parts, though—you may find a use for them later. (That's one of the prime rules of scrounging.)

The first step after that is to cut two ½-inch diameter aluminum rods six inches long, and to bore a ¼-inch hole through the entire length of each. Those holes must be true, so work very carefully and slowly.

Next, the two ¼-inch diameter side-rods that were removed from the original arm are cut to a length of six inches, as measured from the elbow-hinge end. (This end will be reattached to the shoulder motor later.) Each of those rods will then be mated to one of the ½-inch diameter rods by lapping the two until a smooth sliding action is achieved.

That lapping (which is the process of rubbing the two pieces together until all excess material has been worn away and they fit smoothly together—and, incidentally, is the way telescope mirrors are made and polished) is accomplished by applying a polishing compound to the inside of the bore hole in the aluminum rod and moving the ¼-inch steel rod in and out of the hole while rotating it slow-

TABLE 2
RELAY COIL WIRING

Relay	From pin no.	Tc finger no.
RY1	16	20
RY2	16	17
RY3	16	R
RY4	16	M
RY5	16	6
RY6	16	3
RY7	16	21
RY8	16	16
RY9	16	P
RY10	16	L
RY11	16	7
RY12	16	2
RY13	16	15
RY14	16	19
RY15	16	N
RY16	16	8
RY17	16	5
RY18	16	1
RY19	1	18
RY20	1	4
Ground trace	—	A
12-volt trace	—	B

TABLE 3
RELAY CONTACT WIRING

Relay	From pin no.	To finger no.
2	8	W
2	9	V
4	8	12
4	9	11
6	8	D
6	9	C
7	9	16
8	9	X
9	8	S
9	9	13
11	8	F
11	9	E
13	9	Z
14	9	Y
15	8	U
15	9	T
17	8	J
17	9	H
19	9	22

ly with an electric drill. (Ordinary automobile rubbing compound will work very nicely.)

A note of caution: The roughness left by boring the hole can, and probably will, grab the rotating steel rod and wrench the aluminum rod out of the clamp you are using to hold it. An indication that that is about to happen is an increase in the temperature of the aluminum rod that you can detect with your hand. Check for that frequently and, as soon as you notice it, either slow the speed of the drill or remove the steel rod and stop work until things cool down.

The job is finished when the steel rod slides smoothly within the aluminum one. **Stop at that point!** If you continue, the fit will become sloppy and the parts may jam when in motion.

Another note of caution: Each set of rods that is lapped must be kept together as a matched pair. A steel rod that has been lapped in one aluminum rod (now a tube) will not mate well with another!

The next step is to prepare two square posts (made from 3/4-inch square extruded aluminum material with 1/8-inch walls) to attach the new arm to the shoulder motor cross-bar rod.

The length of each post is 1 1/2 inches. One end of each post should be filed so that the walls, which were originally 1/8-inch thick, are reduced to a thickness of 1/16-inch. Fortunately, that only has to be done for the first quarter-inch of the post. Drill a 1/2-inch hole in the other, unfiled, end, so that its outer edge is 1/8-inch from the end of the post.

Four cross-pieces now have to be prepared. The first is the shoulder-hinge plate, shown at the upper-right of Fig. 62. It might be worthwhile to refer back to Parts 1 and 2 of this series (August and September 1980) to review the metalworking techniques presented there.

From a piece of 1/4-inch aluminum plate cut a piece 2 1/2 × 3/4-inches. (Those are the final dimensions—remember to allow for wastage.) Mark two 3/4-inch-square openings at the ends of the piece leaving 1/8-inch clearance from the edge (see Fig. 62).

You can cut out those openings by drilling a series of small holes along the inside of the lines you marked and then cutting or drilling through the "webs" between the holes to remove the center piece. Then, using a warding file, finish the opening, from time to time checking the size of the opening by fitting the *filed end* of the square post that will eventually go into that hole into it. The objective is a snug, push-in, fit with no play. Once the post is in the opening, it should not be able to be removed without some effort.

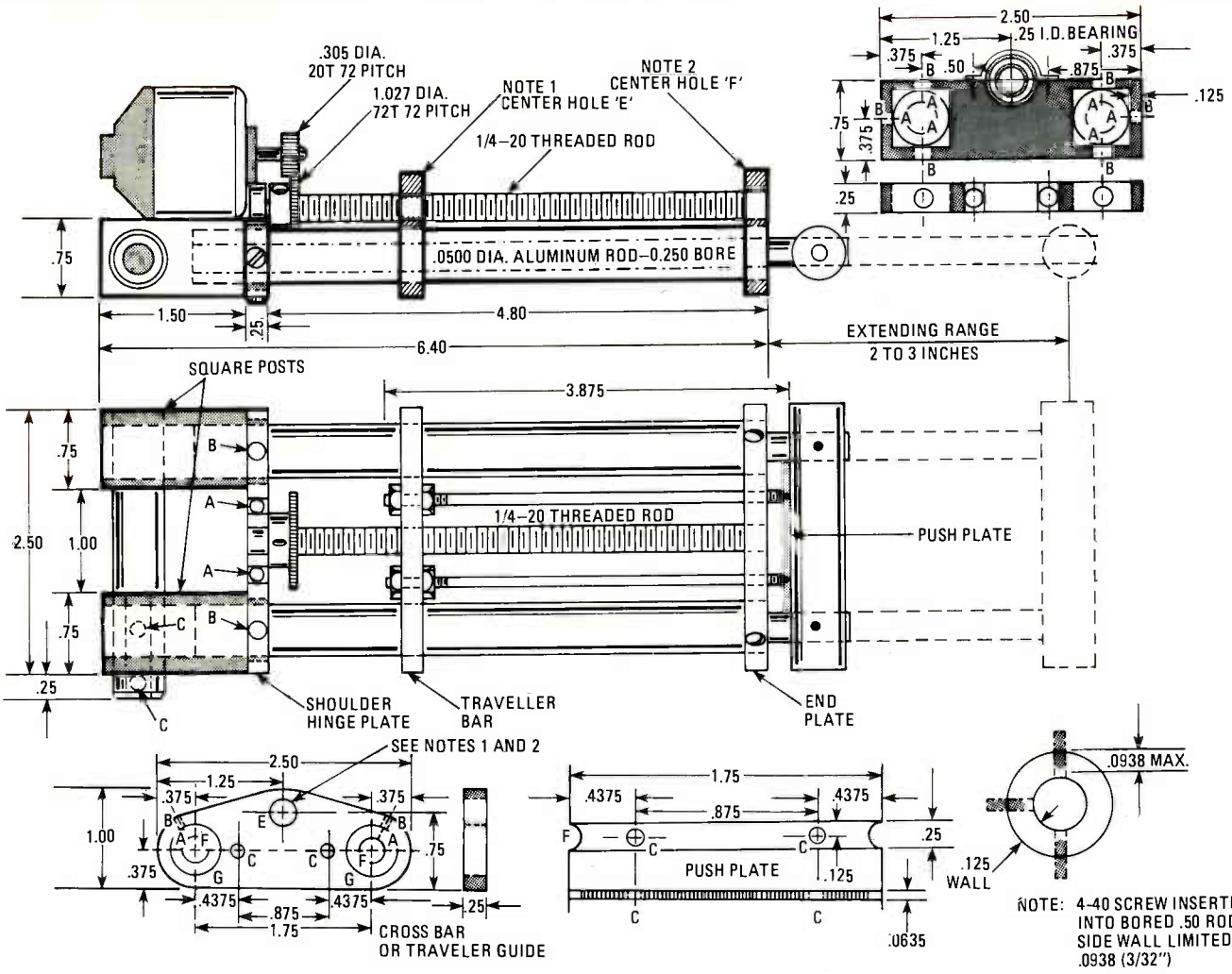
When both square holes are completed to your satisfaction, a recess must be made in the top of the piece to seat the bearing that will hold the end of the 1/4-20 threaded rod.

That bearing can be one of two kinds. It can either have an inside diameter of 1/4-inch that will accept the threaded rod as it is or, it can be smaller and the rod turned or filed down to fit it. The first approach will give more strength, and is recommended. After marking the position the bearing will occupy (the center of the bearing's opening even with the top of the bar, and the bearing in the middle of the bar), the semicircle can be cut using the drill-and-file technique described above or the metal can simply be filed away until the desired shape is obtained.

A 1/4-inch-wide strap of aluminum or

PARTS LIST—EXTENDER ARM

Item	Size	Quantity	Supplier's part no.	Supplier
Aluminum side rod	1/2-in. diam. × 6-inch	2	AB-6	(A)
1/4-inch aluminum plate	1 1/4 × 2 1/2-inches	2	APS-1	(A)
Aluminum or brass plate	1/16 × 1/4 × 2 1/4 inches	1		(K)
	3/4 × 2 1/2-inches	1	APS-75	(A)
Bearing	1/4-in. I.D.,	1	B2-10	(A), (B)
3/4-in. square aluminum post	1 1/2-long	2		(K)
Push rod	4 in. 1/8-in. diam., long, threaded 8-32 both ends	2		(K)
Gear	.305-in. diam., 20-T, 72 pitch	1	P72A-20	(A), (B)
	1-in. diam., 72-T, 72 pitch	1	P72A-72	(A), (B)



DRILL & TAP KEY			
A 43 DRILL–TAP 4-40	C 29 DRILL–TAP 8-32	E 7 DRILL–TAP ¼-20	G 0.500 DRILL OR
B 33 DRILL (BODY DIA. 4-40)	D 19 DRILL (BODY DIA. 8-32)	F 0.250 DRILL (BODY DIA. ¼-20; 0.2497)	DRILL 0.375, REAM TO 0.500

FIG. 62—USE THESE DIAGRAMS, together with instructions given in text, to build extender arm. Counterweight is not shown, but attaches to last cross-bar rod.

brass will be used to hold the bearing in place. With the bearing temporarily in position, bend the strap over it and mark a spot at each end of the strap for a mounting hole. Use a #33 drill bit to make these holes in the strap.

Then, mark *through* those holes to the edge of the plate, on either side of the semicircular cutout. Drill holes at those points using a #43 drill, and tap them to accept 4-40 screws. Do not mount the bearing yet—several more holes still have to be drilled in the plate.

Mark three drilling points in the edge of the aluminum plate for each square post so that the holes drilled will intersect each side of the square posts in the middle. Then insert the posts into the square holes, tapered-end first, and drill completely through the aluminum plate and the side walls of the posts using a #33 bit. You should wind up with six holes in all.

Now take a break and polish the two six-inch drilled-out aluminum rods to a high luster. That not only gives a good appearance, but also insures that the traveler bar (see below) will move freely.

Then insert one of the six-inch rods into the square opening of one of the posts (from the *unfiled* end) for a distance of ½-inch. Drill completely through the three holes previously drilled (through the plate and the square posts) into the aluminum rod with a #43 bit. Tap those holes for 4-40 screws. Do the same at the other square opening.

Attach the rods to the square posts using 4-40 machine screws *no longer than 9/32-inch*. The reason for limiting the length of those screws is to prevent their biting into the sliding steel rods and impeding their motion. Set the assembly aside for a while.

The next two cross-bar pieces, the end plate and the traveler bar, are both made from ¼-inch aluminum plate, 2½ × 1¼ inches, and filed to shape as shown in Fig. 62.

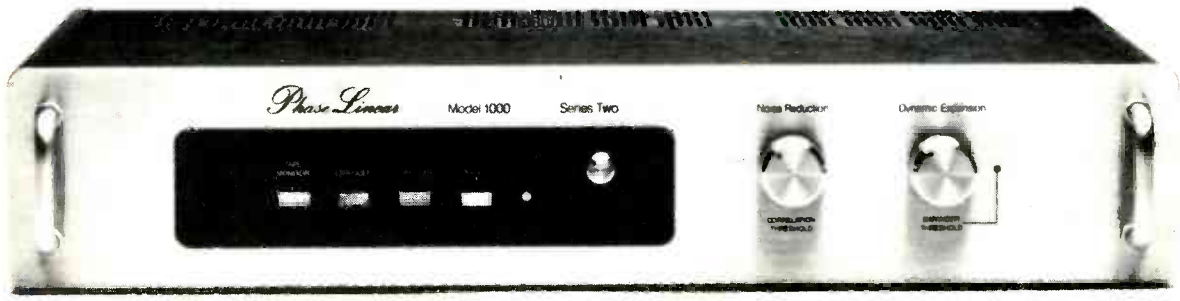
They are essentially the same, but have the following differences: The center hole in the end plate is simply made with a ¼-inch bit. The center hole in the traveler-bar, however, must be tapped to ¼-20 to accept the threaded steel rod. (Drill that one with a #7 bit before tapping.)

Another difference is that, while the ½-inch holes in the traveler-bar for the slide-rods must allow those rods to travel freely through them, their counterparts in the end-plate are cross-drilled, using a #43 bit, and tapped for 4-40 screws, to hold the plate in position on the rods.

Finally—and this holds true for both pieces—two holes are drilled in each, on the center line, and 7/16-inch from the center in each direction. Those holes are made with a #29 drill and are tapped to 8-32 to accept the two four-inch push rods, threaded on both ends.

The last piece to be fabricated is the push plate, which is made from 1/16-inch aluminum or brass plate, 2¼ × ¼-inches in size. Mark a center line along the long dimension of the flat side of the plate. Then, measure ⅞-inch in from both ends along this center line, and drill ¼-inch

continued on page 97



NOISE REDUCTION

They won't rescue a hopeless recording, but when used with an expander, dynamic noise

LAST MONTH, I DISCUSSED THE ORIGINS of noise and compression in audio signals and showed why expansion with a dynamic range expander could make the music sound more realistic. This month, I will show how dynamic noise filters also help, why they are complementary to expanders, and how commercial units are designed. The next two issues of **Radio-Electronics** will contain a construction article in two parts on a combination dynamic range expander and dynamic noise filter (with excellent performance) that you can build for yourself at great savings.

Noise

Noise can usually be removed from a signal very simply—just turn down the treble control. Unfortunately, that also removes part of the signal spectrum and makes the resulting sound appear "distant" or "muted," but the apparent signal-to-noise ratio is improved. That is because most musical energy occurs in the frequency range between 100 Hz and 1 kHz, and because most random noise occurs above 1 kHz. If the noise is "white" (equal noise levels in all equal bandwidths), there will be 19 times as much noise energy from 1 kHz to 20 kHz as there is below 1 kHz. Most noise sources in audio are not white, but they still appear most heavily in the treble range; notably tape hiss, FM noise, and record-surface noise. Small ticks and pops on records are also broadband, and thus mostly treble.

However, that noise is worst during low-level sections of the music. (If your signal is noisy during loud sections, it is beyond repair.) That phenomenon is called masking because the energy of the music "masks" the noise and prevents it from being audible. Thus, if we could turn our treble control down during low-level passages and back up during high-energy sections, the noise will appear to be significantly reduced without affecting the frequency response of the system during loud passages.

That still leaves us with the problem of treble attenuation on low-level signals, but it is not as much of a problem as it might seem. First of all, instruments played softly have dramatically lower levels of harmonics in the treble region and thus will not suffer significantly from the attenuation. Secondly, and very importantly, if the signal also passes through an expander, the reduced gain during the low-level section will make instruments less loud. Nonetheless, there are occasional signals with desirable treble in the presence of audible noise, in which case we find that we're in the dilemma of whether to filter out the noise and harm the signal, or allow the noise to be heard. A good noise filter will compromise here and act as inobtrusively and subtly as possible. Interestingly, if the source material is good, it is less likely that the problem will occur and the noise filter will perform better. Those devices will not repair a very poor recording, but they are incredible on superior discs!

Another reason that expanders and dynamic filters work well together is that for an equivalent amount of noise reduction, each needs to work only half as hard. Therefore, they can work more subtly, to the point where audible side effects are extremely rare. Also, if the total effectiveness is great enough, the listener can never "tune in" to the spectral "signature" of the noise that occurs during silent passages and thus cannot recognize the noise in low-level musical sections.

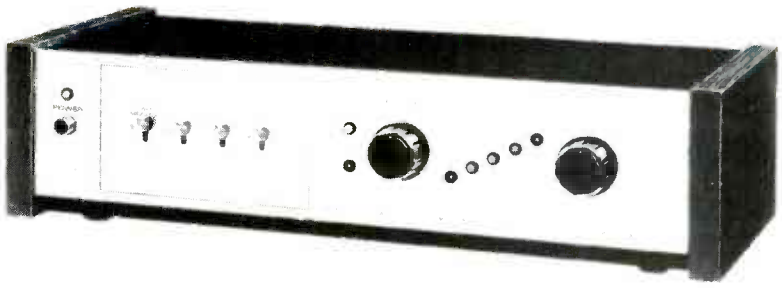
Given those principles then, a

THE *MODEL 1201A* from KLH uses a sliding cut-off filter with a fixed control.

THE *MODEL 3BX* from dbx is a three band expander that also serves as a noise reduction unit.

PHASE LINEAR *MODEL 1000* (left) uses multi-band notch filters. This technique is among the best known noise reduction systems.

HEATHKIT *MODEL AD1304* (right) eliminates compressor circuitry. Instead, FET's gradually turn on the notch filters.



TECHNIQUES

JOSEPH M. GORIN

filters can produce almost incredible results.

dynamically variable filter is not difficult to envision in block diagram form. A typical block diagram is shown in Fig. 1. Does that look familiar? It should; it is identical to the general block diagram for an expander shown last month, except that we now have a VCF (*V*oltage *C*ontrolled *F*ilter), rather than a VCA (*V*oltage *C*ontrolled *A*mplifier). In fact, the circuits are amazingly similar. A VCF can be built from a VCA just by using a VCA to vary the amount of feedback around a low-pass filter.

The commercially available filters can be divided into four types. There are multi-band filters (many filters/controllers), such as the expander type (dbx *3BX*) and notch-filter type (Carver, Phase Linear, Heath), and variable cut-off frequency units with fixed-control filters (KLH, Advanced Audio Systems) and "automatic gain control" filters (Logical Systems). The noise-filter project that will be featured in the next two issues of **Radio-Electronics** is a new type of filter with a great many advantages.

From dbx, Inc., comes a well made three-band expander that can serve as an expander and as a noise-reduction

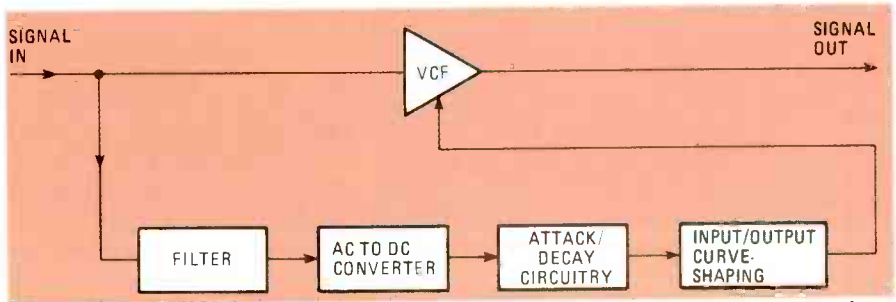


FIG. 1—TYPICAL BLOCK DIAGRAM of a dynamically variable filter. These devices can not perform miracles but they can be very effective on better recordings.

unit at the same time. The *model 3BX* has a suggested retail price of $700. It operates by dividing the signal into three bands, expanding them individually and then summing the result. Since only high-frequency signals can mask high-frequency noise, and only low-frequency signals can mask low-frequency noise, that technique should significantly reduce audible noise. A block diagram is shown in Fig. 2. Notice that the midband section is derived from subtraction, rather than filtering. Thus, if all the expanders have equal gain, the expansion will result in truly flat frequency response without any phase shifts. The attack and decay circuits are different in each expander, which optimizes the results for each band. (The highest frequency band is fastest, of course.)

An advantage of that system is that you get both expansion and noise reduction in one unit. A disadvantage is that, with signals well above the masking level for noise, the frequency response can be unnecessarily non-flat, due to the different action of the expander bands.

Sliding filters with fixed control

The sliding cut-off filter with fixed control is shown in Fig. 1; it has been implemented by KLH in the *model 1201A* and in Advanced Audio Systems *model NR-2*.

The KLH unit senses the musical energy in a broad range near 8 kHz

LOGICAL SYSTEMS *MODEL 318* uses automatic gain control to position the cut-off frequency of its 9 dB-per-octave slope filter.

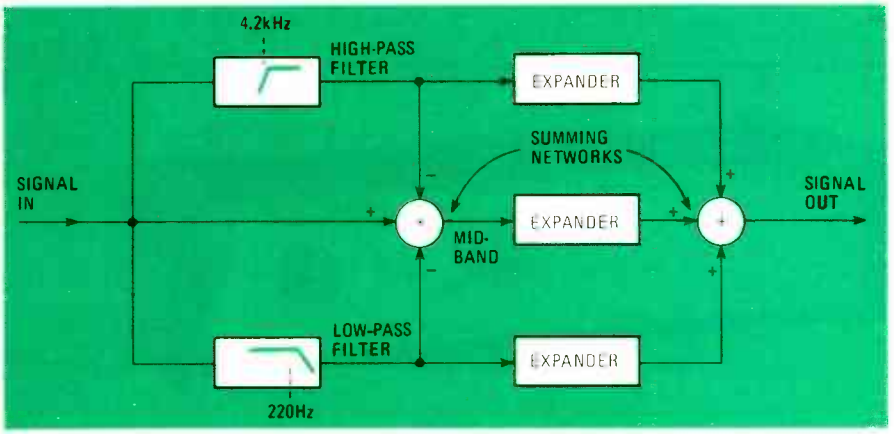


FIG. 2—A THREE BAND EXPANDER, such as the dbx *model 3BX*, divides the signal into three bands, expands them individually, and then sums the result.

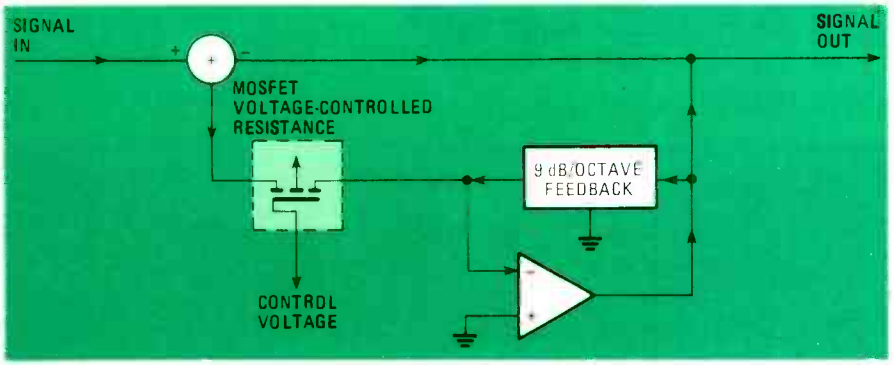


FIG. 3—AMOUNT OF FEEDBACK around the 9 dB-per-octave network is varied by the MOSFET in the KLH *model 1201A*.

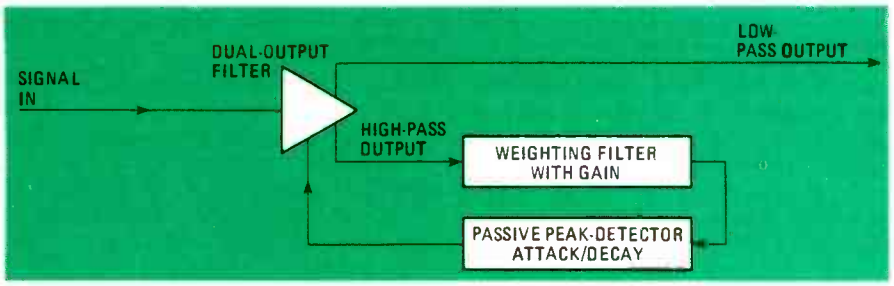


FIG. 4—THE AUTOMATIC GAIN CONTROL LOOP uses feedback to control the cut-off frequencies of both the high-pass and low-pass outputs in the Logical Systems *model 318*.

with its fixed control filter on the assumption that the energy near 8 kHz is representative of the total high-frequency musical energy. The AC/DC converter is of the precision peak-detector variety with very fast attack time and a complex decay-time characteristic, including a special circuit to keep from allowing a record "tick" from opening up the filter for an audible length of time.

The filter shape is an interesting feature of the *model 1201A*. The easiest filter to implement is a 6 dB-per-octave roll-off; that filter sounds very natural because there is no ringing in its step response. But a steeper filter, 12 dB-per-octave, is more effective in removing noise. In a study (see "A Program-Controlled Noise Filter", Journal of the Audio Engineering Society, Jan/Feb 1974, V. 22, No. 1, P. 4), listeners identified an 8 dB-per-octave roll-off as being the optimum. The *model 1201A* uses a 9 dB-per-octave roll-off that controls response with only one element as shown in Fig. 3. (Note that a 12 dB-per-octave roll-off requires two tracking variable devices.)

The MOSFET varies the amount of feedback around the 9 dB-per-octave network. If the MOSFET is of a high resistance, there is very little feedback above 500 Hz, and the filter rolls off there. If the MOSFET is of a lower resistance, the bandwidth can be extended to 25 kHz. The MOSTFET's in the unit are RCA's CA3600 array, chosen because their monolithic construction allows close tracking between the two channels and the bandwidth "calculated" by the control circuits. The bandwidth varies from 500 Hz to more than 20 kHz.

The *NR-2* filter is similar; that device was the subject of an article in August and September, 1979 issues of **Radio-Electronics**. The major difference is in the attack/decay circuits and filter shape. The filter slope is 6 dB-per-octave. The knowledgeable reader can change the shape of 9 dB-per-octave by the addition of an adaptation of the "pinking filter" shown in the August, 1980 issue of **Radio-Electronics** on Page 47. As designed, the bandwidth varies from 800 Hz to 30 kHz.

Sliding filter with automatic gain control

Logical Systems *model 318* kit ($130) also uses the sliding cut-off filter technique with a 9 dB-per-octave slope. Rather than use a fixed-frequency for control, however, it uses an automatic gain control to position the filter cut-off frequency, as shown in Fig. 4.

The AGC loop uses feedback to control the cut-off frequency of both the high-pass (control) output and low-pass (main) output. The passive peak detector is called a "log persistence correlator". In fact, it requires a quite high 5 mV of high-frequency signal at the input to begin to act as a rectifier at all. At high bandwidths it acts like a precision rectifier, and at middle bandwidths it acts as a non-linear rectifier (as though it had an offset equivalent to about 10 mV of high-frequency signal).

ADVANCED AUDIO SYSTEMS *MODEL NR-2* features sliding cut-off filter technology and a filter slope of 6 dB.

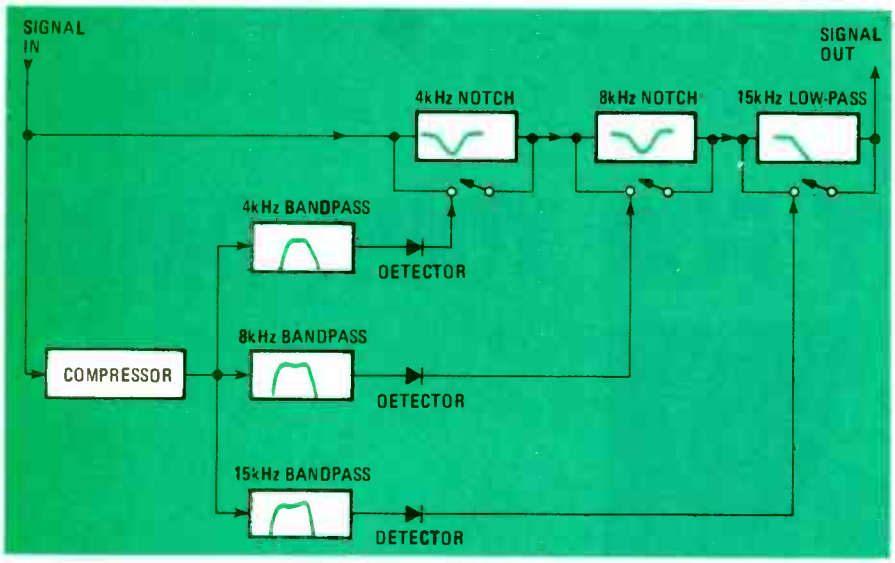


FIG. 5—THE THREE TO FIVE bands of attenuation in multiband notch filters are controlled by the energy in those bands.

THE *MODEL C-4000* preamp from Carver uses only a moderate amount of noise reduction (8 dB) to minimize audible side effects.

The combination of sliding cut-off, AGC and passive peak detection makes that circuit very similar to a *Dolby-B* playback unit in its operation. Like the *Dolby-B*, it has a relatively steep curve of bandwidth vs. input level. The *Dolby-B* is optimized for double-ended noise reduction, i.e. the decoding of encoded material. The *model 318* varies the bandwidth from 1.5 kHz to 20 kHz.

Multiband notch filters

Perhaps the best known of all techniques of noise reduction is the multiband notch-filter technique used in the Phase Linear *1000*, Carver *C-4000* and Heath *AD-1304*. Rather than have a sliding cut-off filter with the problems of estimating the appropriate cut-off frequency, those units have three to five bands of attenuation that are controlled by the energy in those bands. Well under 1 mV of signal is required to open the bands. The block diagram for that is shown in Fig. 5.

If there is enough energy in the 4 kHz band of that circuit, the notch filter is bypassed to allow that energy through normally. If there is not enough energy, the notch is activated, and the noise in that band is attenuated by about 10 dB. Since the notch can only be removed by signals that are close to its center frequency, the problem of masking is greatly reduced.

The three implementations are all similar. All three include fixed expanders (see last month's article for descriptions) and allow only a moderate amount of noise reduction (8 dB in the Carver *C-4000* preamp and 10 dB in the Phase Linear and Heath units) to minimize audible side effects. The Carver and Phase Linear units use diodes to short around the notch filters and compress the signal with an automatic gain control element before the bandpass filters so that there would be some "gray area" between fully open and fully closed to reduce audible instantaneous bandwidth modulation. Heath uses FET's to gradually turn on the notch filters, and thus doesn't need the compressor circuit.

Heath's *AD1304* uses three notch filters at 5 kHz, 9 kHz and 13 kHz. Phase Linear uses notch filters at 4 kHz and 7 kHz and a low-pass filter at 15 kHz. Carver uses notch filters at 2.8 kHz, 4.7 kHz, 7.8 kHz and 14 kHz and a low-pass filter at 17 kHz. The use of even more, narrow filters improves still father the accuracy of the decisions to open the notches. The Carver and Phase Linear units also include high-pass filters at 200 Hz to reduce hum and rumble.

Different kinds of signals have different abilities to mask noise. Cymbal crashes and "s" sounds are very noise-like and mask noise very effectively. Simple tonal signals like sinewaves are very poor at masking noise. To use that fact, a "correlation coefficient" can be estimated, and the threshold of all the filters can be varied accordingly to make a very accurate and sophisticated noise reduction system.

Dynamic noise filters like those described can be effective at dealing with record surface noise and tape hiss.

In the next two issues, we will discuss a design using a sliding cut-off filter, which is controlled very accurately through the use of a feedback control technique. It has a variable amount of maximum noise reduction, allowing the listener to set it to be as subtle or effective as desired. **R-E**

MANUFACTURERS

Advanced Audio Systems
Model NR-2
4040 Moorpark Ave., Suite 200
San Jose, CA 95117
Circle 92 on Free Information Card

Carver*
Model C-4000 Preamplifier
P.O. Box 664
Woodinville, WA 98072
Circle 93 on Free Information Card

dbx, Inc.
Model 3BX
71 Chapel St.
Newton, MA 02195
Circle 94 on Free Information Card

Heath*
Model AD-1304
Benton Harbor, MI 49022
Circle 95 on Free Information Card

KLH Research and Development Corp.
Model DNF1201A
145 University Avenue
Westwood, MA 02090
Circle 96 on Free Information Card

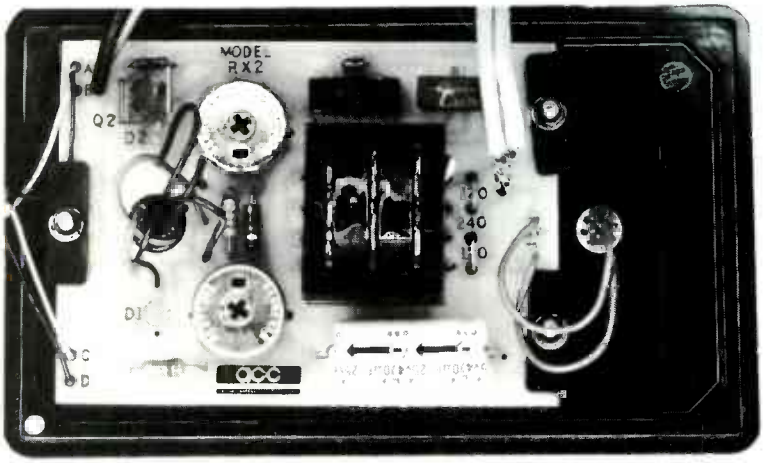
Logical Systems
Model 318
3314 "H" Street
Vancouver, WA 98663
Circle 97 on Free Information Card

Phase Linear*
Model 1000 Series II
20121 48th Avenue West
Lynwood, WA 98036
Circle 98 on Free Information Card

SSS**
Model ASRU
912R Knobcone Place
Loveland, CO 80537
Circle 99 on Free Information Card

* This unit was described last month also because it includes an expander.
**This unit is the subject of the next two months' articles.

ADD-ON ACCESSORY FOR YOUR DMM



J. T. CATALDO

ACCURATE RESISTANCE MEASUREMENTS of less than one ohm have been a problem for experimenters, servicemen, and production testers who do not have the use of expensive, elaborate equipment. Analog ohmmeters will indicate resistance down to one ohm with reasonable accuracy, but below that value, accuracy is difficult to come by.

With proper measurement procedures, digital ohmmeters will indicate resistance as low as 0.1 ohm. That involves measuring the resistance of the test leads after the unknown resistance has been measured. Subtracting the second reading from the first gives the true value of the unknown resistance. The Lohmeter described in this article is an accessory to your present analog or digital multimeter that makes it possible to measure resistances as low as 0.001 ohm without having to do any subtraction. Readings are linear, thereby eliminating the difficulty of reading exponential scales.

In the laboratory, accurate resistance measurements can be made with a Wheatstone bridge or by the use of the "four-terminal" method. In the latter case, a known current is passed through the unknown resistance and the voltage drop developed across it is measured with a voltmeter (see Fig. 1). A practical example of that is the shunt used with ammeters to measure high currents. In the case of measuring resistance, the shunt is the unknown (a very low) resistance and the meter measures the voltage drop. Both the Wheatstone bridge and the four-terminal method produce accurate results.

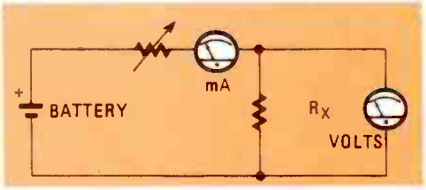


FIG. 1—THE VALUE OF R_X can be determined by passing a known current through it and measuring the voltage drop.

How it works

The Lohmeter is based on the four-terminal method. It contains its own regulated constant-current source. The current will not vary even if the input line-voltage drops as low as 95 volts. One set of leads is provided with clips for connection to the unknown resistance; another set of leads, with banana plugs, is provided for insertion into your meter.

Figure 2 is a block diagram of the circuit. The leads to the unknown resistance are actually 2-conductor cables. One lead in each cable carries the constant current while the other lead (in each cable) returns to the Lohmeter and exits again as the banana-plug leads that connect to your meter to measure voltage.

Two ranges are provided to measure resistances from 0.01 ohm to 100 ohms, with LED's to indicate the range in use. The range is selected via a front-panel range switch. The ×10 range is for resistances of 0.01 to 10 ohms. On the ×100 range, you can measure from 0.1 to 100 ohms. (Resistances smaller than 0.01 ohm may be measured if your meter has a 100 mV scale.)

The complete schematic diagram is shown in Fig. 3. The LM723D (IC1) is a voltage regulator connected as a constant-current source. The LED's (LED1 and LED2) are turned on by RANGE switch S2. Potentiometers R2 and R4 are used to adjust the constant-current source to 100 and 10 mA, respectively. A high-quality potentiometer was selected because of the need to maintain accurate calibration. Pass transistor Q1 is used to limit the current through IC1. Since the transformer used has dual primary and secondary windings, the Lohmeter can be used with 117- or 230-volt lines by

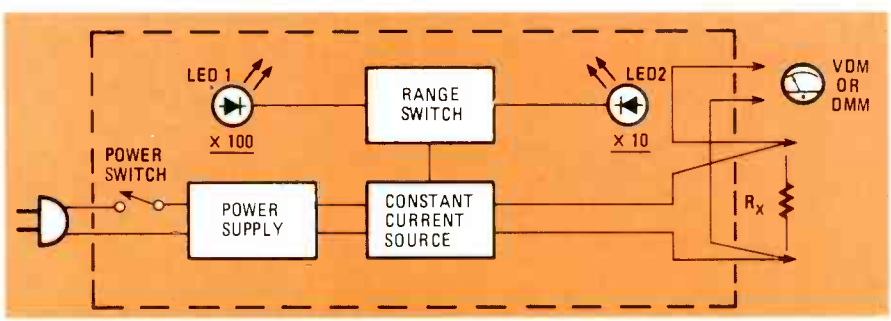


FIG. 2—BLOCK DIAGRAM of the Lohmeter. The current from the constant current source will not vary even if the line-voltage drops to 95 volts.

MEASURES ULTRA-LOW RESISTANCE

Measure resistances as small as 0.001 ohm. You can do it with this easy-to-build Lohmeter and your DMM.

PARTS LIST

All resistors ½ watt, 10% unless otherwise specified
R1—560 ohms
R2, R4—250 ohms, 2 watts, trimmer potentiometer (CTS style 115 or equivalent)
R3—120 ohms
R5, R6—1000 ohms
Capacitors, 20% or better
C1—470 μF, 15 volt electrolytic
C2—.001 μF, 15 volt, ceramic disc
Semiconductors
IC1—LM723D
Q1—2N5496
BR1—50 volt, 1 amp bridge rectifier
LED1, LED2—jumbo red LED
T1—24 volt, 100 mA, center-tapped, PC-mount, dual-primary (Signal DST 3-24 or equivalent)
S1—SPST toggle switch
S2—DPDT toggle switch
Miscellaneous: PC board or perforated construction board, case and front panel, line cord, two-conductor cable, hardware, etc.

The following are available from Alpha Components Corp., P.O. Box 306, El Segundo, CA 90245:
No. RC-2PC—PC board only, etched, drilled and tinned, $6.95 postpaid in USA.
No. RX-2K—Complete kit, including cabinet, front panel, wire, quick disconnects, etc., $39.50 plus $2.50 shipping & handling.
No. RX-2—Factory wired, tested and calibrated unit, $49.50 plus $2.50 shipping & handling.
California residents please add applicable sales tax. Sorry, no credit cards.

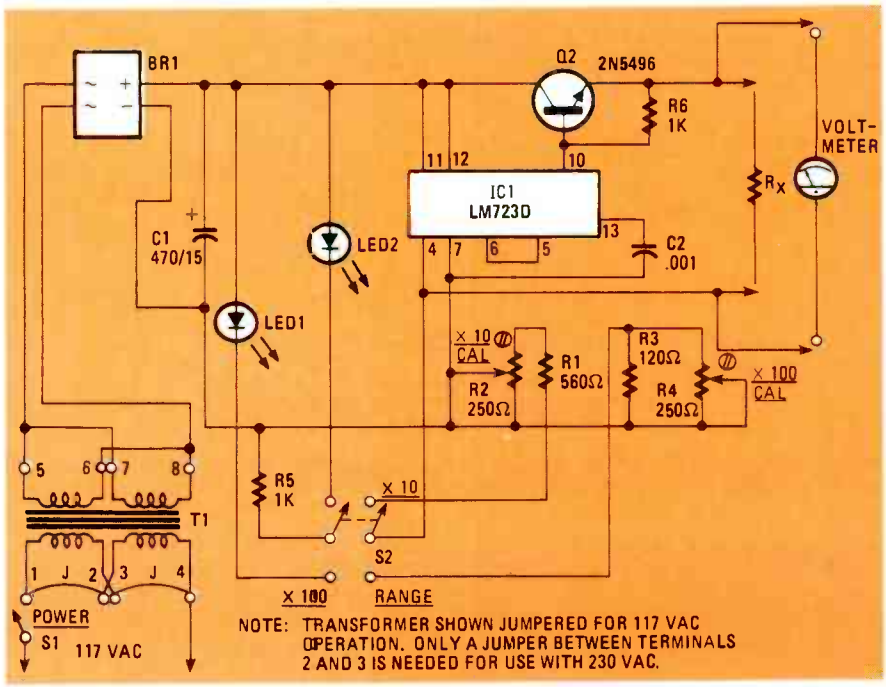


FIG. 3—A SCHEMATIC DIAGRAM of the Lohmeter. The test leads to R_x are two-conductor cables. The two resistance ranges are switch selectable and the LED's indicate which range is in use.

changing the jumpers on the primary windings.

Construction

Although a printed-circuit board makes it easier to assemble, other assembly methods such as a perforated board with solder-type terminals or point-to-point wiring may be used. Don't forget a 14-pin socket for IC1.

The foil pattern for the printed-circuit board is shown in Fig. 4 and the component placement guide is shown in Fig. 5. The switches are mounted on the front panel of the unit and the LED's are soldered to the *foil side* of the board. Since none of the values are critical—except for the calibrating pots—10% resistors and 20% capacitors may be used.

In designing the accessory, considerable thought was given to simplifying assembly. Miniature quick-disconnect terminals are used on the board for connection of the switches. The transformer is mounted on the

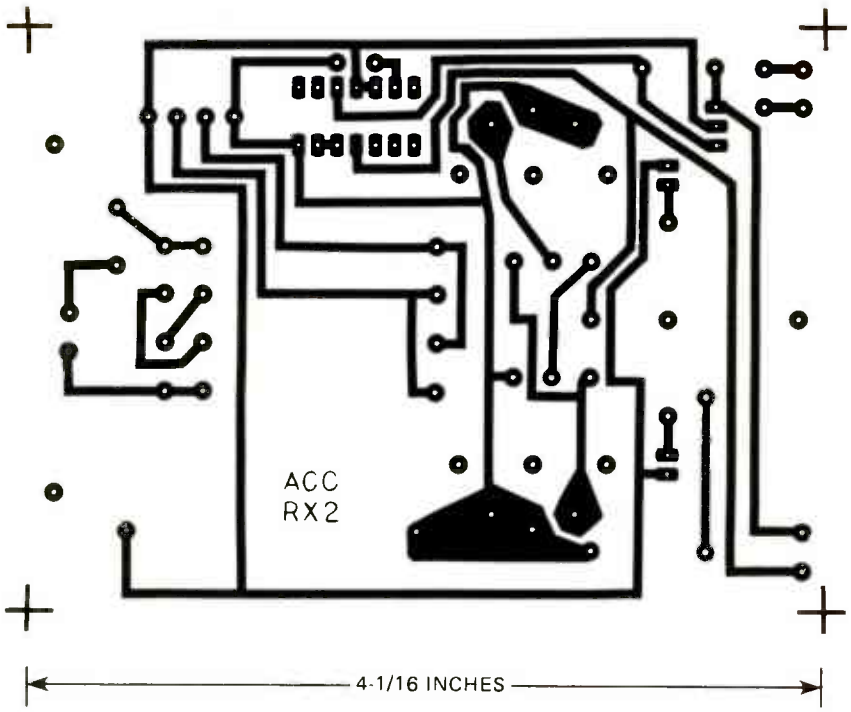


FIG. 4—FOIL PATTERN for the PC board. Point-to-point wiring may also be used.

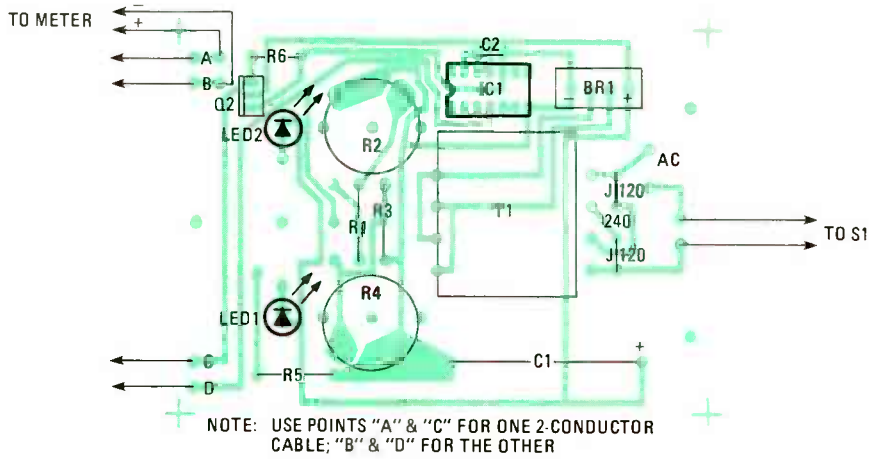


FIG. 5—COMPONENT PLACEMENT guide for the PC board. Switches S1 and S2 are front-panel mounted and the LED's are soldered to the foil side of the board.

TABLE 1

Unknown Resistance (ohms)	Range	Voltmeter Reading (volts)	Example
100 to 0.1	×100	1.0 to 0.001	1.0 volt × 100 = 100 ohms 0.001 volt × 100 = 0.1 ohm
10 to 0.01	× 10	1.0 to 0.001	1.0 volt × 10 = 10 ohms 0.001 volt × 10 = 0.01 ohm
1 to 0.001	× 10	0.1 to 0.0001	100 mV × 10 = 1.0 ohm *or* 0.1 volt × 10 = 1.0 ohm 0.1 mV × 10 = 0.001 ohm or 0.0001 volt × 10 = 0.001 ohm

PC board and its terminals are soldered to pads on it. By using jumpers, conversion from 117 to 230 volts can be made where necessary. Certain solder pads are marked with a dot to help orient polarized components: the emitter of Q2, the anodes of the LED's, pin-one of IC1, the "+"-side of the bridge rectifier, and the positive end of the electrolytic capacitor. The PC board is firmly secured to the front panel by three sturdy, rectangular, phenolic mounts.

Calibration

The calibration procedure is easy. Calibration potentiometers, R2 and R4, are accessible through two holes in the top panel. Simply connect a precision resistor to the clip leads, with the Lohmeter connected to your meter. If you are using your own components, select a value of about 10 ohms—for example, 9.6 ohms. Throw the range switch to ×10. Adjust R2 until you read 0.96 volts (0.96 × 10 = 9.6 ohms). Change the range to ×100 and adjust R4 to read 0.096 volts (0.96 × 100 = 9.6 ohms). The instrument is now calibrated and ready to use.

Operation

To use the Lohmeter, simply plug in the line cord and set the ON-OFF switch, to the ON position. Insert the cables' banana plugs into your voltmeter, maintaining the correct polarity. Set your voltmeter to the 1.0 VDC scale. Select a suitable Lohmeter range and connect the clips across the unknown resistance to obtain a reading.

If, for example, the ×10 range has been selected and the reading is 0.002 volt, then the resistance is 0.02 ohm (10×0.002). For higher resistances, set the range switch to ×100. A reading of 0.002 volt would indicate a resistance of 0.2 ohm; a reading of 0.005 volt would be 0.5 ohm. Any scale can be used since the voltage reading multiplied by the appropriate multiplier gives the value of the resistance. For greatest accuracy, always choose the range that will result in the highest voltage reading. The greatest resistance that can be read, regardless of the voltage-scale used, is about 500 ohms, due to internal voltage limit of the accessory.

That voltage limit does not, however, interfere with *lower* value resistances. If a 100 mV scale is available on your meter, readings as low as 0.001 ohm may be made. For values of that order of magnitude, use the ×10 range. Then the 0.001-ohm resistance will be indicated on the meter as 0.1 mV (.0001 volt). When that reading is multiplied by 10, the resistance is 0.001 ohm (see Table 1).

The Lohmeter is a very versatile accessory. Besides being of value in the laboratory or on the service bench, it can also be used as a production tool for grading and matching resistors, coils, transformers and motor windings, or whenever it is necessary to measure or match low resistance value components. R-E

10 HOME VIDEO QUESTIONS And Answers

Everything that you've always wanted to know about home video. The differences between VHS and Beta, noise reduction for VCR's, stereo TV, and more.

LEN FELDMAN
CONTRIBUTING EDITOR

HOME VIDEO RECORDERS (OR VCR'S) ARE the "hot" electronic product of the year! While the general economic downturn in the U.S. and worldwide has brought about reduced sales of high-fidelity audio products, sales of home video equipment are significantly ahead of last year. (They're anywhere from 70% to 100% ahead, depending upon whose figures you believe.) Relatively speaking, however, video recorders are so new to the public that potential users—retailers and technicians alike—have many questions relating to the operation and use of VCR's. I will try to answer the ten most often asked questions here.

What are the actual differences between the two basic systems: Beta and VHS?

Let's go back to the beginning. Sony Corporation introduced its Betamax system in 1976. It uses a plastic, two-hub cassette that is about the size of a paperback book. While today there are many different tape lengths contained in Beta cassettes, the standard L-500 cassette contains about 500 feet of ½-inch wide tape. At the original Beta-I speed, that provided about one hour of recording capability.

About one year later, Victor Company of Japan (known in the U.S. as JVC) introduced a system that they call VHS (for *V*ideo *H*ome *S*ystem) which differs in several details from the Beta system. The two-hub VHS cassette is large enough to accommodate 800 feet of tape (also ½-inch in width). That provides just over two hours at VHS's slightly slower speed of 1.31 inches-per-second.

Both systems use a rotating tape head that spins at the incredibly fast speed of 1800 RPM. Figure 1 shows the pattern or "magnetic footprint" laid down by the combination of rotating head and slowly moving tape for each of the two systems. Besides those basic differences in speed and track patterns, JVC chose to use a different tape-loading system that they call M-loading. Illustrated in Fig. 2, that system pulls out a small length of tape from the cassette only during recording or playback. JVC maintains that that subjects the heads to slightly less wear than the Beta loading system that keeps the tape threaded at all times, once the cassette is inserted into the recorder.

Which system, Beta or VHS, provides the better quality of picture?

Most experts agree that there is little difference in picture quality between the two popular formats. Bearing in

THE RCA model VDT600 VCR uses the VHS system and has three selectable speeds.

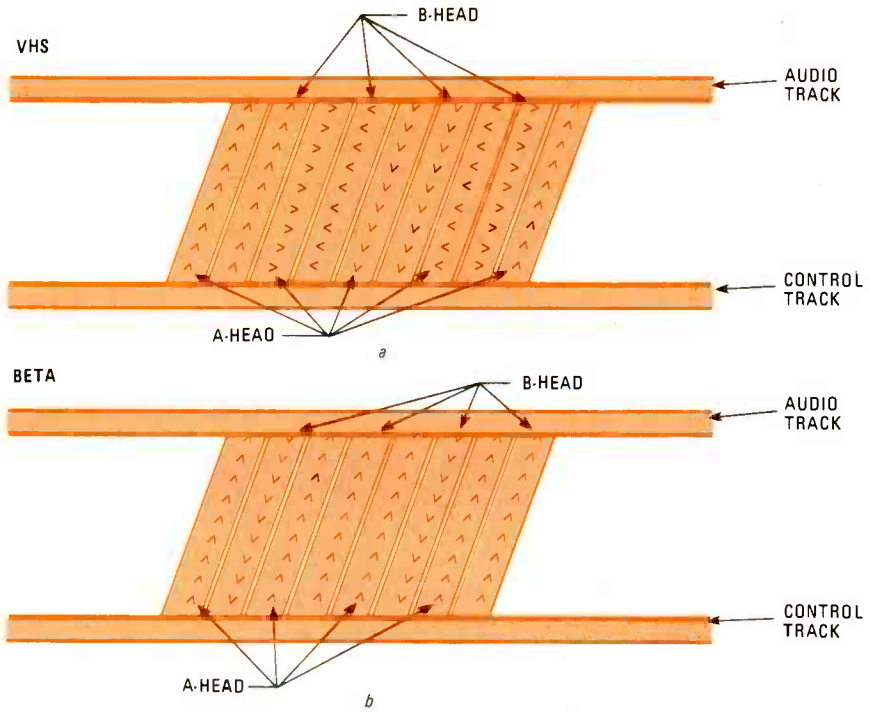


FIG. 1—A MAGNETIC PATTERN is laid down on a slowly moving tape by two rotating heads in both the VHS (shown in *a*) and Beta (shown in *b*) systems.

mind the rotation of those recording/playback heads at 1800 RPM, the effective linear tape-to-head speed works out to about 270 ips for Beta and 230 ips for VHS (using the Beta-II 2-hour, and the VHS SP 2-hour speeds). Both systems can provide slower tape speeds that give longer record times. Currently, an L-830 tape cassette used in a Beta machine at its Beta-III speed will provide up to five hours of recording time, while a T-120 cassette, used in the EP or SLP speed on a VHS machine will permit up to six hours of recording or playback time. While there is some picture degradation at those slower speeds, it is not nearly as bad as one might suppose, since head rotation speed remains the same. Still, Beta speeds are just a bit faster (at progressively slower linear tape speeds) than VHS speeds—which would suggest somewhat better picture quality in theory. In practice, other variables, such as the quality, and care taken in the assembly, of the electronics of each system may have more to do with ultimate picture and sound quality than the basic recording format or tape speed used.

If I buy a video camera, must it employ the same format (Beta or VHS as my VCR?

Although it is true that VHS and Beta VCR's are totally incompatible with each other (tapes made on one will not play back on the other) video *cameras* bear no relationship to the VHS/Beta incompatibility problem. The sole function of a video camera is to translate the image seen by the camera lens into a standard NTSC video signal, much like the one that we receive over the air or from cable-TV companies. Since that type of signal is compatible with either VHS or Beta type VCR's, the signal produced by an video camera purchased in the United States will work with either VCR format.

There is one qualification, however, that should be mentioned. Since manufacturers of video cameras are generally the same ones who make VCR's, they would naturally like you to buy both products from them. If you do decide to purchase one brand of VCR and another brand of camera, you may well run into interconnection problems. The end of the cable supplied with the camera may have a plug or connector which does not mate with the receptacle on the VCR you own. That possibility should be checked out before you make a final decision regarding which of the video cameras you will buy.

If the cable supplied with the camera does not mate with the VCR you already own, there are ways around the problem. The camera supplier may offer an alternate cable that, instead of terminating in a single, multiple-pin, plug, terminates in individual video out, audio out, camera remote and camera-power pin plugs that can then be connected singly to appropriate terminals on the rear panels of most VCR's and separate camera power supplies.

Is it possible to copy a tape from Beta-type VCR's onto a tape used in a VHS tape recorder?

Yes, it is. The signal that is stored on the tape of any home-video recorder, when played back by that recorder, yields a standard NTSC video signal that can be re-recorded and the format used to store that signal initially is irrelevant.

The best way to make such a tape copy is to connect short, shielded cables from the aforementioned audio and video output jacks found on the back of the machine in which the original tape is being played, to the audio and video *input* jacks of the VCR on which the new tape is to be recorded. The originating machine is placed in the playback mode while the second machine is placed in the record mode. If the second machine has a switch labelled TV/CAMERA or TV/VIDEO, that switch should be set to the CAMERA or VIDEO position.

Is it legal to record commercial TV programs in your home for later personal viewing?

Yes, according to a Federal Court decision involving a case in which Universal Pictures and Walt Disney Productions have instituted suit against Sony Corporation. It is generally agreed, however, that if you *sell* the tape you make, for commercial gain or benefit, you are in violation of the law. We should point out that even the case just mentioned is being appealed by the plaintiffs in the case; but most experts agree that, as more and more VCR's find their way into

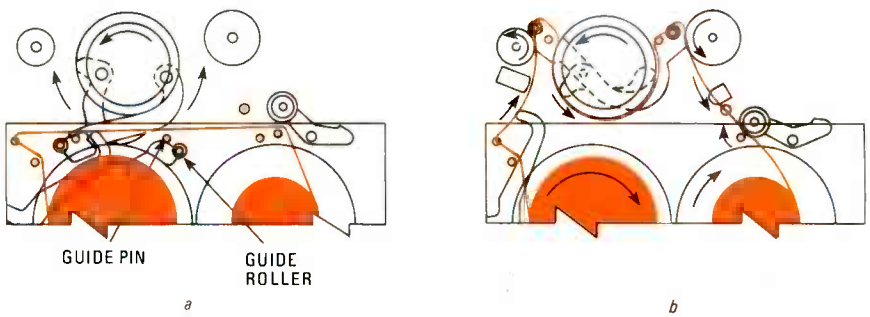


FIG. 2—M-LOADING, used in VHS systems, reduces head wear by not threading the tape (shown in *a*) except during playback and record operations (shown in *b*).

American homes, it becomes increasingly difficult for any court to legislate against their use. There are, however, many unresolved questions regarding home-video recording's legality, such as whether or not it is legal to record programs from pay-TV or cable-TV sources.

Stereo TV (TV with two separate audio channels) has been available for more than two years in Japan. When can we expect to have stereo TV in the United States?

The stereo-TV system used in Japan is somewhat akin to the multiplexing system used in stereo FM in this country, though there are some technical differences. Since audio channels on TV are broadcast via frequency modulation (FM), it would be a relatively simple matter to add stereo audio to present U.S. TV broadcast standards.

The system used in Japan was one developed by NHK, the Japanese Television Network; and it is, in fact, one of several systems now being studied by a U.S. industry committee, under the aegis of the Electronic Industry Association. In that system, a sub-carrier located at twice-the horizontal repetition rate of the video (or, at around 31.5 kHz) is modulated in much the same way that our own FM 38-kHz suppressed subcarrier is modulated for stereo FM.

The problem in this country, however, is that several proponents have offered competing systems and all of that needs to be sorted out by the FCC in what usually turns out to be a long and protracted procedure. It is unlikely that we will have an FCC-approved system for stereo TV in 1981, but perhaps 1982 will witness the beginning of such broadcasting in this country. It should be noted, too, that whichever system is ultimately approved, it will probably provide for bilingual audio channels as an alternate to stereo audio. That, in fact, is the case in Japan as well.

When using a video camera with a VCR, what's the best way to make the transition from scene to scene?

Do not place the VCR in the stop-mode. Doing so, in the case of a VHS machine, will make the tape retract completely into the cassette and in the case of Beta machines will completely disengage the tape from the surface of the tape head. When the next camera scene is begun, there is likely to be a length of tape separating the new scene from the previous one, with nothing recorded upon it. That unrecorded portion of tape accounts for a burst of noise that is visible on the screen during playback.

A better approach is to use the pause control located on the VCR or the pause trigger located on the camera. When either of those controls is used between videotaped scenes, the tape simply stops moving in the VCR but remains in contact with the fast-spinning tape head. Under those conditions, when the new scene begins, there is only the barest of picture flicker between one scene and the next; and, in some cases, there is no jitter or picture roll at all.

A word of caution, however: the VCR tape transport should never be left in the pause mode for more than a few minutes. If that procedure is not observed, the spinning tape head will eventually cause the oxide on the surface of the tape to separate from the base material and tape. Furthermore, the tape head is likely to be damaged. There are now some VCR machines that automatically shut off after five minutes or so if the operator fails to take the transport mechanism out of the pause mode.

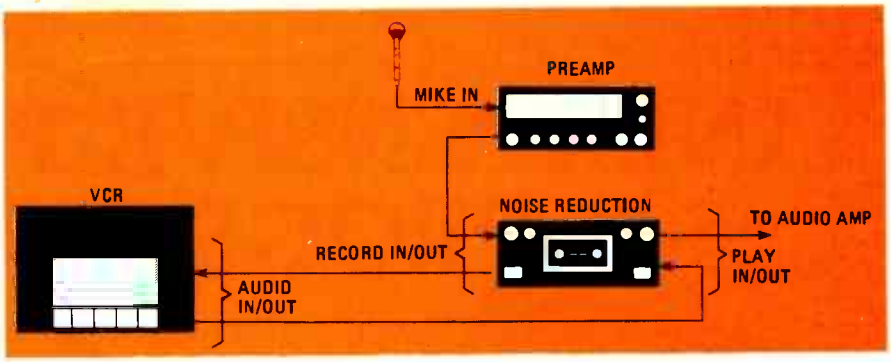


FIG. 3—NOISE REDUCTION in a VCR/camera combination is possible but a separate microphone and preamp must be used.

Are there any other formats available for VCR's, especially ones that result in lighter-weight portables?

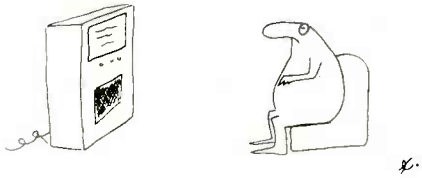
Indeed there are! Recently, Technicolor Audio Visual (a division of the company responsible for so many color movies) announced that, in cooperation with the Funai Company of Japan, it had developed a new type of video cassette recorder that weighs a mere seven pounds, complete with battery. It will work with just about any camera, providing that the correct interconnecting cables are ordered. The tape cassette used with that machine is only slightly larger than a standard audio cassette. It uses ¼-inch tape (instead of the ½-inch tape used in Beta and VHS machines) and, for the moment at least, is limited to 30 minutes of recording or playback. Technicolor believes that they can come up with a one-hour tape of the same cassette size in the near future. The *primary* application for the new portable VCR is likely to be for live videotaping with a camera, rather than for transcribing TV programs off the air.

Why doesn't someone combine the tape-transport section of a VCR right inside the camera?

"Someone" already has! And that someone is Sony Corporation; they demonstrated just such a device recently. For reasons which are known only to Sony, however, the company has indicated that they do not intend to offer that all-in-one video instrument for about five years. Some experts believe that the only reason that Sony exhibited the device to members of the press was to forestall similar introductions from possible competitors, such as Kodak, Panasonic, or JVC; but only time will tell whether that, indeed, is the case.

It is possible to add Dolby noise reduction (or other forms of noise reduction circuitry) to the audio section of a VCR?

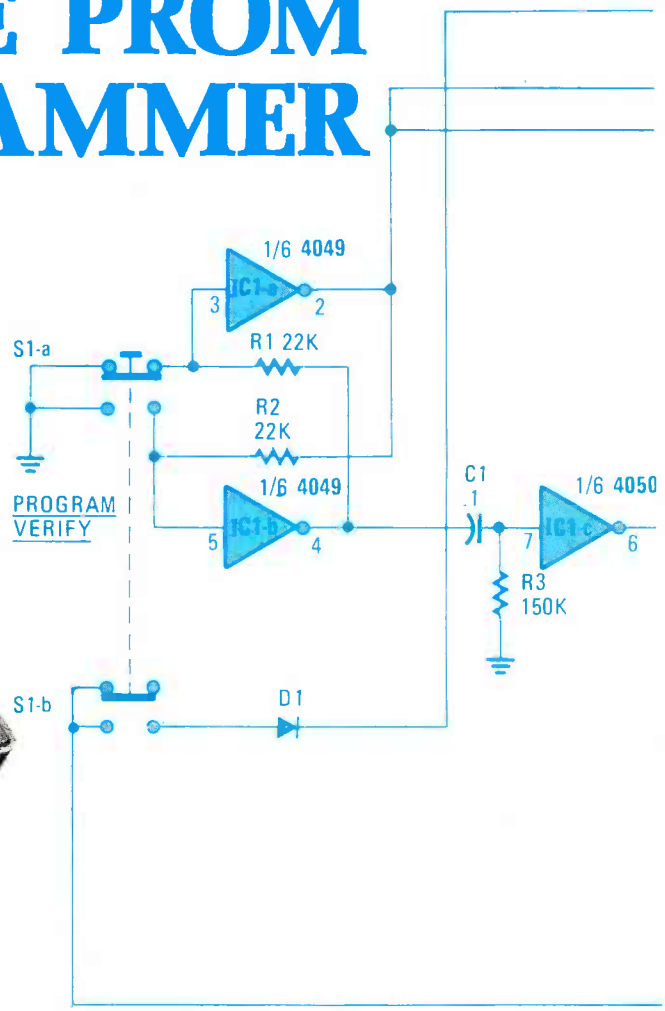
Yes, but making the interconnections is not going to be easy in the case of a complete home-type VCR that contains its own TV tuner/timer. If you wish to incorporate noise reduction into a portable VCR/camera combination, that is much easier—as illustrated in Fig. 3. It is first necessary to use an external, separate microphone, rather than the microphone that is usually built into the camera's pistol-grip handle. A separate microphone preamplifier will also be necessary, but that may take the form of the microphone input on an existing audio stereo cassette deck equipped with Dolby or a separate Dolby encoder/decoder equipped with a MIC input. The usual Dolby (or other noise-reduction encoding) then takes place during videotaping and, in playback, the noise-reduction decoder serves to reduce tape hiss by anywhere from 10 dB upwards, depending upon which system is used. **R-E**



"Interference is along network lines and is not the fault of your illegal descrambler."

BUILD THIS

INEXPENSIVE PROM PROGRAMMER



T.E. LeVERE

Here's a simple circuit that will enable you to program the popular 74S-series of PROM's right on your own workbench.

MORE AND MORE ELECTRONIC DEVICES are being "programmed"—whether or not they contain a microprocessor. In many instances, as is the case with household appliances or games, those programs are not entered by hand or from a magnetic medium such as disk or tape, but are contained in integrated circuits called ROM's (for *R*ead *O*nly *M*emory).

The ROM is a type of memory device that is permanently programmed—while you can read the information it contains as many times as you like, you cannot change it. That's why it's called "read-only."

In general, there are two ways that ROM's are programmed. The first of these is called *mask programming* and is actually a part of the IC manufacturing process. That type of programming is useful only when large quantities of identical ROM's are to be produced.

The other type of ROM—and the one we'll discuss here—is actually known as a PROM (*P*rogrammable *R*ead *O*nly *M*emory). That type of memory IC is supplied with all its bits at either a high or low logic level. In programming it, you change those logic states to meet your requirements. Typically, that programming is accomplished by "blowing" (burning out) internal titanium-tungsten (Ti-W) fuse links, each one representing a bit. That is done by applying a specific excess voltage to the power input of the PROM IC after selecting those bits that are to be a logic-high, and those that are to

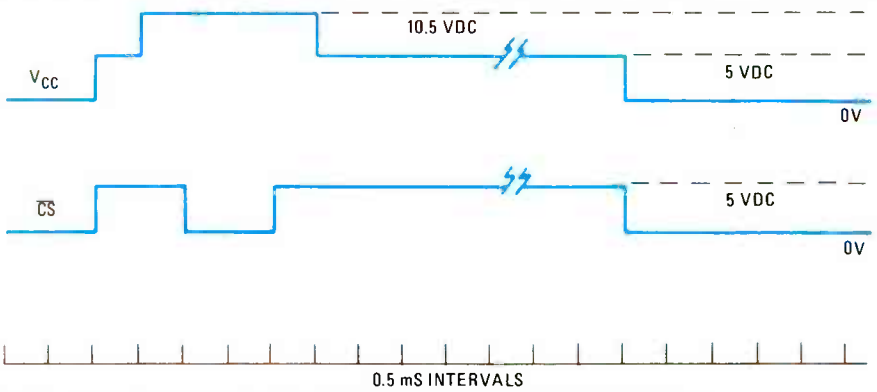


FIG. 1—TIMING SEQUENCE for programming a word of memory into the PROM.

American homes, it becomes increasingly difficult for any court to legislate against their use. There are, however, many unresolved questions regarding home-video recording's legality, such as whether or not it is legal to record programs from pay-TV or cable-TV sources.

Stereo TV (TV with two separate audio channels) has been available for more than two years in Japan. When can we expect to have stereo TV in the United States?

The stereo-TV system used in Japan is somewhat akin to the multiplexing system used in stereo FM in this country, though there are some technical differences. Since audio channels on TV are broadcast via frequency modulation (FM), it would be a relatively simple matter to add stereo audio to present U.S. TV broadcast standards.

The system used in Japan was one developed by NHK, the Japanese Television Network; and it is, in fact, one of several systems now being studied by a U.S. industry committee, under the aegis of the Electronic Industry Association. In that system, a sub-carrier located at twice-the horizontal repetition rate of the video (or, at around 31.5 kHz) is modulated in much the same way that our own FM 38-kHz suppressed subcarrier is modulated for stereo FM.

The problem in this country, however, is that several proponents have offered competing systems and all of that needs to be sorted out by the FCC in what usually turns out to be a long and protracted procedure. It is unlikely that we will have an FCC-approved system for stereo TV in 1981, but perhaps 1982 will witness the beginning of such broadcasting in this country. It should be noted, too, that whichever system is ultimately approved, it will probably provide for bilingual audio channels as an alternate to stereo audio. That, in fact, is the case in Japan as well.

When using a video camera with a VCR, what's the best way to make the transition from scene to scene?

Do not place the VCR in the stop-mode. Doing so, in the case of a VHS machine, will make the tape retract completely into the cassette and in the case of Beta machines will completely disengage the tape from the surface of the tape head. When the next camera scene is begun, there is likely to be a length of tape separating the new scene from the previous one, with nothing recorded upon it. That unrecorded portion of tape accounts for a burst of noise that is visible on the screen during playback.

A better approach is to use the pause control located on the VCR or the pause trigger located on the camera. When either of those controls is used between videotaped scenes, the tape simply stops moving in the VCR but remains in contact with the fast-spinning tape head. Under those conditions, when the new scene begins, there is only the barest of picture flicker between one scene and the next; and, in some cases, there is no jitter or picture roll at all.

A word of caution, however: the VCR tape transport should never be left in the pause mode for more than a few minutes. If that procedure is not observed, the spinning tape head will eventually cause the oxide on the surface of the tape to separate from the base material and tape. Furthermore, the tape head is likely to be damaged. There are now some VCR machines that automatically shut off after five minutes or so if the operator fails to take the transport mechanism out of the pause mode.

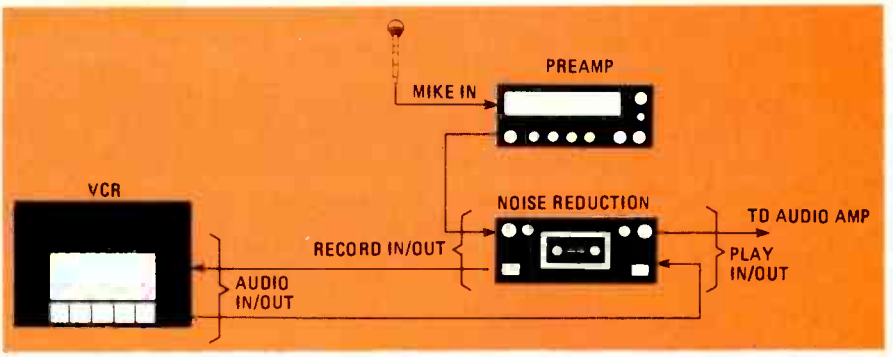


FIG. 3—NOISE REDUCTION in a VCR/camera combination is possible but a separate microphone and preamp must be used.

Are there any other formats available for VCR's, especially ones that result in lighter-weight portables?

Indeed there are! Recently, Technicolor Audio Visual (a division of the company responsible for so many color movies) announced that, in cooperation with the Funai Company of Japan, it had developed a new type of video cassette recorder that weighs a mere seven pounds, complete with battery. It will work with just about any camera, providing that the correct interconnecting cables are ordered. The tape cassette used with that machine is only slightly larger than a standard audio cassette. It uses ¼-inch tape (instead of the ½-inch tape used in Beta and VHS machines) and, for the moment at least, is limited to 30 minutes of recording or playback. Technicolor believes that they can come up with a one-hour tape of the same cassette size in the near future. The *primary* application for the new portable VCR is likely to be for live videotaping with a camera, rather than for transcribing TV programs off the air.

Why doesn't someone combine the tape-transport section of a VCR right inside the camera?

"Someone" already has! And that someone is Sony Corporation; they demonstrated just such a device recently. For reasons which are known only to Sony, however, the company has indicated that they do not intend to offer that all-in-one video instrument for about five years. Some experts believe that the only reason that Sony exhibited the device to members of the press was to forestall similar introductions from possible competitors, such as Kodak, Panasonic, or JVC; but only time will tell whether that, indeed, is the case.

It is possible to add Dolby noise reduction (or other forms of noise reduction circuitry) to the audio section of a VCR?

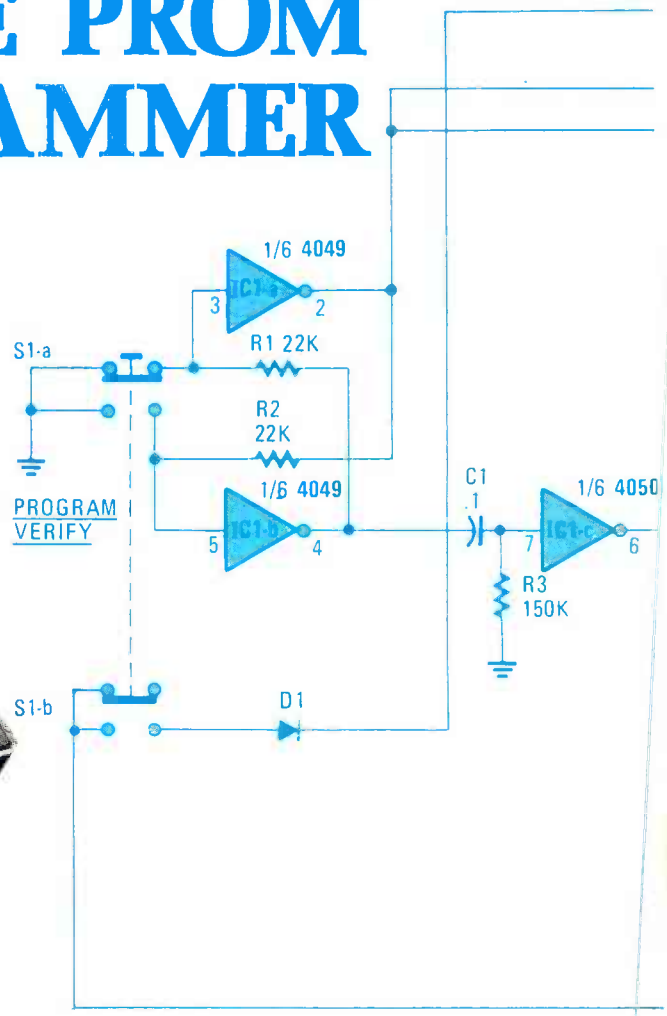
Yes, but making the interconnections is not going to be easy in the case of a complete home-type VCR that contains its own TV tuner/timer. If you wish to incorporate noise reduction into a portable VCR/camera combination, that is much easier—as illustrated in Fig. 3. It is first necessary to use an external, separate microphone, rather than the microphone that is usually built into the camera's pistol-grip handle. A separate microphone preamplifier will also be necessary, but that may take the form of the microphone input on an existing audio stereo cassette deck equipped with Dolby or a separate Dolby encoder/decoder equipped with a MIC input. The usual Dolby (or other noise-reduction encoding) then takes place during videotaping and, in playback, the noise-reduction decoder serves to reduce tape hiss by anywhere from 10 dB upwards, depending upon which system is used. **R-E**

"Interference is along network lines and is not the fault of your illegal descrambler."

BUILD THIS

INEXPENSIVE PROM PROGRAMMER

T.E. LeVERE



Here's a simple circuit that will enable you to program the popular 74S-series of PROM's right on your own workbench.

MORE AND MORE ELECTRONIC DEVICES are being "programmed"—whether or not they contain a microprocessor. In many instances, as is the case with household appliances or games, those programs are not entered by hand or from a magnetic medium such as disk or tape, but are contained in integrated circuits called ROM's (for *R*ead *O*nly *M*emory).

The ROM is a type of memory device that is permanently programmed—while you can read the information it contains as many times as you like, you cannot change it. That's why it's called "read-only."

In general, there are two ways that ROM's are programmed. The first of these is called *mask programming* and is actually a part of the IC manufacturing process. That type of programming is useful only when large quantities of identical ROM's are to be produced.

The other type of ROM—and the one we'll discuss here—is actually known as a PROM (*P*rogrammable *R*ead *O*nly *M*emory). That type of memory IC is supplied with all its bits at either a high or low logic level. In programming it, you change those logic states to meet your requirements. Typically, that programming is accomplished by "blowing" (burning out) internal titanium-tungsten (Ti-W) fuse links, each one representing a bit. That is done by applying a specific excess voltage to the power input of the PROM IC after selecting those bits that are to be a logic-high, and those that are to

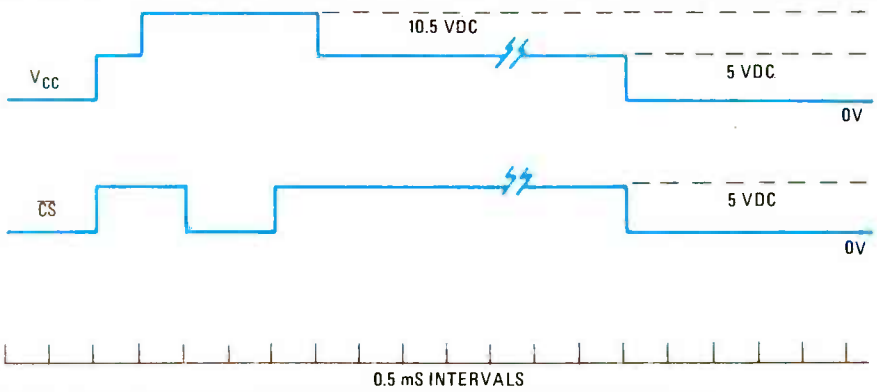


FIG. 1—TIMING SEQUENCE for programming a word of memory into the PROM.

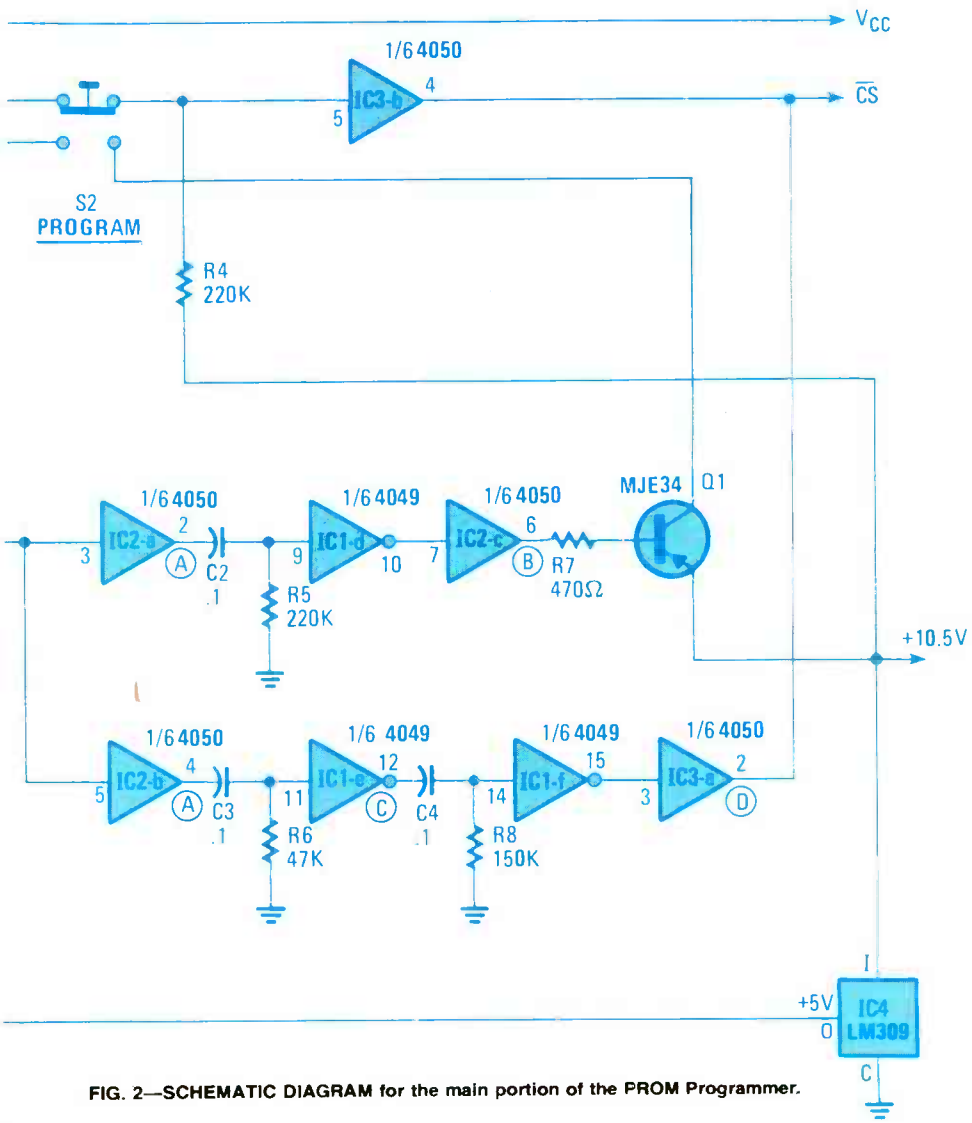


FIG. 2—SCHEMATIC DIAGRAM for the main portion of the PROM Programmer.

PARTS LIST—PROGRAMMER

Resistors, 1/4 watt, 5%
R1, R2—22,000 ohms
R3, R8—150,000 ohms
R4, R5—220,000 ohms
R6—47,000 ohms
R7—470 ohms
R9-R13—220 ohms
R14-R21—3900 ohms
Capacitors
C1-C4—0.1 μF, ceramic disc
Semiconductors
D1—1N914 or 1N4148
IC1—4049 CMOS hex inverter (RCA)
IC2, IC3—4050 CMOS hex buffer/driver (RCA)
IC4—LM309 or LM340 five-volt regulator (National)
Q1—MTE34 PNP power transistor, (Motorola; or Radio Shack 276-2027 or equivalent)
LED1-LED13—jumbo red LED (Radio Shack 276-041 or equivalent)
S1—DPDT pushbutton switch
S2—SPDT pushbutton switch
S3-S7—SPDT toggle switch
S8—two-pole, nine-position rotary switch
Miscellaneous: perforated construction board, IC sockets (including one for PROM), 10.5-volt power supply, enclosure, wire, etc.

be a logic-low.

While in theory it sounds simple, a good deal of care must be taken when "burning" a PROM. If the voltage is too low, the fuse links will not be destroyed; if it's too high, or applied for too long a time, undesirable side effects may result. If just *one* bit is programmed incorrectly, the entire PROM is ruined.

The circuit presented here for programming fusible-link PROM's is a simple one, involving only three IC's, one transistor, and a voltage regulator, together with the switches necessary to set up the program. It is intended for use with Texas Instruments' 74S-series of programmable memories.

The programming process

There were several reasons for selecting that family of PROM's to work with. First, they are readily available (check the advertisers in the back pages of **Radio-Electronics**). Second, they are relatively inexpensive—a few dollars for a 32-word type. Third, they require only a single five-volt supply and are available with either open-collector or three-state output configurations, and are rather fast (under 30 nanoseconds, generally). Finally, while several different memory configurations are available in that series, each type of PROM is programmed in the same manner, which means that the circuit can be used for a number of applications.

The circuit design is intended to meet the rather tight timing sequence needed for programming that family of PROM's. Basically, programming involves selecting the word of memory to be programmed by setting the address lines, grounding the bits that are to be programmed, and holding the bits that *are not* to be programmed at the supply voltage (five volts). The actual programming takes place when the supply voltage is briefly stepped-up to 10.5 volts and the IC is enabled by means of the chip-select ($\overline{CS}$) line. Details of that sequence are shown in Fig. 1. The upper line indicates the voltage applied to the V_{CC} pin, while the lower one shows the voltage at the $\overline{CS}$ pin of the IC.

Initially, the supply voltage (five volts) is applied to both the V_{CC} and $\overline{CS}$ pins, which disables the IC. The programming sequence is started by raising the voltage at the V_{CC} pin to 10.5 volts and then, after 500 microseconds (0.5 mS)—TI suggests a range of from 10 μS to 1 mS—$\overline{CS}$ is brought to ground and the memory enabled for 1 mS. After that, $\overline{CS}$ is returned to five volts and the 10.5 volts at the V_{CC} pin is reduced to five volts. At this point it is possible to ground the $\overline{CS}$ pin to verify that the programming took place as planned.

Texas Instruments makes several recommendations concerning the programming of the 74S– series. First, since the process involves burning out the Ti-W fuse links, it is recommended that V_{CC} be removed between programming sequences to avoid overheating the chip. Second, it is recommended that the 10.5-volt programming pulse have a duty cycle of no more than 30 percent of the entire programming cycle. With an automated programmer, that could be a problem but since our circuit is manually operated, it is nothing to be concerned about.

Circuit description

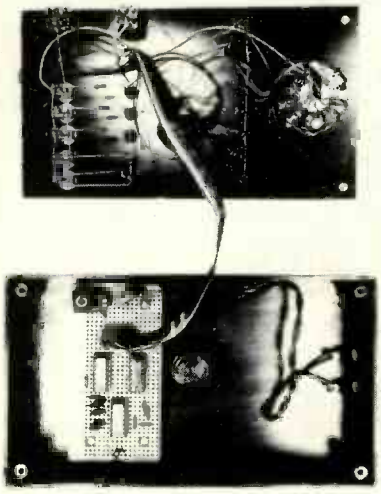
The main portion of the PROM programmer circuit is shown in Fig. 2. It uses two 4050 CMOS hex buffer/drivers, a 4049 CMOS hex inverter, one PNP power transistor and a five-volt regulator, such as an LM309 or LM340.

A power supply that can provide 10.5 volts DC (Fig. 3) is required to open the fusible links of the PROM. The regulator reduces that to 5 volts, which is needed at several points in the circuit.

Two switches are used in this section. The first, S1, supplies power to the PROM and/or initiates the programming sequence while S2 supplies 10.5 volts to the V_{CC} pin when it is required.

Programming is accomplished by depressing switch S2 and holding it down while switch S1 is pressed momentarily. Verification is obtained through the use of S1 alone. Details of that will be presented later.

In brief: the 4049 hex inverter is used to debounce switch S1 and to form several half-monostable circuits



INTERNAL view of the PROM programmer shows how the perfboard is mounted inside the case. The front panel is connected via ribbon cable.

PARTS LIST—POWER SUPPLY

Resistors, ½-watt, 10%
R22—1600 ohms
R23—220 ohms
Capacitors
C5—250 μF, 25 volts, electrolytic
C6—.1 μF, ceramic disc
C7—1 μF, tantalum
Semiconductors
BR1—bridge rectifier, 50 PIV
IC5—LM317T, adjustable voltage regulator
T1—18 volts, one amp
Miscellaneous: construction board, wire, solder, etc.

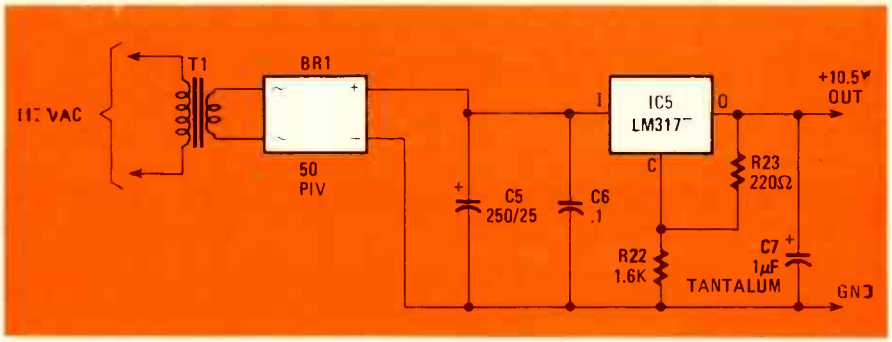


FIG. 3—SCHEMATIC DIAGRAM of the power supply for the PROM Programmer. It provides the 10.5 volts DC required to open the fusible links of the PROM.

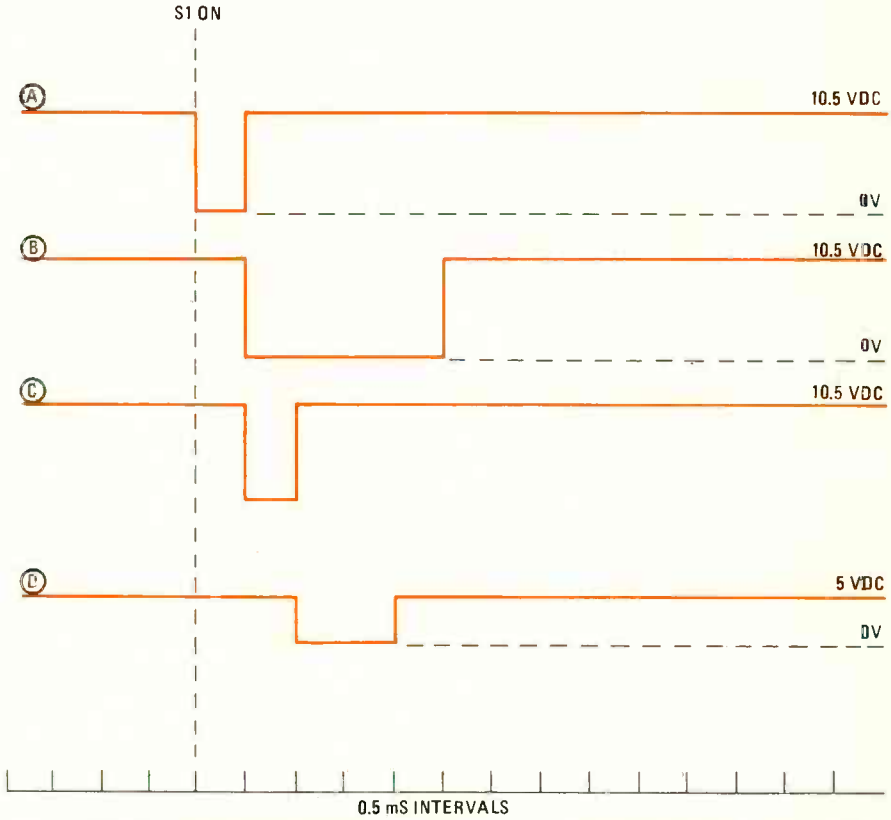


FIG. 4—TIMING DIAGRAM shows waveforms at specific points within the circuit. Circled letters correspond to circled letters in Fig. 2.

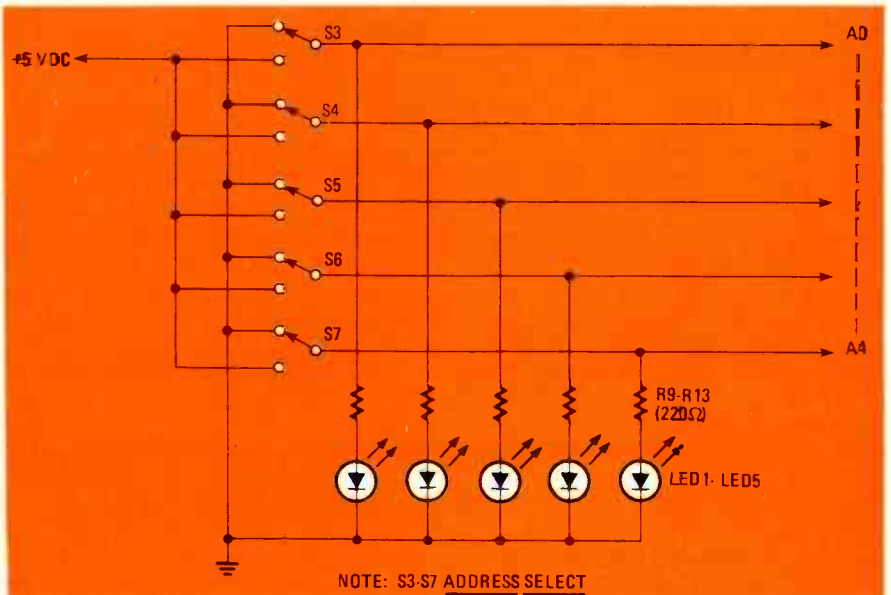


FIG. 5—PROM ADDRESSES are selected by five toggle switches and visual confirmation is provided by discrete LED's.

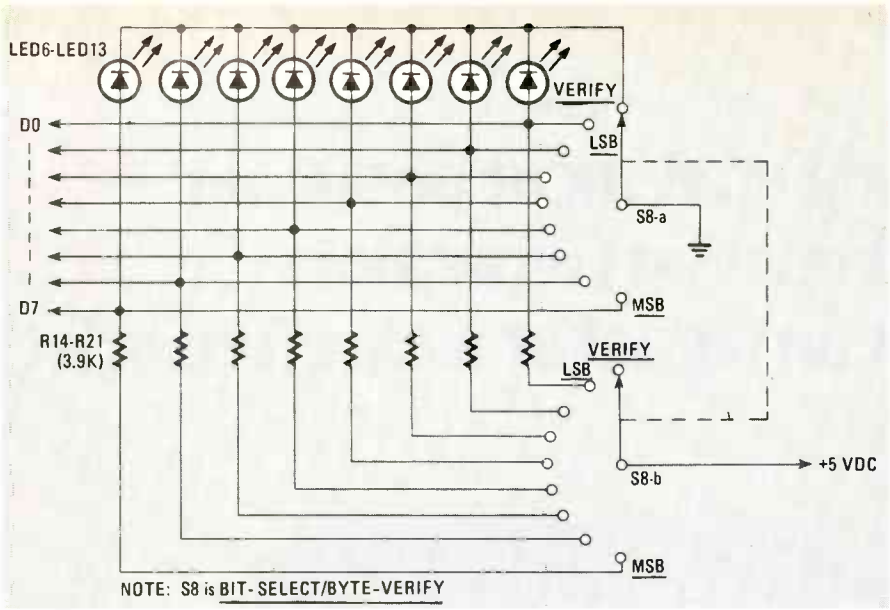


FIG. 6—A WORD IS PROGRAMMED sequentially one-bit at a time via a 9-position rotary switch.

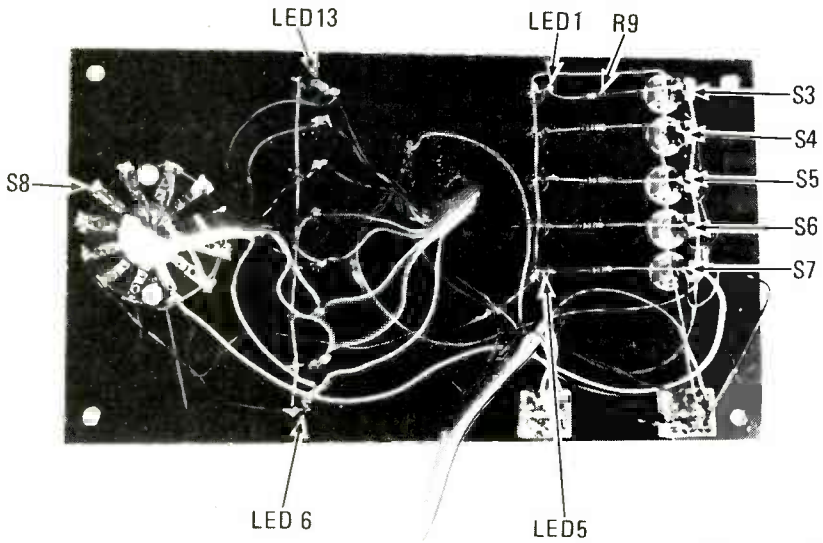


FIG. 7—PLACEMENT OF THE FRONT PANEL mounted components. Power switch S1 is located in the lower right corner and switch S2 is just to the left of S1. Connections to the PROM are made via a front-panel mounted DIP socket.

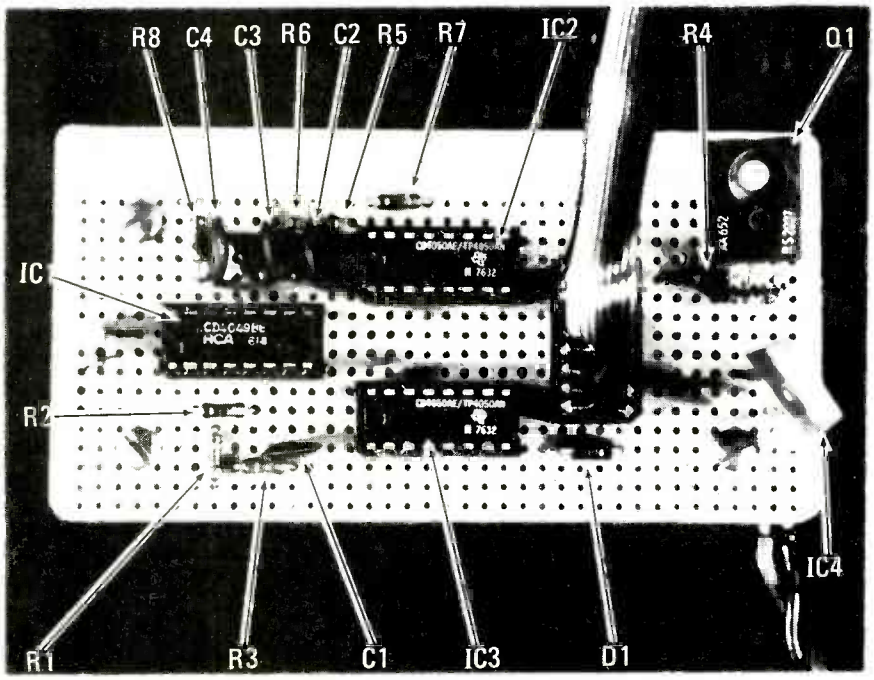


FIG. 8—THE PROTOTYPE used perfboard construction for the bulk of the circuitry.

used to time the programming sequence. One of the 4050 buffer/drivers is powered by 10.5 volts and acts as a waveform shaper for the signals from the 4049. The other is powered from the 5-volt regulator and is used as a level-translator to supply 5 volts to the V_{CC} and $\overline{CS}$ pins. The circled letters on the schematic (Fig. 2) correspond to those in Fig. 4, that shows the waveforms.

While the addresses and bit-patterns may be set using as crude a method as alligator clips, the switch circuits shown in Figs. 5 and 6 make programming much simpler.

Figure 5 illustrates an address-selector circuit using five SPDT switches. Each switch is tied to one address bit of the PROM and to an LED, that acts as a status indicator. The LED's allow you to make sure that the address you selected is correct—remember, programming one bit incorrectly will ruin the entire PROM!

To set up the word to be programmed, the circuit in Fig. 6 works quite well. Its major component is a double-pole, nine-position rotary switch. One pole of that switch is tied to the five-volt supply with eight of its positions going to the eight data outputs of the PROM through 3.9K resistors. The other pole of the switch is at ground potential, so that only one of the data outputs is grounded for programming purposes at any time.

The ninth switch position is used for program verification, and removes the data-output pins of the PROM from the 3.9K resistors and grounds the cathodes of the LED's. Any bit at a logic-1 will cause its associated LED to light.

With the switch wired in that manner, it is easiest to program from the most-significant bit to the least-significant bit and to verify the programming, in that order, afterwards. That is the switch is first moved to its most counterclockwise position, bits seven through zero are programmed as the switch is turned clockwise, and the switch is then turned to its final position for obtaining vertification of the programming.

Construction

Assembling the PROM programmer is extremely simple and it may be built on perforated construction board without difficulty. Component placement is not critical. Refer to Figs. 7 and 8 for component placement. A small chassis box can be used to hold the circuit board and a power supply, and to mount the LED's and switches.

With two exceptions—both due to human error—that setup has performed faultlessly. It should work at least as well for you. **R-E**

A sweeping statement about our new Function Generator: It provides a clean signal at a carefree price.

Sabtronics can offer low prices because we sell what we manufacture, directly to you. And the 5020A Function Generator you get from us is second to none in price/performance. We give you the waveform you want — 1 Hz all the way up to 200 kHz in five overlapping ranges: stable, low-distortion sine waves, high linearity triangle waves, fast rise/fall-time square waves — plus a separate TTL square wave output and high and low level main outputs. For precise frequency settings we have a fine control in addition to the usual primary control found in competitive units.

The sweep input allows external frequency control and frequency sweeping over 100:1 range, and control over both the output amplitude and DC offset is provided for all wave forms.

Get a clean signal at a price that won't clean you out. Send in the coupon and order your new 5020A Function Generator now. Credit card holders may call (813) 623-2631.

BRIEF SPECIFICATIONS

Frequency Range: 1 Hz-200 kHz in 5 overlapping ranges (1 Hz-20Hz, 10Hz-200 Hz, 100Hz-2kHz, 1kHz-20kHz, 10kHz-200kHz). **Waveforms:** Sine wave, square wave, triangle wave. **Outputs (BNC connector):** High: 10V p-p max (600Ω), Low: – 40dB of high output (600Ω), TTL: Standard TTL level capable of driving 10 TTL loads. **Input:** Impedance 27 kΩ, DC coupled sweeps the cutput frequency <100:1. **Power requirement:** 105-120V 50/60 Hz, 4 VA max. **Dimensions:** 8″ wide X 6.5″ deep X 3″ high (203 X 165 X 76mm). **Weight:** 1.5 lbs. (680 g).

Making Performance Affordable

sabtronics INTERNATIONAL INC.

5709 N. 50th Street, Tampa, FL 33610
(813) 623-2631

In Canada contact: Kumar & Co.
Mississauga, Ont. Canada

Sabtronics International, Inc., 5709 N. 50th Street, Tampa, FL 33610

____ Model 5020A Function Generator kit(s) @ $85.00 ..... $ _____
____ Model 5020A Function Generator(s) assembled @ $99.00 . $ _____
For delivery in Florida, add 4% Sales Tax ..... $ _____
Shipping and handling @ $6.00 per instrument* ..... $ _____
10% deposit for C.O.D. orders ..... $ _____
I enclose ☐ money order ☐ check.
(Allow 2-3 weeks for personal checks to clear.)
Charge: ☐ Visa ☐ Mastercard

Account No. _____ Exp. Date _____
Name _____
Street _____
City _____ State _____ Zip _____

*USA only. Canada $7.50; Overseas airmail $25.00. RE

A superb frequency counter is frequently not counted-just because it doesn't have a high price-tag.

The truth is, our 8000B 1 Gigahertz is an excellent counter. In fact, it's preferred by many engineers, technicians, and electronic enthusiasts. Not a single competitor on the market today can surpass our price/performance ratio.

And we've deliberately kept our prices down. First, we've refused to join everybody else in their high mark ups. Instead of "charge what the market will bear," for us it's "charge a fair price." Second, we sell what we manufacture, directly to you. So extra costs of extra steps are automatically eliminated. Third, we have to build a lot of frequency counters to meet the demand. Because we do sell so many, we don't have to charge a high price to make a profit.

And about quality . . . Sabtronics frequency counters always have the most innovative features available. For example, our 8000B 1 Gigahertz Frequency Counter has a 10 Megahertz precision crystal timebase. But most important, the 8000B, using the most advanced LSI circuitry, has a guaranteed sensitivity of 30 millivolts up to 1 Gigahertz, with 20 millivolts typical. The three-stage differential amplifier IC makes this possible. Altogether, the 8000B uses only 6 IC's, making the chance of failure virtually nonexistent.

In Canada contact: Kumar & Co.
Mississauga, Ont. Canada

Three selectable gate times provide the measurement speed you need — and greater resolution. The resolution is further enhanced by our counter's 9-digit display.

Like the 8000B, Sabtronics' 8610B is a high-quality precision frequency counter. It features only 4 IC's, and offers a frequency range up to 600 Megahertz.

The cases of both counters are high strength impact-resistant ABS plastic. Elegant but very rugged. Sabtronics doesn't believe in skimping on the high quality construction that brings excellent performance. But we're not about to charge a high price just because we could get it!

Send in the coupon and order your new frequency counter now. Credit card holders may call.

BRIEF SPECIFICATIONS:

Frequency Range: 10 Hz to 1 GHz (Model 8000B), 10 Hz to 600 MHz (Model 8610B); **Timebase:** Frequency: 10 MHz, Stability: ± 1 ppm (20 to 40C°.), Aging Rate: < 1 ppm/year; **Sensitivity** (adjustable): Input A < 15 mV to 100 MHz, Input B < 30 mV, 100 MHz to 1 GHz (Model 8000B), < 30 mV, 100 MHz to 600 MHz (Model 8610B); **Gate Times:** .1 sec., 1 sec., 10 sec.; **Resolution:** 0.1 Hz to 10MHz, 1 Hz to 100 MHz, 10 Hz to 1 GHz; **Display:** 9-digit LED 0.4"; **Power Requirements:** 4.5 to 6.5 VDC (4 C-cells) or optional AC adapter; **Dimensions:** 8" wide X 6.5" deep X 3" high (203 X 165 X 76 mm), 1.3 pounds (590 g) excluding battery.

Making Performance Affordable

sabtronics INTERNATIONAL INC.

Sabtronics International, Inc., 5709 N. 50th Street, Tampa, FL 33610, (813) 623-2631.

Please send me the following:

_____Model 8000B 1 GHz Frequency Counter(s), Assembled @ $199.00 each	$_____
_____Model 8000B 1 GHz Frequency Counter(s), Kit @ $184.00 each	$_____
_____Model 8610B 600 MHz Frequency Counter(s), Assembled @ $129.00 each	$_____
_____Model 8610B 600 MHz Frequency Counter(s), Kit @ $114.00 each	$_____
Shipping and handling, $6.00 per unit*	$_____
10% deposit for C.O.D. orders	$_____
Florida residents add 4% Sales Tax	$_____

I enclose ☐ check ☐ money order. (Allow two to three weeks for personal checks to clear.)

Charge: ☐ Visa ☐ Master Charge

Account No. _____ Exp. Date _____

Name _____

Address _____

City _____ State _____ ZIP _____

*U.S. only. Canada $7.50; overseas air mail $25.00. RE

hobby corner

An all-electronic judge for the Pinewood Derby, and other tidbits.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

LAST MONTH WE DISCUSSED THE DIFFERENT considerations in designing a circuit that could judge the contestants in the Pinewood Derby and looked at one circuit that used relays. Now we'll finish up the subject with an electronic approach to the same problem.

The circuit shown in Fig. 1 is an adaptation of one sent in by Warren Baker of Albany, NY. In that case there are two lanes, each of which uses one type-D flip-flop from a 7475 IC to control an LED.

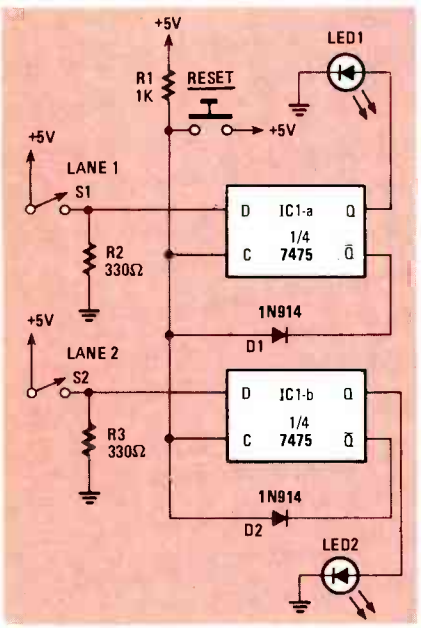


FIG. 1

Here are the logic states at the inputs and outputs of the IC before the race begins:

- C input (clock) is high so Q is the same as D.
- D input is low.
- Q output is low and the LED is off.
- $\overline{Q}$ output (opposite of Q) is high.

Now, let's suppose the car in lane one is the faster and trips momentary switch S1 first. Here is what happens in IC1-a:

- D input goes high.
- Q output goes high and turns LED_1 on.
- $\overline{Q}$ output goes low pulling the clock line low.
- C input goes low and prevents Q from changing on both flip-flops within the IC.

So, LED_1 is on and LED_2 is off, showing the car in lane one as the winner.

What happens, then, when the car in the second lane hits *its* switch? Very little. The D input of IC1-b goes high but, since Q can not change because C is low, nothing further happens.

Indicator LED_1 stays on and LED_2 stays off until the RESET switch is used. That brings the clock line back to a high state, and because both D inputs are low, the entire circuit returns to the "ready" state for the next race.

It is quite easy to use this arrangement for more than two lanes. Add a switch, resistor, diode, flip-flop, and LED for each additional lane and hook them up as shown in Fig. 1. Be sure to connect each C input to the clock line.

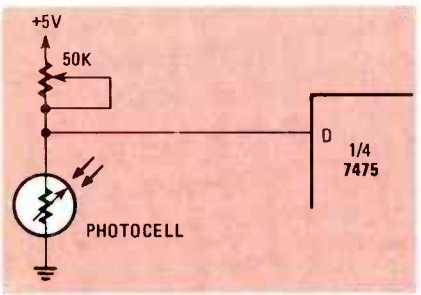


FIG. 2

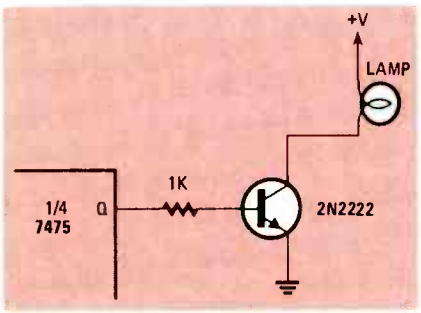


FIG. 3

For those of you who want to avoid mechanical switches, Fig. 2 is the input (trigger) circuit used by Bruce Bohnert of Glendale, AZ. When the shadow of the car passes over the cadmium sulfide photocell, the resistance of the cell increases and causes the D input to go high. That does the same thing as the momentary switches shown in Fig. 1.

The potentiometer in Bruce's circuit is a sensitivity control and is used to adjust for ambient light conditions. Of course, if the area has a low light level, it may be necessary to provide additional illumination at the end of the track.

If you want indicators that are brighter than LED's, you can use a transistor switch as shown in Fig. 3. When the Q output of the IC goes high, the transistor conducts and the lamp lights. The transistor is a 2N2222, which will handle small and medium lamps. For a really large lamp, you can use a mechanical relay switched by a transistor. The supply voltage, +V, should meet the requirements of the lamp and transistor used.

Thanks to all of you who have helped by sending in your circuits.

Contest timer

What if you run other types of contests and want an electronic judge? All you have to do is to build the circuit shown in Fig. 1. Give each contestant a manual switch and the first contestant to press his switch turns his light on and locks the others off.

Mosquito repeller revisited

The mosquito-repeller circuit ("Hobby Corner," March, 1980 issue) met with mixed results according to your letters. Some of you said it was successful, but most turned thumbs down on it. Perhaps it depends upon the type of mosquito in your area.

I don't have anything to try it on way up here in the mountains, so I'll have to take your word for its effectiveness. All I can suggest is that you make sure that your output device (earphone, speaker) is capable of emitting the high-frequencies involved.

Two letters about mosquito repellers were particularly interesting. One was from Tom Jakubowski (Brookfield, IL), who has worked on this problem with the Army. According to Tom, every device that they tested was as effective in the "off" position as in the "on."

The other was from Bruce Boatner of Ruston, LA, who wrote: "Though I did discover that frequencies around 20kHz drive dogs wild, the mosquitos were not particularly impressed. One was especially cooperative as I tuned up. I was considering a more direct application of signal, but I couldn't get the earphones on the little bugger . . ."

continued on page 82

B&K PRECISION · PHILIPS · TRIPLETT · VIZ (formerly RCA) · LEADER · HICKOK · Hitachi · Simpson · FLUKE · NLS Non-Linear Systems · KEITHLEY · DORIC · DATA PRECISION

DATA PRECISION Model 938

0.1%, 3½-Digit, LCD DIGITAL CAPACITANCE METER

Reg. $179.
NOW $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 3½-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 — warranteed for 2 full years.

PORTABLE OSCILLOSCOPES

BATTERY OPERATED

NLS Non-Linear Systems

Call For Our Prices

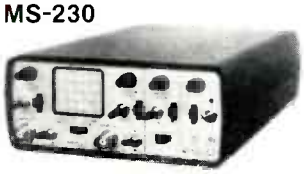
MS-15

Single Trace 15MHz

MS-215

Dual Trace 15 MHz

MS-230



Dual Trace 30MHz

KEITHLEY MODEL 130 DIGITAL MULTIMETER

NEW $115.

	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%

New Sweep/Function Generator

B&K PRECISION

MODEL 3020

Call For Our Price

- 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 or externally programmable

New Portable Digital Capacitance Meter

B&K PRECISION

MODEL 820

Call For Our Price

- 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
- Special lead insertion jacks or banana jacks
- Fuse protected
- Uses either rechargeable or disposable batteries
- Overrange indication

New Low Distortion Function Generator

B&K PRECISION

MODEL 3010

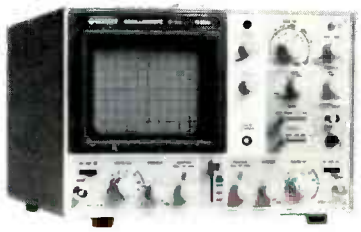
Call For Our Price

- 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

HITACHI

V-151B 15 MHz Single Trace
V-152B 15 MHz Dual Trace
V-202B 20 MHz Dual Trace, High Performance
V-302B 30 MHz Dual Trace
V-352B 35 MHz Dual Trace, High Performance
V-550B 50 MHz Dual Trace, High Performance

Call For Special Intro Price Offer



master charge · VISA

THE TEST EQUIPMENT SPECIALISTS

TOLL FREE HOT LINE

800-223-0474

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

ADVANCE ELECTRONICS

HOBBY CORNER

continued from page 80

New 3rd hand

A couple of years ago, I told you about a terrific circuit-board holder called *The 3rd Hand* made by Studio 3 (P. O. Box 1184, Kailua, Hawaii 96734). I have just had an opportunity to try out a new model of it.

FIG. 4

I am happy to report that the new *3rd hand* is even more convenient than the old one. Now you don't even have to clamp in the circuit board with thumb screws. Instead, there is a spring with a PVC gasket. (See Fig. 4.) In spite of the fact that your boards slip in and out easily, they are held firmly.

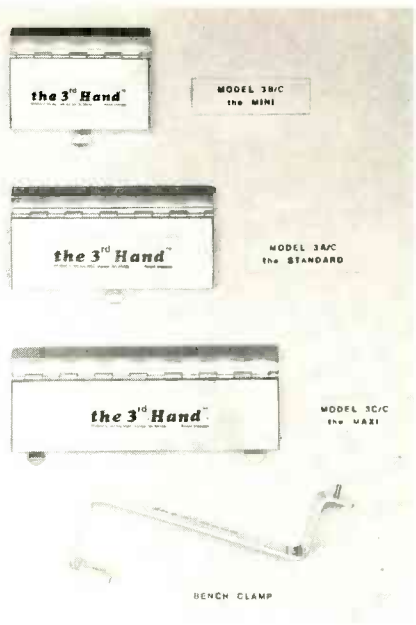


FIG. 5

There are now three sizes to handle any size board (see Fig. 5). Another nice feature is an extension clamp to move the *3rd hand* back away from the edge of your workbench. Prices range from about $5 to $15. If you can't find this useful tool at your local distributor, contact the people at Studio 3. **R-E**

UNIVOLT'S DT-810 DIGITAL MULTIMETER

The unique space age digital multimeter with transistor gain (hFE) measurement capability should be the only multimeter you own.

Ora Electronics has offered in the past many fine Digital Multimeters (D.M.M.'S). We still sell the famous D.M.M.'S such as Beckman, Fluke, Hickok, and others. We have always followed the advance in technology used in D.M.M.'S, and we always wanted to supply our many good customers with the most Ideal Multimeter, at a price they can afford. In the past we had to sell good, but expensive Multimeters, expensive but "fair" Multimeters, and plain "cheap" Multimeters.

WE FOUND IT!

Several months ago, a famous Test Equipment Manufacturer, walked in to our headquarters with a Prototype of a Digital Multimeter. We were very impressed it had almost everything we wanted plus a bonus, the only question remaining was "how expensive is it?" When we heard the answer, a big smile appeared on our faces. After several improvements we are proud to offer it. After you read the features (and price) I am sure you are going to order one or more, of these fine D.M.M.'S that we call the "UniVolt".

LCD DISPLAY.

The unit has a 3.5 Digit liquid crystal display. The sharp digits are 14mm high and have a viewing angle of 140°.

HIGH ACCURACY.

The basic D.C. accuracy of the UniVolt is 0.5% of reading +1 digit, which makes it one of the more accurate instruments in its class. The input impedance is very high,10 mega- Ohms (10,000,000) Ohms, which helps in measurements of low voltage and high frequency signals.

MEASUREMENT RANGES.

The UniVolt has D.C. voltage range of 100uv to 1000V in five steps, A.C. voltage range of 100mV to 1000V, current measurement range of 100mA to 10A (DC) and resistance range of 1 to 2,000,000 Ohms.

CONTINUITY & DIODE TEST.

A fast and accurate continuity test mode utilizes a built-in buzzer to indicate continuity. The same mode is used to check diodes and their approximate forward voltage.

EASE OF OPERATION.

The UniVolt is small, it measures 6½" x 3⅜" x 1¼". It's light weight, only 9.87 oz. including battery! It utilizes push buttons, for easy one-hand operation and the front panel has a unique color coding for reduced errors.

OVERLOAD PROTECTION

The unit has an extensive overload protection on all ranges. On D.C. current ranges it uses a .5A GMA type fuse. A spare fuse is supplied with the unit at no extra cost.

MAINTENANCE FREE

The heart of the UniVolt Multimeter is a 40 pin L.S.I. chip; the Intersil ICL710G. This space ages chip has proven to be one of the most sophisticated and reliable micro-electronic circuit in use, it is supported by minimum amount of external parts, which are over specified to insure failure safe instrument. Of course, Ora Electronics stands by this instrument and guarantees it for one year (See specific warranty information).

ORA ELECTRONICS

A division of Alliance Research Corp.

OUR SERVICE MAKES THE DIFFERENCE

18215 PARTHENIA ST. NORTHRIDGE, CA 91325

(213) 701-5848 Telex 181011

OTHER FEATURES

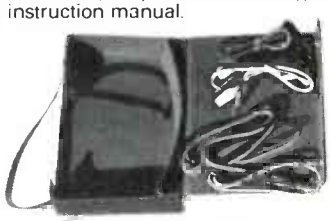
It uses one 9 volt carbon battery (included), which last approximately 200 hours of continuous use. Its sampling time is 0.4 seconds, operating temperatures of 30°F to 104°F, and operating humidity of less than 80% R.H.

BONUS!!

We left the best to the end. The UniVolt DT-810 has something unique. It has a **transistor gain (hFE) measurement mode!** This unique feature enables you to measure hFE values of 0-1000 of either P.N.P. or N.P.N. transitors.

SPECIAL PRICE

We had originally decided to sell the unit for $119.95, but in order to promote the new advancement in D.M.M. design, represented by the UniVolt, for a limited time only you can buy this incredible unit for only $99.95 including: standard red & black test leads, a fresh 9v carbon battery, a spare 0.5A GMA type fuse and an instruction manual.



FREE CASE

We have worked long on the UniVolt project and we hate to see scratches or bad looking units. So we decided to go all the way, when you buy the UniVolt DT-810 Multimeter (and for a limited time only!) we will give you absolutely free a hard vinyl leatherette, carrying case, with felt padding and a compartment for your test leads. The regular selling price for this case mode CC-01 is $8.00.

ACCESSORIES AVAILABLE.

The only two accessories available are: UP-11, hFE probe with special plug and 3 color codes alligator clip, and the UP-12 I.C. clip adaptor, which will help you hook your multimeter to any I.C. pins. (You can buy both probes for only $6.00, but only when you purchase the UniVolt DT-810 now.)

ORDER NOW!

It's very easy to order your UniVolt DT-810 multimeter. Send $99.95 (California residents add 6% sales tax) plus $2.50 delivery charge to the address below, if you want the optional accessories, please add $6.00 (California residents add 6% sales tax). A cashier check or money order will help speed your order. Credit card holders (master card or visa) can call our toll free number **(800) 423-5336**, in California it's **(800) 382-3663**. C.O.D. orders will be accepted, but you must pay by cash or money order and a C.O.D. charge of $1.40 will be added. If you decided to buy another brand of Multimeter, please call us too, we carry many other types of multimeters and test equipment at low prices.

CIRCLE 29 ON FREE INFORMATION CARD

new products

More information on new products is available. Use the Free Information Card inside the back cover.

MOTO-TOOL KITS, from Dremel, a division of Emerson Electric Company, feature full color point-of-purpose packaging; newly designed, highly functional boxes, and a tool-accessory assortment.

CIRCLE 151 ON FREE INFORMATION CARD

Model 3801 Variable Speed Moto-Tool Kit offers best-quality *model 380* ball-bearing 5,000 to 28,000 RPM Moto-Tool housed in a tough, double-wall polyethylene deluxe storage/carrying case with snap-lock cover. It comes with 40 accessories and is a high-speed multi-use tool for cutting, carving, polishing, grinding, sanding, or other operations.

Model 3701 Variable Speed Moto-Tool Kit (shown) contains the bronze sleeve bearing 5000 to 28,000 RPM *model 370* Moto Tool and 35 accessories. It comes in a handy storage/carrying case to hold Moto-Tool and accessories.

Model 2701 Constant Speed Moto-Tool Kit features the *model 270* bronze sleeve-bearing 30,000 RPM Moto-Tool and 30 accessories in handy storage/carrying case.

Model 2501 Constant Speed Moto-Tool Kit is quiet, smooth, and cool running, even under load conditions. A new *model 250* sleeve-bearing 30,000 RPM Moto-Tool comes with 25 accessories in a touch polyethylene storage case for holding Moto-Tool and accessories in place.

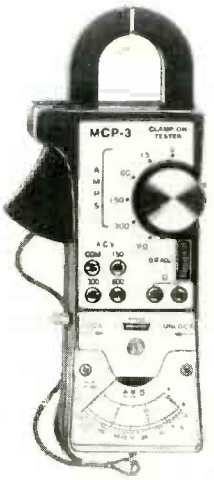
Model 2401 Constant Speed Moto-Tool Kit with *model 245* Moto-Tool, with constant-speed 25,000 RPM motor and shatter-proof housing, comes with built-in hanger and 14 accessories.

Prices are: *Model 3801*, $84.95; *model 3701*, $72.95; *model 2701*, $62.95; *model 2501*, $54.95, and *model 2401*, $44.95.—**Dremel,** Division of Emerson Electric Co., 4915 21 St., P.O. Box 518, Racine, WI 53406.

ANALOG MULTIMETER, *model ME-300,* has a DC sensitivity of 30,000 ohms-per-volt and an AC sensitivity of 10,000 ohms-per-volt. Its features include centerscale readings of 6, 12, and 24 volts, a wide-scale meter deflection angle of 95°, a mirrored scale for easy reading, and five function modes—DC volts, AC volts, DC milliamperes, AC milliamperes and ohms. This portable unit has a voltage-measurement range to 480 volts DC and 480 volts AC, a current-measurement range to 12 amps DC and 6 amps AC, and a resistance-measurement range to 3 megohms. Operated by two 1.5-volt AA batteries, the *ME-300* has an accuracy of ±4% AC and ±3% DC. The meter movement and PC board are protected against burnout by diodes, a fuse, and a fusable link. Price is $38.00.—**SOAR Electronics Corp.,** 200 13th Ave., Ronkonkoma, NY 11779.

CIRCLE 152 ON FREE INFORMATION CARD

AMP/VOLT/OHM METER, *model MCP3,* is a clamp-on instrument that locks in the measurement reading with a meter-locking button, mak-



CIRCLE 153 ON FREE INFORMATION CARD

ing it easier to read when used in hard-to-reach places. This compact, lightweight unit features a jaw-width capacity of 1⅛ inches, fuse-protected ohms circuit and a color-coded front panel. The *model MCP3* has five amperage ranges, three AC-voltage ranges and a 0 to 1000-ohms range. Accuracy specifications: AC amps/volts are ±3% full-scale and resistance is ±3% of scale length. The *model MCP3* comes with carrying case, test leads, batteries, and instruction manual. Price is $54.95.—**Universal Enterprises, Inc.,** 14270 N.W. Science Park Dr., Portland, OR 97229.

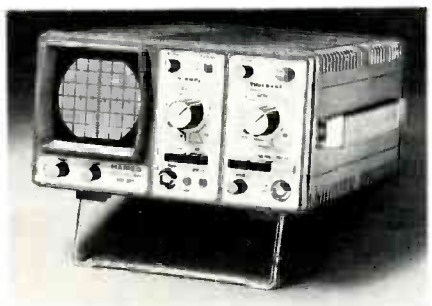
DIGITAL LOGIC PROBES, *model 3300A 10 MHz—TTL/COMOS Logic Probe, and model DPL-1 1.5 MHz—Universal Logic Probe.* The *model 3300A* (shown) has an input impedance of greater than 150 K ohms and features 50-nanosecond minimum pulse-width detection. There is a 10-MHz frequency response and a multi-family, switch-selectable threshold level (DDT/TTL and HTL/CMOS). Power requirements are 5 volts at 30 mA or 15 volts at 40 mA. It can detect single or multiple pulses. The dimensions are 7.1 × 0.9 × 0.9 inches and the weight is 70 grams. There is a .25-amp fuse for input overload and probe-power protection.

CIRCLE 154 ON FREE INFORMATION CARD

The *model DPL-1 1.5 MHz* has an input impedance of 300K ohms with a 300-nanosecond minimum pulse-width detection; it can detect single or multiple pulses. Thresholds are: logic-1 (HI-LED) 70% V_{CC}; logic-0 (LO-LED) 30% V_{CC}. The maximum input voltage is +50-volts DC continuous or 115-volts AC up to 15 seconds. It has built-in lead reversal protection; the low-power requirements are 5 volts at 30 mA or 15 volts at 40 mA. The operating temperature range is 0-50°C.

The model 3300A is priced at $41.95; model DLP-1 costs $29.95.—**Energy Electronic Products,** 6060 Manchester Ave., Los Angeles, CA 90045.

20 MHz DUAL TRACE SCOPE, *model V-202,* offers a 5.5-in. square CRT with an internal graticule. It features vertical sensitivty of 1 mV/div to 7 MHz (using × 5 amplifier) and 5 mV/div over the full bandwidth. Dynamic range for the vertical



CIRCLE 155 ON FREE INFORMATION CARD

amplifier is eight divisions or more. The display modes are Ch 1, Ch 2, Dual, Add, and Diff.

Other features include Z-axis modulation, continuously variable scale illumination, trace rotation, front-panel X-Y operation, and built-in TV sync separator. The weight is 19 lbs., and the measurements are 11 × 7.6 × 16 in. Price $850.00 with two ×1/×10 probes included.—**Hitachi Denshi America Ltd.,** 175 Crossways Park West, Woodbury, NY 11797. **R-E**

communications corner

Things are different outside the big cities.

HERB FRIEDMAN, COMMUNICATIONS EDITOR

THE ACTOR BURT REYNOLDS ONCE DELIVERED a line that sums up a major problem concerning the preparation of articles and features in specialty and limited-interest publications.

In the motion picture *Smokey and the Bandit*, Sally Fields and Burt Reynolds have discovered they have a mutual attraction for each other and are trying to find some common ground on which to base a lasting relationship. Unfortunately, she has been reared in the "sophisticated" East, and he is a "good ol' boy" from the South. Though both are intelligent, they share no common interests and little common knowledge. Exasperated, she asks if she is stupid, and Burt replies: "Whether you're stupid depends on where you're standing."

In electronics, most writers and columnists are based in the East, and often have no idea what's going on in other parts of the country. Sure, we attend conventions, seminars, and the like, but we're often with people having the same interests and we might as well have stayed at home. Fact is, in this modern age of fast-changing technology we often get only the highlights of some new leading edge in the state-of-the-art, and really fail to know what's going on back where technology just plugs along, doing the same unspectacular but necessary job day after day.

For example, in a recent column I reminisced about open-wire transmission line. Shucks (shucks??), we haven't seen that stuff up here in *cable country* in years. The way our local parts distributors tell it, they can't remember how far back it was that open-wire line was discontinued. Yet that issue of **Radio-Electronics** wasn't out a week before the first letters came in telling how open-wire line was needed and still used in South Carolina where deep-fringe TV reception was often the norm. (Please fellers, next time you write, tell me where to buy open-wire line and insulators. I'll pass it along to readers who ask.)

Another example is amateur radio. Up this way in the Big Apple, it appears most amateurs run around with 2-meter handie-talkies on their belts. Club activity also appears to be predominantly "repeater-oriented," though there's a nice all-band operation that can be heard on occasion coming from the Hall of Science.

One reason for that is that there's almost no place to find a good selection of ham gear; most of what's around is 2-meter transceivers. Many years ago, New York was the center of communications with seemingly countless "radio stores" offering a full line of ham equipment. Today, after the conglomerates and business-school graduates got through mismanaging the assorted chains, there's virtually nothing left. Only Radio Shack was smart enough to hire an old-time radio person, Lewis Kornfield, rather than some 25-year-old MBA, and Radio Shack is the only decent chain for "heavy equipment" up this way—but they don't go in for much ham gear. In short, ham radio doesn't look like much from the tall office buildings.

But I recently got a chance to tour the radio "shops" in what we back East consider the backwaters of our country, and it just ain't the way it appears to be. First off, there are ham radio shops, such as Henry Radio in Los Angeles, the likes of which we haven't seen in the East in 20 years. The shelves aren't just limited to 2-meter gear; they're loaded with all-band equipment and there are customers spending their money.

Out in Long Beach, California, there's a club operating not just for a few special events, but full-time on all bands from the radio room of the Queen Mary (which is now a hotel/restaurant). During the summer, thousands upon thousands of visitors each day see ham radio in action (the tour goes right through the radio-room complex). The club has built the modern solid-state gear right into the old console. There, in just one panel, is an all-band rig that exceeds the performance of the old Queen Mary gear that takes up about ten panels and a few racks. What a tremendous display of the old and the new in a visual picture understood by visitors of any age and nationality! Yet it wasn't done by folks from the "Big City."

Many writers have written that CB is dead. Sure, there are few brands left, and very little in the way of sales if we consider anything under one or two million as "insignificant." Yet travel the backwaters of the West. There might be no one else on the road—front or rear—for a couple of hundred miles, but the nearest ranch or spread is just behind the hill, and you'll find that CB is alive and kicking. Antennas still sprout from cars, vans, and pickups like corn in an Iowa field. Out there, where your life might depend on CB, it's still going strong because they haven't heard that it's "dead."

It's just as Burt said: "Whether you're stupid depends on where you're standing." So if your favorite magazine appears to have missed some point, or just plain "blown it," give the editors the benefit of the doubt and assume they just don't know. And, believe it or not, most editors appreciate reader mail; write and tell them what the real facts are.

Vertical antennas

In a recent column I discussed antenna gain, which brought some mail asking why omnidirectional whips (verticals) on cars and vans appear to be directional at certain frequencies; that is, a whip in the center of a van's roof appears to have greater radiation front and rear, with reduced radiation to the sides.

Without getting into the reason for it

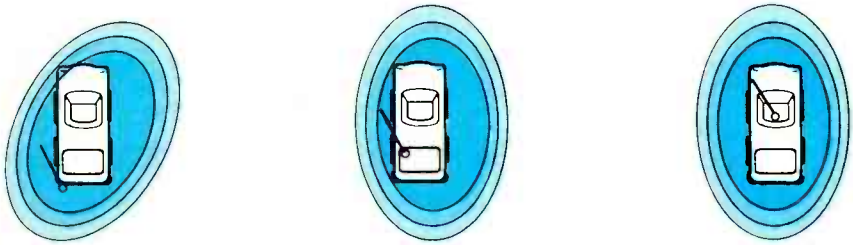
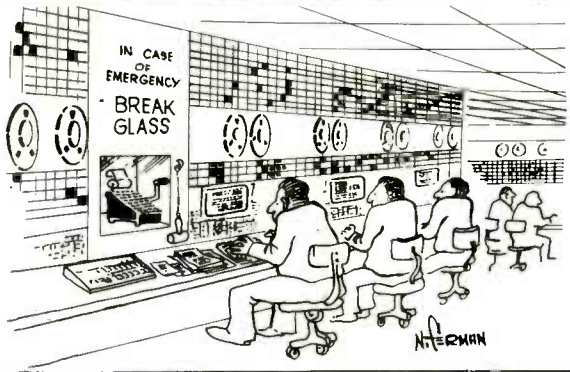


FIG. 1

(which would take up most of this issue), the RF from a mobile whip effectively searches for the longest mirror-image ground, with maximum effort occurring for the first 1/4-wavelength. If most of the metal, hence ground, is located to the front and rear, the radiation will favor the front and rear. If the antenna is mounted off the left rear fender, maximum radiation will be towards the front right fender. That effect is most pronounced at HF frequencies, say 27 MHz, because the 1/4-wavelength "ground" needed is often greater than or equal to the length of the whole vehicle. At UHF or VHF frequencies, say 146 MHz, the antenna is usually positioned so there is at least 1/4-wavelength of vehicle "ground' in all directions, and the antenna pattern becomes more closely omnidirectional. That is why for a given antenna location, the 2-meter antenna appears to be primarily omnidirectional, while a CB antenna tends to favor a particular heading. At the low HF frequencies like 3.9 MHz there is so little ground under the antenna that the signal tends to be omnidirectional near the ground, with much of the radiation aimed skywards. (It's a whole different ballgame at the very low HF frequencies where the vehicle does not represent an appreciable part of a ground system.)

The illustrations in Fig. 1 are actual antenna patterns from a full-length CB whip mounted on a standard size automobile. They give you some idea what to expect in the 27 MHz frequency range. They clearly illustrate how the radiation pattern from a vertical antenna favors the "longest ground." **R-E**



new ideas

DIGITAL COMBINATION LOCK

THIS DIGITAL COMBINATION LOCK NOT only requires you to enter a specific seven-digit number, but to do it within a fixed period of time. Any mistake, and the lock automatically resets itself.

The sequence of numbers is entered either through a non-matrixed keypad (each key has its own set of contacts) or through a similarly arranged group of normally-open, momentary pushbutton switches.

A schematic of the circuit is shown in Fig. 1. To illustrate how the lock works, assume that the correct combination is "1234567." When the first digit is entered, via switch S1, IC1 is triggered and four things happen: The IC, wired as a one-shot, starts timing (duration is set by R1-C1 and is about five seconds as shown); the output of the IC goes high, the TIME LIMIT LED lights, and a pulse is output, through IC5-a, to IC2, a 7490 counter.

The counter, in turn, outputs the BCD (*B*inary *C*oded *D*ecimal) equivalent of "1" to IC3, a 7441 BCD-to-decimal decoder/driver having ten outputs (see Fig. 2).

When a BCD number appears at the inputs of the 7441, the appropriate output pin of that IC goes low.

"Coincidentally," the second switch in the sequence is connected across that output line, so when it is depressed, a negative-going pulse is applied to IC5-b, that inverts it. That "low" is NAND-ed with the "low" from IC1 by IC5-a, and a second pulse is sent to the counter. What happens after that is obvious.

Finally, when S7 is closed, the "6" pin on the 7441 goes low. That causes IC2 to

continued on page 98

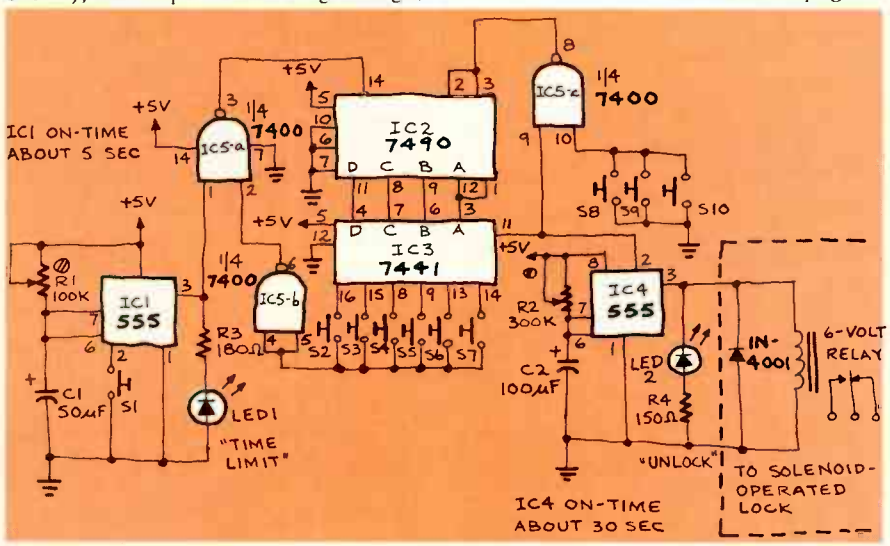


FIG. 1

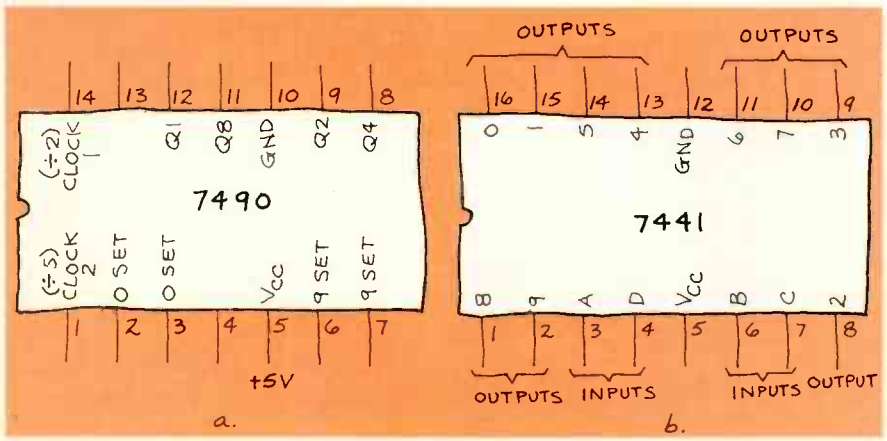
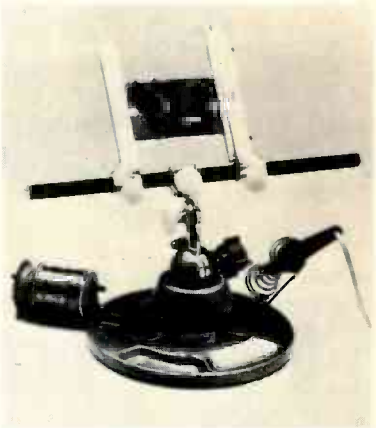


FIG. 2

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. In addition, Panavise will donate their model 324 Electronic Work Center, having a value of $49.95. It combines their circuit-board holder, tray base mount, and solder station (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 and to subsequently republish my idea in collections or compilations of reprints of similar articles. 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

Mail your idea along with this coupon to: **New Ideas Radio-Electronics, 200 Park Ave. South, New York, NY 10003**

stereo products

More information on stereo products is available. Use the Free Information Card inside the back cover.

CARTRIDGE TRANSFORMER, CST-80, is an interface between tonearms equipped with moving-coil cartridges, and preamplifiers that lack built-in moving-coil input amps. It is available in two impedance ranges: 3 ohms with 30 dB gain and 40 ohms with 20 dB gain. Using controlled-parameter-circuit design techniques, the *CST-80*'s specifications include a wide frequency

CIRCLE 131 ON FREE INFORMATION CARD

response (95 kHz, −1 dB), minimum distortion (.005% THD at 1 kHz, −10 dB *input*) and low phase shift. Suggested retail price for either *CST-80* version is $300.—**Audio Interface,** P.O. Box 7369, Van Nuys, CA 91409.

GROUND-LOOP FAULT ELIMINATOR, the *model 3900 Ground Eliminator*, improves the hum performance of stereo systems. It is designed to eliminate ground-loop errors in connecting cables which may cause either subtle or gross hum

CIRCLE 132 ON FREE INFORMATION CARD

defects. Completely passive circuitry is employed to avoid introducing distortion of any kind. Price of the *3900* is $14.95 (kit) and $16.00 (wired).—**Ace Audio Co.,** 532-5th St., East Northport, NY 11731.

THREE LIGHTWEIGHT HEADPHONES, *models HP-1100, HP-880 and HP-550,* for serious listening, have just been introduced. Traditionally, headphones with strong bass output have been quite heavy and, therefore, uncomfortable for prolonged listening. The *HP-1100* and *HP-880* have the low-impedance drivers necessary for superior bass reproduction, but are "human-engineered" for comfort, with soft ear cushions and dual-band construction that distributes weight uniformly across the listener's head. The third headphone, *model HP-550*, weighs only 5.8 oz. and has a special pressure-type construction for monitoring recording sessions. The *HP-550* shuts out external sound, while capturing every detail of the recording program. A two-way diaphragm made of polyester film provides excellent

CIRCLE 133 ON FREE INFORMATION CARD

rigidity and low mass for accurate sound reproduction. Suggested retail prices for the *HP-1100, HP-880* and *HP-550* are, respectively, $79.95, $64.95 and $39.95.—**US JVC Corp.,** 58-75 Queens Midtown Expressway, Maspeth, NY 11378.

TURNTABLE, *model XR-Q11*, features an internal microcomputer that can be programmed to play up to seven selections on a record side in any order. After programming, operation is totally automatic from initial cueing to final arm return and motor shutoff. The system will also shut down in case of malfunction and a warning indicator will light up.

All controls are located on the front panel, outside the dust cover. The *model XR-Q11* also features a dual-head magnetic sensing system that

CIRCLE 134 ON FREE INFORMATION CARD

measures platter speed by reading magnetic pulses and triggers quartz-servo speed correction system. Manufacturer's specifications include a wow-and-flutter of 0.015% and a signal-to-noise ratio of 78 dB.

According to the manufacturer, the straight, low mass tonearm is pivoted at the exact point that minimizes vibration transfer, thus improving dynamic balance. The arm suspension and high-density *BMC* (Bulk Molding Compound) turntable base reduces acoustic feedback. Price is $650.—**Sansui Electronics Corp.,** 1250 Valley Brook Ave., Lyndhurst, NJ 07071. **R-E**

Start learning and computing for only $129.95 with a Netronics 8085-based computer kit. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.

THE NEW EXPLORER/85 SYSTEM

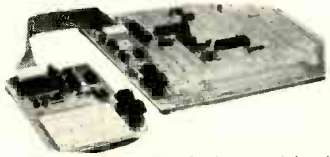
Special! *Full 8" floppy, 64k system for less than the price of a mini! Only* **$1499.95!**

(Also available wired & tested, $1799.95)

Imagine — for only $129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers on-board S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only $129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.

Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. $129.95

Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)



Level "A" With Hex Keypad/Display.

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 advanced 8155 RAM I/O . . . all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

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 . . . cassette tape recorder input and output . . . cassette tape control 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 F000, leaving 0000 free for user RAM/ROM. Features include tape load 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 to 9600 baud . . . 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 Keypad/Display 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 . . . go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

HEX KEYPAD/DISPLAY SPECIFICATIONS

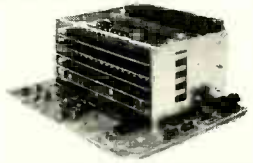
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

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 selectable in 4k blocks . . . address decoding for onboard 8k EPROM expansion selectable in 8k blocks . . . address and data bus drivers for onboard expansion . . . wait state generator (jumper selectable), to allow the use of slower memories . . . two separate 5 volt regulators.

LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.



Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of 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 EFFF 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 2k x 8 RAM IC's (allowing for up to 12k of onboard RAM).

DISK DRIVE SPECIFICATIONS

- 8" CONTROL DATA CORP. professional drive.
- LSI controller.
- Write protect.
- Single or double density.
- Data capacity: 401,016 bytes (SD), 802,032 bytes (DD), unformatted.
- Access time: 25ms (one track).

DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible).
- 2 Serial I/O ports
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

Beginner's Pak (Save $26.00!) — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price $199.95), now at SPECIAL PRICE: **$169.95** plus post. & insur.

Experimenter's Pak II (Save $53.40!) — Buy Level "A" (Hex Keypad/Display Version) with Hex Keypad/Display, Intel 8085 User Manual, Level "A" Hex Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $279.35), all at SPECIAL PRICE: **$219.95** plus post. & insur.

Special Microsoft BASIC Pak (Save $103.00!) — Includes Level "A" (Terminal Version), Level "B", Level "D" (4k RAM), Level "E", 8k Microsoft in ROM, Intel 8085 User Manual, Level "A" Monitor Source Listing, and AP-1 5-amp Power Supply, (regular price $439.70), now yours at SPECIAL PRICE: **$329.95** plus post. & insur.

ADD A TERMINAL WITH CABINET, GET A FREE RF MODULATOR: Save over $114 at this SPECIAL PRICE: **$499.95** plus post. & insur.

Special 8" Disk Edition Explorer/85 (Save over $104!) — Includes disk-version Level "A", Level "B", two S-100 connectors and brackets, disk controller, 64k RAM, AP-1 5-amp power supply, Explorer/85 deluxe steel cabinet, cabinet fan, 8" SD/DD disk drive from famous CONTROL DATA CORP. (not a hobby brand!), drive cabinet with power supply, and drive cable set-up for two drives. This package includes everything but terminal and printers (see coupon for them). Regular price $1630.30, all yours in kit at SPECIAL PRICE: **$1499.95** plus post. & insur. Wired and tested, only **$1799.95**.

Special! Complete Business Software Pak (Save $625.00!) — Includes CP/M 2.0, Microsoft BASIC, General Ledger, Accounts Receivable, Accounts Payable, Payroll Package: (regular price $1325), yours now at SPECIAL PRICE: **$699.95**.

Please send the items checked below:

- ☐ **Explorer/85 Level "A" kit** (Terminal Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **Explorer/85 Level "A" kit** (Hex Keypad/Display Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **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 post. & insur.
- ☐ **Level "B" (S-100) kit** . . . **$49.95** plus $2 post. & insur.
- ☐ **Level "C" (S-100 6-card expander) kit** . . . **$39.95** plus $2 post. & insur.
- ☐ **Level "D" (4k RAM) kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **Level "E" (EPROM/ROM) kit** . . . **$5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85 . . . **$49.95** plus $3 post. & insur.
  - ☐ Fan For Cabinet . . . **$15.00** plus $1.50 post. & insur.
- ☐ **ASCII Keyboard/Computer Terminal kit:** features a full 128 character set, u&l 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 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator) . . . **$149.95** plus $3.00 post. & insur.
  - ☐ **DeLuxe Steel Cabinet** for ASCII keyboard/terminal . . . **$19.95** plus $2.50 post. & insur.
- ☐ **New! Terminal/Monitor:** (See photo) Same features as above, except 12" monitor with keyboard and terminal is in deluxe single cabinet; kit . . . **$399.95** plus $7 post. & insur.
- ☐ **Hazeltine terminals:** Our prices too low to quote — **CALL US**
- ☐ **Lear-Sigler terminals/printers:** Our prices too low to quote: **CALL US**
- ☐ **Hex Keypad/Display kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **AP-1 Power Supply kit** ±8V @ 5 amps) in deluxe steel cabinet . . . **$39.95** plus $2 post. & insur.
- ☐ **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 post. & insur.
- ☐ **32k RAM kit** . . . **$299.95** plus $2 post. & insur.
- ☐ **48k RAM kit** . . . **$399.95** plus $2 post. & insur.
- ☐ **64k RAM kit** . . . **$499.95** plus $2 post. & insur.
- ☐ **16k RAM Expansion kit** (to expand any of the above in 16k blocks up to 64k) . . . **$99.95** plus $2 post. & insur. each.
- ☐ **Intel 8085 cpu Users' Manual** . . . **$7.50** postpaid.
- ☐ **12" Video Monitor** (10MHz bandwidth) . . . **$139.95** plus $5 post. & insur.
- ☐ **Beginner's Pak** (see above) **$169.95** plus $4 post. & insur.
- ☐ **Experimenter's Pak** (see above) . . . **$219.95** plus $6 post. & insur.
- ☐ **Special Microsoft BASIC Pak Without Terminal** (see above) . . . **$329.95** plus $7 post. & insur.
- ☐ Same as above, plus **ASCII Keyboard Terminal With Cabinet, Get Free RF Modulator** (see above) . . . **$499.95** plus $10 post. & insur.
- ☐ **Special 8" Disk Edition Explorer/85** (see above) . . . **$1499.95** plus $26 post. & insur.
  - ☐ **Wired & Tested** . . . **$1799.95** plus $26 post. & insur.
- ☐ **Extra 8" CDC Floppy Drives** . . . **$499.95** plus $12 post. & insur.
  - ☐ **Cabinet & Power Supply For Drive** . . . **$69.95** plus $3 post. & insur.
- ☐ **Drive Cable Set-up For Two Drives** . . . **$25** plus $1.50 post. & insur.
- ☐ **Disk Controller Board With I/O Ports** . . . **$199.95** plus $2 post. & insur.
- ☐ **Special: Complete Business Software Pak** (see above) . . . **$899.96** postpaid.

SOLD SEPARATELY:

- ☐ **CP/M 1.4** . . . **$100** postpaid.
- ☐ **CP/M 2.0** . . . **$150** postpaid.
- ☐ **Microsoft BASIC** . . . **$325** postpaid.
- ☐ **Intel 8085 cpu User Manual** . . . $7.50 **postpaid.**
- ☐ **Level "A" Monitor Source Listing** . . . **$25** postpaid.

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE: 800-243-7428

To Order From Connecticut Or For Technical Assistance, call (203) 354-9375

Total Enclosed (Conn res. add sales tax) $ _____

Paid By:

☐ Personal Check ☐ Cashier's Check/Money Order

☐ VISA ☐ Master Charge (Bank No. — — — —)

Acct. Nu. _____ Exp. Date _____

Signature _____

Print

Name _____

Address _____

City _____

State _____ Zip _____

NETRONICS Research & Development Ltd.
333 Litchfield Road, New Milford, CT 06776

CIRCLE 47 ON FREE INFORMATION CARD

service clinic

If that capacitor keeps burning up in your set, here may be the reason why.

JACK DARR, SERVICE EDITOR

EVERYONE REMEMBERS THOSE FAMOUS four-legged capacitors that caused so much trouble a few years back (They are used as collector-shunt capacitors on horizontal output transistors). These, as well as other special capacitors found in late-model sets, must be replaced only with exact duplicates. They can *not* be replaced by ordinary bypass capacitors.

These capacitors are used in circuits where there is a high-amplitude pulse at the horizontal sweep frequency (or a multiple of it). This frequency (15,750 Hz) is in the audio range although it is often thought of as RF. It acts like RF because of it's high amplitude (as anyone who has ever placed an unwary fingertip too near a high-voltage rectifier input has found out).

The key clue to the type of capacitor required lies in its circuit location. If it is in the horizontal circuit, especially in a circuit carrying a high current or pulse, the capacitor should be a special high-RF type. I ran into an example of this only last week. The set was a Magnavox *T982-04C*. Capacitor C309 was shorted and burnt up. It was replaced with what seemed to be a good substitution—a 0.25-μF capacitor rated at 400 volts. It promptly got very hot and burned up too. A 600-volt type did the same thing. A 4-μF capacitor rated at 450 volts AC did make the set work, but it too broke down in a couple of weeks.

After some difficulty in finding C309 on the schematic (see Fig. 1), it turned out to be the horizontal-deflection yoke return capacitor. All of the deflection current must flow through it and this can reach very high peak values. Actually, what was confusing was that the original was shown on the schematic as only rated at 100 volts. There really is only a small DC voltage across it, but there's a large pulse voltage.

Checking the Magnavox parts list, it's listed in the critical parts area as a 1.25-μF *special* capacitor rated at 100-volts DC. If the chassis used a horizontal-centering potentiometer (see Fig. 1-a) the part number is 250653-5. However, in some chassis the horizontal-centering pot is not used (see Fig. 1-b), and in these, two 1- μF capacitors (Part number 171363-1), shipped as a kit, are hooked in parallel across the C309 connections. Although these capacitors are available on the replacement market, for some reason we can't get cross-references for substitutions and so we must use exact factory replacements.

The principle here applies to sets of any make, as long as the capacitor is used anywhere in the high-pulse circuits or any place where high currents flow at the horizontal sweep frequency. What is special about these capacitors is that they use a dielectric material that is capable of carrying high pulse/RF currents without overheating.

If you are not certain that a special capacitor is needed, there is a simple test you can try: Put a stock capacitor in there, and if it promptly burns up, odds are you need a special one. Capacitors, as well as resistors, burn up due to too much current. With a resistor, it's usually DC, but with capacitors usually only a high pulse-current can make a good capacitor burn up from dielectric heating. (Although heat is also a good indication that a can-type electrolytic capacitor is leaky and about to fail.)

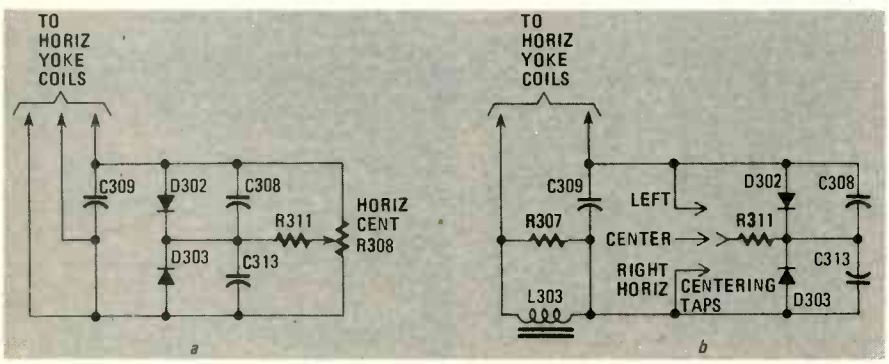


FIG. 1

If the failure characteristics sound familiar, it's the same thing that happens with the fast-recovery diodes that are used in these same circuits. If a stock type is used, it will promptly overheat because it cannot recover fast enough from the sharp pulses, and thus is subjected to too much reverse current.

High-frequency pulse currents can cause some really odd things. In one case, the symptom was that a resistor kept burning up. On the load-side of the resistor there was a nice big electrolytic capacitor. My snap judgment was that this capacitor was leaky. But when the capacitor was replaced, the resistor just burned up again. The cause turned out to be a small bypass capacitor on the input side of the resistor that was used to filter out a very high pulse. When this capacitor opened up, it permitted the high pulse to go on through the resistor, and get to the electrolytic. To the pulse, the electrolytic looked like a short to ground and too much current flowed through the resistor. We usually look for a short on the load side of a burnt resistor, but in this case it was just the opposite because of the high pulse current.

So, if you find capacitors getting hot and burning up, check the factory parts list to find out what type of capacitor should be used for replacement. It can save you a lot of trouble in the long run.

Antique sets

I have a flyer on my desk saying that the Antique Radio Services (also known as Supreme Publications) people, formerly dealing in old radio equipment, have now expanded to cover early-model radio and television service data. They have many old Rider manuals, and Sams Photofact folders, as well as other data now out of print.

The address is Antique Radio Services, Att'n Hartford Beitman, 646 Kenilworth Terrace, Kenilworth, IL. 60043. If you're into rebuilding old sets, this is the place to get in touch with. **R-E**

service questions

DON'T DIG FOR PART NUMBERS

I have a Silvertone 528.54870 stereo for repair. Both output transformers have

continued on page 96

Jim-pak electronic components

One-Stop Component Center™

This is a partial listing of over 500 items available from 500 authorized Jim-pak Distributors:

TTL

7400	2/.85	7490	.85
7402	2/.85	7493	.85
7404	2/.85	74100	2.25
7406	2/1.19	74109	2/1.19
7407	2/1.19	74121	.69
7408	2/.89	74123	.99
7410	2/.85	74150	1.95
7414	.99	74154	1.95
7417	2/1.10	74157	.99
7420	2/.85	74161	1.19
7447	1.19	74164	1.59
7474	.69	74174	1.59
7475	.79	74175	1.49
7476	.69	74192	1.19
7485	1.19	74193	1.19
7486	2/1.19	74367	.99
7489	2.99	74393	1.95

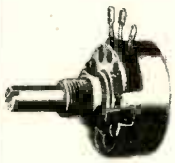
GRAB BAGS

GB100	Cer. Caps. (100)	2.95	GB123	Heat Sinks (30)	3.95
GB101	Mylar Caps. (60)	4.95	GB127	Transistors (100)	3.95
GB102	Electrolytics (60)	4.95	GB137	Chokes (50)	3.95
GB103	Tantalums (40)	4.95	GB139	Term. Strips (40)	3.95
GB108	TTL IC's (50)	4.95	GB140	Spcr/Stndff (150)	2.95
GB110	Asst. LEDs (100)	5.95	GB141	Washers (200)	2.95
GB113	Trimmers (30)	4.95	GB145	Lugs (100)	2.95
GB116	¼w Resist. (200)	2.95	GB154	1&2w Resist. (100)	2.95
GB117	½W Resist. (200)	2.95	GB162	7-Seg. Dsplys. (50)	5.95
GB120	Slide Switch (25)	3.95	GB173	3/8" Pots. (100)	5.95

LS Schottky

74LS00	.55	74LS109	.79
74LS02	.55	74LS123	1.95
74LS04	.69	74LS138	1.49
74LS08	.55	74LS139	1.49
74LS10	.55	74LS154	2.49
74LS14	1.09	74LS157	1.49
74LS30	.55	74LS161	1.79
74LS32	.69	74LS174	1.79
74LS38	.69	74LS175	1.79
74LS42	1.49	74LS192	1.89
74LS47	1.49	74LS193	1.89
74LS48	1.79	74LS221	1.95
74LS73	.79	74LS244	2.49
74LS74	.79	74LS245	3.49
74LS75	.99	74LS367	1.29
74LS85	1.95	74LS374	2.49
74LS90	1.09	81LS97	2.49

POTENTIOMETERS



2 Watt @ 70°C
7/8" Slotted Shaft
Linear Taper

1K 5K 10K
25K 50K 100K
1 Meg

CMU . . $2.95

3/4 Watt @ 70°C
15 Turn Pot.
Linear Taper

100Ω 500Ω 1K
5K 10K 50K
100K 500K 1Meg

830P . . $1.79

REGULATED POWER SUPPLY KIT

Uses LM309K. Heat Sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. 3½"x5"x2"H

JE200 . . . . . $14.95

SOCKETS

Low Profile		Wire Wrap	
8 pin LP	2/.59	14 pin WW tin	.75
14 pin LP	2/.69	14 pin WW gold	1.09
16 pin LP	2/.79	16 pin WW tin	.79
18 pin LP	2/.89	16 pin WW gold	1.19
20 pin LP	2/.99	24 pin WW gold	1.69
22 pin LP	2/1.09	40 pin WW gold	2.75
24 pin LP	.79	14 p. plug/cover	1.29
28 pin LP	.82	16 p. plug/cover	1.39
36 pin LP	.99	24 p. plug/cover	1.95
40 pin LP	1.19	Also, The Molex Line	

DIODES & TRANSISTORS

IN751	2/.59	2N2219A	2/1.19
IN757	2/.59	2N2222A	2/.89
IN1188	2.69	2N2907A	2/.89
IN3600	5/.99	2N3055	.99
IN4001	4/.59	2N3772	2.25
IN4004	4/.69	2N3904	2/.69
IN4007	4/.79	2N3906	2/.69
IN4148	10/.99	2N4401	2/.79
IN4733	2/.69	2N4403	2/.79
IN4734	2/.69	2N5129	2/.69
IN4735	2/.69	2N5139	2/.69
IN4742	2/.69	2N5210	2/.79
IN4744	2/.69	2N5951	2/1.29

DESK TOP ENCLOSURES

DTE-8 (Pictured)	$31.95
DTE-11 (Pictured)	34.95
DTE-14	36.95
DTE-HK (Case for JE600)	47.95
DTE-AK (Case for JE610) (Pictured)	52.95

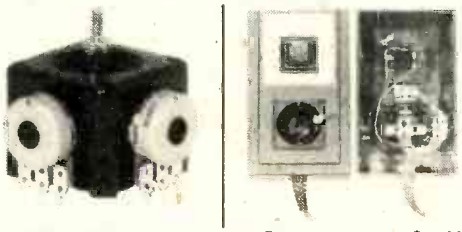
CAPACITORS

Dipped Tantalum		ELECTROLYTIC	
.1mfd@35V	2/.89	1mfd@50V	3/.69
.47mfd@35V	2/.89	4.7mfd@50V	2/.59
1mfd@35V	2/.89	10mfd@50V	2/.69
2.2mfd@25V	2/1.09	22mfd@50V	2/.79
3.3mfd@25V	2/1.19	47mfd@50V	2/.89
4.7mfd@25V	2/1.39	100mfd@50V	.59
10mfd@25V	1.19	220mfd@50V	.69
33mfd@25V	3.95	1000mfd@25V	1.19
100V MYLAR		2200mfd@16V	1.39
.001-.01mfd	4/.79	**50V CERAMIC**	
.022mfd	4/.89	10pf-.022mfd	4/.59
.047mfd	4/.99	.047mfd	4/.69
.1mfd	4/1.19	.1mfd	4/.79
.22mfd	4/1.29		

CMOS

4000	.69	4030	.79
4001	.69	4040	1.95
4002	.69	4044	1.39
4006	1.95	4046	2.49
4009	.89	4047	2.75
4010	.85	4049	.89
4011	.69	4050	.89
4013	.85	4051	1.95
4016	.85	4066	1.19
4017	1.49	4069	.79
4018	1.49	4070	.79
4020	2.19	4071	.79
4023	.49	4081	.69
4024	1.29	4093	1.19
4027	.89	4511	1.95

JOYSTICKS



JS-100K	100K Linear Taper Pots	$5.49
JVC-40	40K (2) Video Controller	5.95

MICROPROCESSORS

Z80A	CPU (4MHz)	14.95
MC6800	8 Bit MPU	14.95
8080A	CPU	7.95
8212	8 Bit I/O Port	3.95
8216	Bi-Directional Bus Driver	4.49
2513/2140	Character Generator	12.95
8T97	Tri-State Hex Buffer	2.25
AY-5-1013	30K Baud UART	6.95
AY-5-2376	88-Key Keyboard Encoder	13.95
2114-3	4K Static RAM (300ns)	9.49
MK4116	16K Dynamic RAM (250ns)	9.95
2708	8K EPROM	10.95
2716	16K EPROM (+5V)	19.95

CONNECTORS

DB25P	D-Subminiature Plug	3.95
DB25S	D-Subminiature Socket	4.95
DB51226	Cover for DB25P/S	2.25
22/44SE	P.C. Edge	2.95
UG88/U	BNC Plug	2.19
UG89/U	BNC Jack	3.95
UG175/U	UHF Adapter	.59
SO239	UHF Panel Recp.	1.49
PL258	UHF Adapter	1.95
PL259	UHF Plug	1.95
UG260/U	BNC Plug	2.39
UG1094/U	BNC Bulkhead Recp.	1.49

TOOLS

PCB-3	P.C. Board Vise	$12.49
WS-150	5"Wire Strip./Cut. (12-24AWG)	3.99
SG-30	10" 110-120V 30W Solder Iron	7.50
SG-TIP	Replacement Tip for SG-30 S. Iron	1.25

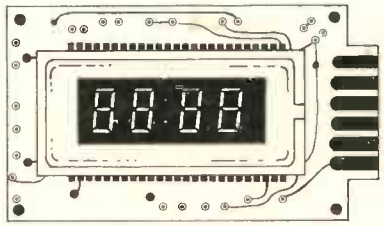
LINEAR

LM301N	.59	LM7805T	1.75
LM305H	1.39	LM7812T	1.75
LM307N	.75	LM7815T	1.75
LM308N	1.19	LM380N	1.49
LM309K	2.25	LM384N	2.49
LM310N	2.69	LM555N	.69
LM311N	1.49	LM556N	1.49
LM317T	2.29	LM565N	1.95
LM318N	2.95	LM566N	1.95
LM319N	2.95	LM567N	1.79
LM320K-5	2.25	LM723N	.79
LM7905T	1.75	LM741N	.65
LM7912T	1.75	LM1310N	2.95
LM7915T	1.75	LM1458N	.99
LM323K	5.95	LM1488N	1.59
LM324N	1.29	LM1489N	1.59
LM337T	2.29	LM1800N	4.49
LM339N	1.29	76477N	3.95

WALL TRANSFORMERS

AC250	250mA 12VAC (117V/60Hz)	$3.95
DV9200	200mA 9VAC (117V/60Hz)	3.95

12VDC AUTOMOTIVE/ INSTRUMENT CLOCK MODULE



.300 GREEN DISPLAY

MA1003 . . . . . $19.95

CIRCLE 13 ON FREE INFORMATION CARD

SERVICE QUESTIONS

continued from page 94

open primaries. I can't find replacements for them anywhere. Sears has discontinued them, and Thordarson shows no replacement. Where can I get these?—D.D., Moundville, IL

Fortunately for me (and you!) this is a tube-type job. In such cases, you don't really have to bother looking up part numbers of the original. Look at the *specs*. You can guess at the wattage rating by the transformer's size; small ones about 5 watts, slightly bigger 10-watts, and so on. In your case, the tubes are 6BQ5's. Those have a plate impedance of 5,000 ohms, and the output impedance is supposed to be 8 ohms.

Just look for a transformer with a 5,000-ohm primary, and an eight-ohm-secondary, say at 5 watts (guess in this case)—and there you are. Thordarson's 24S92 should do the job for you nicely. You'll find two full pages of tube types with the appropriate replacement transformers, on pages 156-157 of the Thordarson catalog.

FUSE BLOWS

In this Sharp 3K-63, I've tried several things to find why the +105-volt line is being pulled down, blowing the fuse. Only one that helps is opening the base to the horizontal output transistor! Open the collector, same thing. Why?—E.B. McG., Washington, DC.

That was the first letter. I told him that removing the base drive from horizontal output evidently let the transistor cut off; so, no excess current. However, with normal drive, the current went too high, and blew the fuse. The DC supply circuit was good; only when there was *AC* drive present did it draw too much.

Feedback from Mr. McGee was that, after checking all other things on and around the flyback, he suspected the flyback itself. He was right. A new flyback cleared up all the problems. It was definitely pumping into a short circuit. Thanks, Mac.

VERTICAL PROBLEM

I've received repeated callbacks on this Zenith 19EC45. Problem is vertical; raster comes up from bottom almost ⅓ of height. I replaced Q708, and it works. However, it comes back in about three months, same thing. Cooling that transistor results in full raster. Transistor doesn't check bad, but a new one will make it work again! (for a few months.) I've been using Sylvania ECG-152's as substitutes. Any help will be appreciated!—E.S., Baltimore, MD.

The ECG-152 looks as if it should work here. However, from the results, it must be overloaded somehow. It may be getting a peak that goes above the rating. Suggestion (in all cases like this): Check specs of substitute. Now, look for one with higher voltage and current rating. Here, something like ECG-375, which is a vertical deflection transistor, same case, etc., with a 150-volt rating, and 3-amp current. The heck of it is that the only way to find out is to put one in and try it. Keep your fingers crossed.

HOT CAPACITORS

Your idea worked! In this Admiral T43K10-1A, Capacitors CH65 and CH16 were running hot. I obtained exact duplicate Admiral capacitors, wired them in, and presto—nice cool caps. (**Note**: Call WATS Line for Admiral parts—1-800-447-8361, if you didn't see it before.)

Thanks to Ronald Lippert, Rockwood PA for the help.

(**Note**: When calling the WATS line, be sure to have Admiral part numbers! In the above case, they were CH16, No. 65A239-22; CH65, No. 65A239-21.)

SLOW-BLOW FUSE FAILURE

I'm puzzled by a Motorola TS-929 B31 chassis. The slow-blow fuse in the horizontal output-tube cathode blows; I've changed three of them in a year. Current doesn't seem to be too high, about 220 mA. Grid drive OK, etc. Don't get it—W.M., Phoenix, AZ.

continued on page 98

holes at both points. Cut off the excess end-material to leave semicircular openings with a 1/4-inch diameter.

Drill two 1/8-inch holes, 7/16-inch from each edge of the plate for the push rods, and tap them for an 8-32 thread. Finally, drill another 1/8-inch hole at the exact center of the piece, and tap it to 8-32, as well. That hole will be used to attach the push plate to the forearm.

Position the push plate against the steel cross-bar rod that used to belong to the elbow and, using a center punch, mark the exact center of the hole that was just drilled in the push plate. Set the push plate aside and use a #19 drill bit to drill completely through the cross-bar rod. The push plate will be attached to the cross-bar rod using a 3/4 × 8-32 screw inserted, of course, through that rod into the threaded hole in the plate.

Final assembly

Cut the 1/4-20 threaded rod from the original arm to a length of five inches. That rod is pushed through the end plate and threaded into the traveler plate for approximately two inches. Install the two four-inch push rods and secure them to the traveler bar with 8-32 hardware.

Secure a shoulder-lock gear (1 inch, 72-T, 72-pitch) to the upper-end of the threaded rod and, having inserted the threaded rod into the bearing, clamp the assembly into place on the shoulder-hinge bar.

Replace the motor that originally drove the threaded rod with a small 12-volt DC miniature motor (see parts list) and attach a 0.305-inch, 20-T, 72-pitch gear to its shaft. Secure the motor to the outside square bar on the shoulder-hinge mount and attach the square bars (and the arm they're attached to) to the shoulder motor as shown in Fig. 63.

Limit switches can be installed on small aluminum plates attached to the end plate and mounted under the motor, which is fastened to the aluminum bar mounting-post. Those limit switches take the place of the ones that are used in the flexing-elbow assembly and are wired accordingly.

The additional weight of the manipulator may present too great a load for the shoulder motor to handle. If that is the case, a lead counterweight can be fabricated and attached to a rod inserted into the shoulder assembly and extending backwards from the joint as shown in Fig. 64. Move the counterweight back and forth until the motor operates without strain.

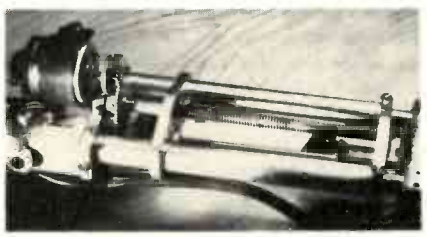


FIG. 63—COMPLETED EXTENDER ARM shows how new motor is attached and how it is connected to drive threaded rod.

FIG. 64—LEAD COUNTERWEIGHT (left) is used if weight of entire arm assembly puts too much strain on shoulder motor.

Coming up

The next two sections of this series will give instructions for building the relay-driver board that supplies 5-volt signals to the board described here; for building a *Touch Tone* encoder to generate signals for remote-control operation; for the companion decoder that supplies logic-level signals to the relay-driver board, and for an FM transmitter to get the signals from the encoder to the decoder.

And, for everyone waiting to let his computer do the work, the relay-driver board will also accept instructions from the computer's parallel port.

Just wait till you see what's coming up! **R-E**

SERVICE QUESTIONS

continued from page 96

If it takes about four months to blow, that is a slow-blow fuse indeed! Seriously, that sometimes happens. Check the fuse after it opens; look at the ends of the fuse-link. If there is a distinct "blob" on both ends of it, that fuse was blown by excess current. However, if there are no blobs, but the open in the link is hardly visible, the fuse is a victim of metal fatigue. Another symptom: the link often droops in the middle.

Heat can cause that. Check and clean up the fuse-holder. Alternate: use a pig-tail fuse, and leave the leads long enough to get it away from the chassis. Also, you might try using a circuit-breaker of the proper rating, tacked across the fuse holder. Those are equivalent to a slow-blow fuse.

INTERMITTENT FUSE BLOWING

I've got a heck of a problem: this GE 19YC chassis blows the 1.8A fuse (in the +135V line.) I've tacked a circuit-breaker across it to save fuses! I've been all over the thing; all I found was that if I disconnected the blue wire to T815, the fuse wouldn't blow. Raster is very narrow, but the high-voltage stays up, etc. (T815 is the pincushion-corrector transformer.)

If I reconnect that wire, it may work for a couple of hours—then all of a sudden pow! I got some odd readings around here in the resistance, too. That is weird; help!—J.C., Texas City, TX.

Crystal ball says that you have probably got an intermittent short to ground, or another winding, in that winding of T815. This is the horizontal winding; there are high voltages on it. You can get some really odd faults in that transformer although they're not all that common (thank goodness!) Suggest you try a new transformer.

HINT

You had an item on the GE 15XB horizontal oscillator in your August 1980 issue. Here's one more thing that was not mentioned. If you replace any of the parts inside the *shield* of the oscillator, be very sure to put the shield back on before testing. The oscillator in those won't run on-frequency if it is left off!—Mark Williams, Miami, OK.

(Right! Evidently that circuit is built so that the shunt capacitance of the shield is an important part of the circuit. Works like that in several cases, especially in IF and some color bandpass circuits.)

HORIZONTAL-OUTPUT FAILURE

I wrote you last December about a Sony KV-1711 that was eating horizontal output transistors. You tried to help. I have just found the cause in this case. It was a *shorted* picture tube! Ran into the same thing in another Sony, a KV-9200. Quick test, pull the high-voltage anode lead off. Everything works fine. Put it back on and *zap*!—M.H. Gross, Hurst, Texas.

(Thanks very much. New one on me! I should know by this time that I have not heard everything yet, and probably never will. One to be remembered, in the cases where "Everything is all right, but it won't work!")

NO VIDEO AT FIRST

When I turn on this Magnavox T936, I have sound, but the video won't come on. After about 15-20 minutes, it comes with good color, etc.! About 40 minutes later, the picture jumps and tears. I wrote you about that and you suggested a few things. Checked them all out, and finally found that the 3rd video-IF transistor was causing the whole problem. Incidentally, do you know of a substitute for a 129N1 Magnavox?—Yusuf H. Bandukwala, Houston, TX.

Glad you found it. Oddly enough, if we have a bad IF transistor, it seems to be in the 3rd video-IF stage more often than in the rest! Recommended substitutes for 129N1 transistor are RCA SK-3716 or Sylvania ECG-161. Thanks for the feedback. **R-E**

NEW IDEAS

continued from page 88

reset and also triggers IC4, another 555 one-shot. Its duration is controlled by R2-C2 and during its "on" period, it lights the UNLOCK LED and activates a five- or six-volt relay. The contacts of the relay, in turn, can be used to control a solenoid-operated lock, a car's ignition circuits, an automatic garage-door opener, etc. When IC4 has "timed-out," (about 30 seconds, using the values in the schematic) the relay opens.

The combination lock has several features intended to prevent its being opened by someone who does not know the proper combination. First, of course, is the time limit on entering the combination. Second, if any number is pressed out of sequence, the output line of IC3 will not go low, which means that even if the next key pressed is the correct one, no signal will be transmitted to IC5-b. Finally, switches S8-S10 are connected so that if they are closed, they will reset the counter to 0.

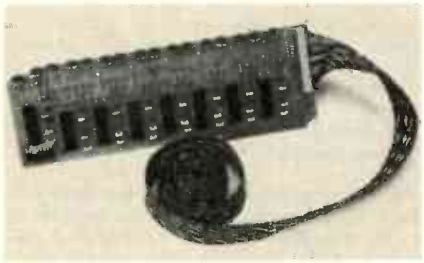
Any seven-digit number, where no digit is used more than once, can serve as the combination. Just wire the switches so the first number corresponds to S1, the second to S2, etc.

In closing, a word to the wise—don't use your telephone number even if you have one without repeated digits! It's too easy for anyone to obtain and is probably one of the first things someone looking for a combination would think of trying.—*Tom Rezachek*

computer products

More information on computer products is available. Use the Free Information Card inside the back cover.

APPLE COMPUTER ACCESSORIES, the *Applecations Series,* is a line of devices designed for the *Apple II* computer. The *AI-02* Analog Input Card is a single-card data acquisition system with 16 analog channels. Each channel is monitored



CIRCLE 121 ON FREE INFORMATION CARD

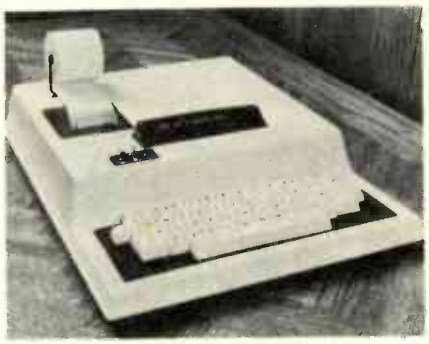
with 8-bit resolution. Channels are individually addressible and conversion time is 70 microseconds.

The Latched Analog Output Card, the *A003* (shown) is available in 2, 4, and 8-channel configurations. A program written in any language can set the output of a channel with a single operation. The *A003* accepts an 8-bit quantity and produces either a 0 to 10 volt or a −5 to +5 volt output (jumper selectable).

The *D109* is a complete digital interface system on a single *Apple II* Card. It features 32 input or output lines, optional current drive and isolation, interrupt capability, two shift registers and four programmable timers.

The *SC14* is a Signal Conditioner System for analog inputs. Input voltages in millivolts may be amplified to provide a full-scale reading and low-pass filtering may be added to reduce noise. Each channel of the *SC14* is individually programmable and the unit transmits a low impedance 0- to 5-volt output. Suggested retail prices: *AI-02* is $299; *A003* is $195 to $437 (depending on configuration); *D109* is $330; *SC14* is $255.—**Interactive Structures, Inc.,** 112 Bala Ave., Box 404, Bala Cynwyd, PA 19004.

AIM-65 ENCLOSURE, designed for the Aim-65 microcomputer, is made from high-strength ABS plastic and comes complete with mounting hardware, wire, and switches, ready for assembly. All parts are pre-cut and drilled and there is room for



CIRCLE 122 ON FREE INFORMATION CARD

two additional boards. Color is white with blue base. Price is $49.94 plus $2.50 for shipping and handling.—**Don-El Enterprises,** 3261 Michigan Ave., Costa Mesa, CA 92626.

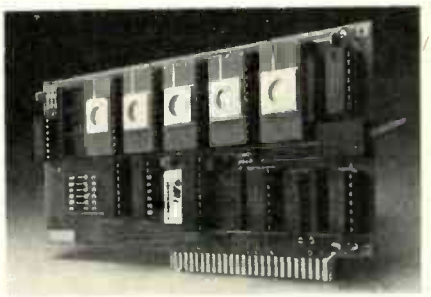
PERSONAL COMPUTER, the *Challenger 1P Series 2,* is an enhanced version of the *C1P.* It has 8K memory and now offers new sound, music and voice output capability via a digital to analog converter. The computer has a variety of applications: Its wide range of screen formats and resident BASIC makes it useful for educational purposes; and with its modem interface it can be

used as a remote terminal for timesharing services. With its floating-point math capability and "immediate-mode" operation, the computer can be used as a scientific calculator. The mini-floppy version, *C1P MF Series 2*, comes with a two-disk

CIRCLE 123 ON FREE INFORMATION CARD

operating system that allows the use of *OS-65D*, a business and development system. The two systems are expandable via the accessory *630 I/O Expander* to provide color, dual joystick operation, dual remote 10-keypad operation, AC remote-control interface, programmable sound generator, program-selectable modem and high-speed ports. The suggested retail price for the *C1P Series 2* computer is $479. The *C1P MF Series 2* sells for $1,279 and the *630 Expander* is $229.—**Ohio Scientific,** 1333 Chillicothe Rd., Aurora, OH 44202.

SOFTWARE, *6502 Development System,* contains within one program a text editor, assembler, disassembler, and symbolic debugger. The system resides in a little over 8K of RAM memory. It is available on *Apple* compatible diskettes and also on EPROM, with socket adaptors to replace Integer BASIC and convert the *Apple* computer to a dedicated 6502 Development tool.



CIRCLE 124 ON FREE INFORMATION CARD

The *Text Editor* supports the entry and maintenance of the 6502 assembler text files and has several commands including auto line numbering, Locate and Replace labels, Load Text file from disk, etc.

The *Assembler* can process all 6502 op-codes as well as pseudo op-codes such as ORG, OBJ, EQU, etc.

The *Disassembler* will disassemble a specified portion of machine resident code and produce a text file compatible with the Assembler. It includes a dump command to dump memory onto the CRT, listing both hex and ASCII values.

The *Debugger* aids in testing machine language code by executing a program step by step, and displaying each instruction and the values contained in up to 500 memory locations. Price is $395.—**Microproducts,** 30420 Via Rivara, R.P.V., CA 90274. **R-E**

EDITORIAL
continued from page 14

What we need is equity. Some basic rules. Rules like:

1. Cable companies should provide programming *only.*
2. Existing programming must not be removed from free TV just because the cable company is willing to pay a higher price, even if they have to increase the price they charge their customers to do so.
3. An industry group with consumer members, *not a government agency,* to set up rules fair to both the supplier and the customer.

I'd like to read your comments: you, the TV viewer; you the Cable-TV operator; you the TV manufacturer; you the TV broadcaster; and you the TV servicer. Send me your comments. We'll publish as many of them as we can. There are many sides to this story. I hope to be flooded with your views. Perhaps, out of it all, we can help put together the silver lining and blow that cloud completely away.

Larry Steckler

LARRY STECKLER
Publisher

"I'm afraid, sir, that I'm not entirely out of the woods yet when it comes to the programming."

market center

CLASSIFIED COMMERCIAL RATE (for firms or individuals offering commercial products or services). **$1.65 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 a personal item) **$1.00 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.

PLANS & KITS

PRINTED circuit boards from sketch or artwork. Kit projects. Free details. **DANOCINTHS INC.,** Box 261, Westland, MI 48185

DECODE Morse and RTTY signals off the air with new **Morse-a-Word** or **RTTY reader.** Morse keyboard also available. Kits or factory wired. Send for details. **MICROCRAFT,** Box 513R, Thiensville, WI 53092 (414) 241-8144.

CRYSTAL radio builders . . . $1.00 brings you two sets plans, details, price list. **BOB RYAN,** P.O. BOX 3039, Dept. R., Anaheim, CA 92803

SOUND effects synthesizer. Uses voltage controlled circuits to make wide range of sounds: birds, wind, sirens, more. Doubles as drum synthesizer. PC board and plans $9.95. **WAVEFORM PROCESSING,** 7 Bradford Ave., Pittsburgh, PA 15205

EINSTEIN reformed, superceded! Free! **408 VERMONT,** Daytona 32018

UNIQUE one digit clock kit. Featured in Feb. 80 issue of **R-E.** Send for free article reprint and info. **VERSATRON CO.,** Box 23573, Pleasant Hill, CA 94523

SUBSCRIPTION T. V. DECODER CIRCUITS
Detailed plans $ 4.60
JOE P. O. BOX 61
CUMBERLAND, R. I. 02864

MICROCOMPUTER service. Maintenance and repair for all microcomputers and peripherals. Fast. Reasonable. **PRAIRIE MICRO CLINIC,** Box 325, Herington, KS 67449 (913) 258-2179

PAY-TV unscrambler. Build your own. Fits all TV sets. Complete plans, $6.95. **PCEP ENTERPRISES,** Box 837-R, New York, NY 10274

SAVE gas, increase MPG 6%. Do it yourself, blueprints $5.00. **HAVAY,** 13551 Wake, Santa Ana, CA 92709

AMPLIFIERS, 35 to 150 watts RMS; DC amplifier designs and detailed plans and circuit board layouts, for under $200.00. Send $12.50 for complete plans and kits costs to **AUDIO ENGINEERING COMPANY,** P.O. Box 210, Alda, NE 68810

To run your own classified ad, put one word on each of the lines below and send this form along with your check for $1.65 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.

STEPPER motor evaluation kit contains quality Airpax stepper motor (960 steps/rev), versatile driver control board for manual or computer operation, and instruction handbook. Ideal for robot builders, computer hobbyists, experimenters, etc. $74.69 postpaid. Call or write **SPARKY ELECTRONIC SYSTEMS, INC.,** Dept RE-2, 64-62 Dry Harbor Road, Middle Village, NY 11379, 212-894-3000

COMPLETE 2300 MHz down converter kit. Includes 30 inch dish kit, 50 feet of RG/59U cable, receiver kit, power supply kit, and instructions. All you need is a coffee can. $195.00 plus shipping. **MARBLE ELECTRONICS,** 32 Sea Street, North Weymouth, MA 02191, (617) 335-4839

SUBSCRIPTION television education manual! Two scrambling/decoding methods with detailed circuits. Decoder dealers listed. $14.95. Kits available. ABEX, P.O. Box 26601-R3, San Francisco, CA 94126

COMPLETE plans; frequency counter, digital volt meter, $4.50 each; set of 10 telephone projects, $9.50; 12 synthesizer musical projects, $9.50; send US dlls. payable in a Mexican bank; **GEORGE SAMPSON,** Apartado Postal 47-143, Mexico 14 D.F.

KILL obnoxious loud TV commercials automatically. Complete plans, $5.00. **BRIDGES,** 1248 N. Denver, Tulsa, OK 74106

UNUSUAL electrical, electronic testers. Analog, digital and indicators. Hobbyist, professional. Free catalog. **BLUFFTON PRODUCTS, INC.,** 115 Poplar Road, Bluffton, OH 45817

TO receive commercial free-unedited movies, night club acts, sporting events; Send $229.95 for complete ready to install Micro-Wave Antenna, or $9.95 for detailed plans refundable on purchase of an antenna to: **DYNACOMP ELECTRONICS,** Dept. GF-2, POB 4181, Scottsdale, AZ 85258

EDUCATION & INSTRUCTION

ELECTRONICS books from world publishers. Lowest prices, ask catalog. **BUSINESS PROMOTION,** Lajpatrai Market, Delhi, India

UNIVERSITY degrees by mail! Bachelors, Masters, PhD's . . . Free revealing details. **COUNSELING,** Box 317-RE 1, Tustin, CA 92680

LEARN Microcomputers on your own computer. Send $5.00 for 2 complete instruction manuals. **PACCOM,** 14905 NE 40th, Dept. ERE120, Redmond, WA 98052

FREE KIT Catalog
FUNCTION GENERATOR KIT $59.95
Auto-Ranging Cap-meter kit $79.95
Phone 415 - 447 - 3433
Write or Phone for FREE CATALOG.
Average 1 minute Saturday call is 21¢.
contains TEST & EXPERIMENTER'S EQUIP.
DAGE SCIENTIFIC INSTRUMENTS BOX 1054R LIVERMORE CA 94550

AMAZING ELECTRONIC PROJECTS and PRODUCTS: Lasers Super Powered, Burning Cutting, Rifle, Pistol. Pocket. See in Dark—Shotgun Directional Mike—Unscramblers—Giant Tesla—Stunwand—TV Disrupter—Energy Producing, Surveillance, Detection, Electrifying, Ultrasonic, CB, Auto and Mech. Devices, Hundreds More—All New Plus INFO UNLTD PARTS SERVICE. Catalog $1. **Information Unlimited, Dept. R8 Box 716 Amherst, N.H. 03031.**

HIGHLY PROFITABLE ELECTRONIC ONE-MAN FACTORY
Investment unnecessary, knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! **Postcard will do. Barta-RE-J, Box 248, Walnut Creek, CA 94597.**

SATELLITE TELEVISION

SATELLITE television...Howard/Coleman boards to build your own receiver. For more information write: **ROBERT COLEMAN,** Rt. 3, Box 58-ARE, Travelers Rest, SC 29690

LINK analysis: understand the science behind satellite TV receiving systems. Six-page printout on equipment configurations **for your site.** Signal strengths, antenna gains required. Azimuth, elevation to NA satellites, F1 programmers, frequencies. Link equations solved for antenna/LNA tradeoffs. Provide longitude/latitude or nearest highway intersection. $12. Check, MC/VISA (account, bank number, expiration): **CHANNEL ONE,** Willarch Road, Lincoln, MA 01773.

SATELLITE television business manual. Successful MBA/CPA entrepreneurial team show how to organize, finance, and cash in on tax benefits. $9.95. **EARTH STATION CONSULTANTS,** PO Box 212, Ada, OK 74820

Satellite TV

FOR THE HOME

Sick of Network TV?

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.

We don't just sell information! We Manufacture Hardware!

Our 94-page catalog and information book tell the whole story! Inexpensive dishes, high pro-feeds, computer aiming software! Specs, kits and more! Send $7.95 today!

24-hour C.O.D Hotline
(305) 339-7600

SPACECOAST RESEARCH
Dept. T, P.O. Box 442, Altamonte Springs, FL 32701

Enjoy Satellite TV Now

Better than Cable TV—Over 200 TV and radio services. Why waste money? Learn the whole story and build a video system the family can enjoy. No commercials, **FREE** movies, sports and Vegas shows—worldwide, crystal clear reception connects to any TV set. Big (8 × 11 in.) book loaded with details, photos, plans, kits—**TELLS EVERYTHING! Satisfaction Guaranteed.**

Send $7.95 TODAY! Add $2.00 for 1st class (air mail) or call our 24 hour C.O.D. rush order line **(305) 862-5068.**

GLOBAL ELECTRONICS,
P.O. Box 219-E, Maitland, Florida 32751

BUSINESS OPPORTUNITIES

MECHANICALLY inclined individuals desiring ownership of Small Electronics Manufacturing Business—without investment. Write: **BUSINESS-ES,** 92-R, Brighton 11th, Brooklyn, NY 11235

NEW tax loopholes discovered. Everyone eligible. Free sample newsletter. Write: **ULC,** Box 179-CU, Clarkston, GA 30021

CRT rebuilding machinery. Large profits can be made **rebuilding picture tubes** with our **patented** equipment. **Facts** don't lie. **Training provided.** Phone (312) 583-6565. Write: **LAKESIDE,** 4071 N. Elston, Chicago, IL 60618

EMPLOYMENT OPPORTUNITIES

CALIFORNIA electronics booming! Thousands of high paying electronics jobs! Details free: **HARTMAN PUBLISHING,** 24149 Big Basin, Dept. 17, Saratoga, CA 95070

WANTED

RECEIVING tubes, old fashioned types, unused and boxed. **TSUTOM YOSHIHARA,** C1-105, Deguchi-cho 34, Suita, Osaka 564, Japan

IDEAS, inventions, new products wanted! Write for Kit. **INVENTION MARKETING, INC.-RE,** 701 Smithfield, Pittsburgh, PA 15222

MILITARY surplus radios—R-278A and AN/URR-35C. Very good condition only. Send price to: **B.R. AKER,** 1119 W Wisconsin, Portage, WI 53901

WANTED Arkay kits, Lafayette KT 100 & catalogs, toy radios from Western and Midway Company. **HARRISON,** PO Box 24, Terrace Park, OH 45174

WE buy sell used vacuum pumps, diffusion pumps and **picture tube** rebuilding equipment. Phone—(312) 583-6565. Write—**LAKESIDE,** 4071 N. Elston, Chicago, IL 60618

DISCOUNT TRS-80® DEALER A301
COMPUTER SPECIALISTS

FREE COMPUTER CATALOG UPON REQUEST

$ Discount $ on TRS-80's

26-3001	4K Color	$360.00
26-1062	16K III	888.00
26-4002	64K 1 DRIVE	3440.00

1-800-841-0860 TOLL FREE
MICRO MANAGEMENT SYSTEMS, INC.
Downtown Plaza Shopping Center
115 C. Second Av., S.W.
Cairo, Georgia 31728
(912) 377-7120 Ga. Phone No.

SOFT WARE

PROGRAMS for **Heath trainer/accessory** ET3400/ETA3400. Accurate calculator program cassette $9.50. Terminal plans $4.00. **C. Oaks,** Box 7114, Toronto, Ont. M5W 1X8

SATELLITE VISION
SATELLITE VISION
SATELLITE VISION

We manufacture the highest spec 3-meter data & video dish in the world 41db gain! We also sell direct. Immediate delivery or you pick up. Complete details including satellite TV information, aiming service and discount schedule. Send $1.25 for postage & handling to:
TIGER TENNAS©
P. O. Box 561
Casselberry, Florida 32707

BUY DIRECT

Burglar·Fire Protection

Protect Your Life, Home, Business, Auto, etc.

- Our catalog shows how. Install your own alarm systems and devices and save $$$$. We offer FREE write-in engineering service.

FREE CATALOG Lowest Prices on Reliable, High Quality Alarm Systems and Devices

Burdex Security Co. Box 82802-RE Lincoln, Ne. 68501

CRYSTAL RADIO
Complete!
$25.00 ppd.
BOB RYAN
PO Box 3039
Anaheim, CA
92803

COMPUTER MARKET CENTER

COMPUTER MARKET CENTER ADVERTISING RATES 1" by 1 column (1 5/8") $55.00. 1 1/2" by 1 column (1 5/8") $82.50. 2" by 1 column (1 5/8") $110.00. All ads must be prepaid. Send order and remittances to Computer Market Center, **Radio-Electronics Magazine,** 200 Park Avenue South, New York, New York, 10003. Address telephone inquiries to 212-777-6400. Frequency rates are available.

TEXAS

PDP8 Options

CR8-E (CTL)	$720
DK8-E	$400
DK8-EC	$400
DK8-EP	$505
DKC8-AA	$580
H948-BA	$550
H960-AA	$950
H967-AB	$1,050
H9603-CA	$2,160
KA8-E	$450
KC8-AA	$652

Federated Consultants
1218 South Ervay
Dallas, TX. 75215
214-428-5300 (Brier)
Master Charge & Visa Accepted

CALIFORNIA

FREE! INFO-PAK for small computer users mailed twice a year. We sell and broker all kinds of *SMALL COMPUTER SOFTWARE* from S-100 to TRS-80. SOFTWARE REVIEW, 704 Solano Ave., Albany, CA 94706 (415) 527-7730.

BUY THIS SPACE
$55.00 puts your ad in this space in front of 197,223 active Radio-Electronics readers. To place your ad write Computer Market Center, Radio-Electronics, 200 Park Avenue South, New York, New York 10003 or call 212-777-6400.

CANADA

DYNAMIC INFORMATION TECHNOLOGIES LTD.
P.O. BOX 6553 STN.A.
SAINT JOHN, N.B., CANADA
E2L 4R9 (506) 642-4260
TERMINALS, PRINTERS, MICROCOMPUTERS SOFTWARE.

SUPPORT MARCH OF DIMES

RETAILERS

An ad for your computer store in this space in Radio-Electronics COMPUTER MARKET CENTER puts you in touch with our computer audience. They use microcomputer equipment for both business and hobby interests. For further details call 212-777-6400.

Take stock in America. Buy U.S. Savings Bonds.

ramsey the first name in Counters !

9 DIGITS 600 MHz $129.95 WIRED

PRICES

CT-90 wired, 1 year warranty	$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack +AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally; an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
MINI-100 Kit, 90 day part warranty	59.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90-day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100 uV to 1 KV, 5 ranges
DC/AC current:	0.1 uA to 2.0 Amps, 3 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	10.1% basic DC volts
Power:	4 'C' cells

AUDIO SCALER

For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

ACCESSORIES

Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

ramsey electronics, inc.
2575 BAIRD RD. • PENFIELD, NY 14526

PHONE ORDERS
CALL 716-586-3950

TERMS Satisfaction guaranteed - examine for 10 days, if not pleased return in original form for refund. Add 5% for shipping insurance to a maximum of $10. Overseas add 15%. COD add $2. Orders under $10., add $1.50. NY residents add 7% tax.

CIRCLE 11 ON FREE INFORMATION CARD

ADVANCED COMPUTER PRODUCTS

FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!

1. **Proven Quality** Factory tested products only.
2. **Guaranteed Satisfaction**
3. **Over $1,000,000.00 Inventory**

1981 CATALOG AVAILABLE SOON.

Send $2.00 for your copy of the most complete catalog of computer products.
A must for the serious computer user.

STATIC RAM BOARDS

Now Even Less than 1½¢ per bit!

- **S-100 32K** (uses 2114)

ASSEMBLED	Kit
450ns. 459.00	450ns. 429.00
250ns. 489.00	250ns. 459.00

Bare Board 43.95
Bare Board w/all parts less mem. 99.95

MODEL 2065
64K DYNAMIC RAM MODULE $600.00

- Designed to IEEE Proposed S-100 bus standards
- Supports 16K/4-type front panels
- Operates with either an 8080 or Z-80 based S-100 system providing processor-transparent refreshes with both
- Bank-select system allows system memory expansion and is compatible with Cromemco products
- Bank select port's address is jumper-selectable
- Any 16K block can be made bank-independent
- All 64K can be made bank-enable on power-on and reset

California Computer Systems

The VISTA V-80 Disk Drive System

- 23% more storage capacity than TRS-80
- 120 day warranty
- 40 track patch at NO CHARGE

TRS80 ADD-ON
SALE $299.00

THE VISTA V-200 FOR EXIDY

Price: Starting as low as $1199.00

Model	Storage Capacity	Drive Configuration	Data Rate	Shipping Weight	Price
V200 E-20	400	2 Drive Single Head	25 kbs	1199.00	
V200 E-22	800	2 Drive Double Head	25 kbs	1549.00	
V200 E-30	600	3 Drive Single Head	32kbs	1524.00	
V200 E-32	1.2 MEG	3 Drive Double Head	32 kbs	1999.00	

ATTENTION VIDEO HOBBYISTS!!!

- ★ BOX BUILDERS
- ★ USE AS REMOTE TUNER/TIMER
- ★ FULL SCHEMATICS AVAILABLE
- ★ FOR ONLY $5.90! – FREE W/PURCHASE

A Recent Special Purchase Allows Us To Present The Following:

NEW, UNUSED COMPONENTS
From The RCA VDT-201 Videocassette Recorder

1. UHF/VHF Tuner Subassembly with all knobs and Video Demodulator — $59.95
2. HF Modulator with Audio & Video inputs. Channel 3 or 4 Output — $39.95
3. Digital Clock Module AM/PM Fluorescent Readout (Green) — $19.95
4. 300 Ohm to 75 Ohm Matching or — $ 2.40
   Subtotal $123.34
5. Complete Set of All The Above for Only — $74.95

Please Call For Volume Discounts

RAM BOARDS SPECIAL
16K Altair Mits Dynamic RAM Boards
Assem. & Tested $119.95 Untested $95.00 **16K**

LOW COST FLOPPY DISK SUBSYSTEM

Siemens FDD 120-8 (2) VISTA Floppy Controller (S-100) Case, Power Supply & Cables, CP/M Disk Operating System Assembled & Tested
Walnut Wood Sides $1499.00
★CHECK OUR FLOPPY DISK PRICING ON THIS PAGE★
SAVE $300.00 ($1799.00 VALUE)

WATANABE MIPLOT

Max pen speed 50 mm/sec resolution 10 mm typically .05 mm, built-in character generator sizes and 4 degrees of rotation absolute draw relative draw, alpha printing done with simple commands
$1195.00

IMS STATIC RAM BOARDS

	250 ns.	450 ns.
8K Static	$209.00	$189.00
16K Static	$449.00	$399.00
32K Static	$729.00	$629.00

CENTRONICS PRINTER
Model 737

- Centronics complete printer
- The 737 has everything. Check and compare the features.
- New low price — $835.00

SALE! SD SYSTEMS BOARDS
TAKE 10% OFF!

	KIT	ASSEM
SBC 100 Single Board Computer (2MHz) $265.00	$ 349.00	
SBC 200 Single Board Computer (4MHz)	299.00	399.00
Z80 Starter System	319.00	449.00
VDB 8024 Video Display Board	335.00	459.00
Versa-Floppy II	325.00	429.00
Expando PROM	115.00	225.00
SD100 Computer System w/64K	–	6995.00
SD200 Computer System w/64K	–	7995.00

6800 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp. (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Anth. Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

APPLE/EXIDY/EXPANDO TRS 80 16K-UPGRADE KIT

$49.95 TRS-80/APPLE $49.95

MEMORY EXPANSION KITS, 4116's, 16K (200/250 ns.)
8 pcs for **$49.95**
w/instructions & jumpers
Call For Volume Pricing

- ★ Special: TRS80 Schematic ..... $ 4.95
- ★ Expansion Interface Schematic . $ 4.95
- ★ Expansion Interface Connector ... 7.95

EXPANDORAM II MEMORY KITS

- ★ Bank Selectable
- ★ Uses 4116 200 ns.
- ★ Write Protect
- ★ Power 8VDC, ±16VDC
- ★ Phantom NEW LOW PRICES ★ Up to 4 MHz

Expando 64 Kit (4116) Assem. & Tested Add $50.
16K $269.00 48K $435.00
32K $349.00 64K $505.00

PERSCI MODEL 299B DISKETTE DRIVE
3.2 Mbytes capacity (unformatted), max. seek time 100MS.
ACP Price..... **$2,199.00**

UV "Eprom" Eraser
Model UVs-11E $69.95
Holds 4 Eprom's at a time. Backed by 45 years experience.
Model S-52T...$265.00
Professional Industrial Model

EMAKO-20.. Reg. $777.00 **$599.00**

UNBELIEVABLE!!
125 Caps. 60 lpm - Vertical Formal Unit - 96 Characters - Upper/Lower Case - 4.5" to 9.5" Adjustable - 80 col/40 col double width - Full 96 char. ASCII

EMAKO-22..... $799.00
Prints a 132 col/line. Available with parallel or serial output at same price.

VISTA V-300 PRINTER Vist

25 CPS, Full Character Daisy Wheel, 136 Column Model
No. FP1500 **$1995.00**

BASE II PRINTER

80 Column Impact Printer

- 60 Lines Per Minute
- 115/230 VAC, 50 or 60 Hz.
- 72, 80, 96, 120 or 132 Char/Line
- Self-Test Switch

REG. $699.00

WITH ALL OPTIONS ACP PRICE **$599.00**

Option "M" Terminal Screen Buffer (1920 Char.) $50.00
Option "S" High Speed Paper Advance & Graphics 50.00
Option "T" Tractor Feed 50.00

Z-80/Z-80A/8080 CPU BOARD

- ★ On board 2708 ★ 2708 included (450ns.)
- ★ Power on jump ★ Completely socketed.
- Z-80 Assembled and Tested $185.00
- Z-80 Kit $129.95
- Z-80 Bare PC Board ..... $ 34.95
- For 4MHz Speed Add $15.00

8080A Kit ..... $ 99.95
8080A Assembled $149.95

S-100 MOTHERBOARD SPECIAL
8 slot expandable w/9 conn.
reg $69.95. ..... NOW $52.95

SIEMEN'S FLOPPY
SALE SIEMENS $429.00 SHUGART 801R $475.00

- Special buy while supply lasts
- 8" Drive with Double-Density
- 90 Day Warranty

★CHECK OUR FLOPPY DISK PRICING! ON THIS PAGE

ACOUSTIC MODEM
NOVATION CAT™ 0-300 Baud Bell 103 Answer, Originate
149.95

'D' CAT MODEM NOW AVAILABLE $199.00

MONITORS

Sanyo 12" Data Display DM5112CK	$325.00	Zenith 13" Color Monitor	499.00
Motorola 12". High Resolution, 22 MHz, OEM Model #M3000-340	219.00	MCA 13" Color TV	349.00
		VAMP 19" Color Monitor	575.00
		VAMP 15" Color Monitor	449.00
Motorola 5" Model #1000-155 (DEM)	119.95	Sanyo 9"	169.95
		Sanyo 15"	279.00
		Leedex 12"	139.95

DATA BOOKS • COMPUTER BOOKS

1980 IC Master	$59.95
INTEL Data Book	7.50
INTEL MCS 85 Manual	7.50
SALE • OSBORNE BOOKS • SALE	**Sale**
Intro to Micros Vol. 0	12.50
Intro to Micros Vol. I	12.50
8080A Programming	12.50
6800 Programming	12.50
Z80 Programming	16.00
Vol. II Some Real Microprocessors w/Binder	27.50
Vol. III Some Real Support Devices w/Binder	18.50
Intro to Micros Vol. III	18.50
SALE • SYBEX COMPUTER BOOKS • SALE	
6502 Games	$12.95
Intro. to Personal & Business Computing	12.95
Mircoprocessors From Chips to Systems	12.95
Microprocessor Interfacing Techniques	12.95
Programming the Z80	12.95
Programming the Z8000	12.95
Programming the 6502	12.95
6502 Applications Book	12.95
CPM Handbook	12.95

MICROPROCESSORS

Z8001 16 bit to 8Mb	$189.00
Z8002 16 bit to 64K	149.00
Z80	10.75
Z80A	14.50
F-8 (3850)	16.95
2650	18.95
CD1802	13.95
8080A	8.50
8080A-4MHz	19.95
SALE 8085	14.95
8008-1	14.95
2901	9.90
2901a	14.95
2903 4-bit Supersice	29.95
TMS 9900JL	49.95
CP1600	39.95
6502	11.50
6502A	16.95
IM6100	29.95
6800	11.75
6800B 2.0 MHz	19.95
6802P	17.95
8035	18.95
8755	49.95
8748	69.95
8809	37.95
8086	69.95

ADVANCED SUPPORT

AM9511 Arith. Processor	175.00
9512 Arith. Processor	175.00
9513 Univ. Timing	79.95
AM9517 DMA Controller	18.95
AM9519 Universal Interrupt	18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	36.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHZ	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

8155/8156 I/O	24.95
8755 I/O with Eprom	84.95
8202 Dyn. Ram Cont.	34.95
8205/74S 138 Decoder	3.95
8212 8 bit I/o	2.75
8214 Priority Int	5.25
8216 Bus Driver	2.75
8224 Clock Gen	2.95
8224-4 (4MHz)	9.75
8226 Bus Driver	3.95
8T26 Bus Driver	2.95
8228 Sys. Control	5.50
8238 Sys. Cont	5.50
8251 Prog. I/O	8.95
8253 Int. Timer	12.95
8255 Prog. I/O	6.50
8257 Prog. DMA	18.95
8259 Prog. Int	17.95
8275 CRT Controller	49.95
8279 Prog. Keyboard	15.95

6800 SUPPORT CHIPS

6810 128 x 8 Ram	4.75
6820 PIA	5.95
6821 PIA	6.50
6828 Priority Int	9.95
6834-1 512 x 8 Eprom	16.95
6845/HD46505 CRT Cont	39.95
6847 Color CRT	49.95
6850 ACIA	5.95
6852 Serial Adapter	5.95
6860 Modem	10.95
6862 Modulator	11.95
6871A 1.0MHz OSC	25.95
6875	8.95
6880 Bus Driver	2.95
MC6848	19.95
68047	24.95

SHIFT REGISTER SALE

2503V	1.49	2525	1.49
2504V	1.49	2527	1.49
2507V	1.49	2528	1.49
2517V	1.49	2529	1.49
2524V	1.49	2533	1.49

6502 SUPPORT CHIPS

6520 PIA	7.50
6522 Mull	11.95
6530-002,003,004,005	21.95
6532	19.96
6551	19.95

PROMS

2708 450 ns	8.25
2708-6 650 ns	7.50
1702A	4.95
2732	74.95
2716-5V	14.95
2716-5V, 12V	29.95
2758-5V	19.95
5203AQ	13.95
5204AQ	14.95
1M 5610	3.90
SALE 8223 32 x 8	2.95
82S115 512 x 8 (TS)	16.95
82S123 32 x 8	4.90
82S126 256 x 4	4.90
82S129 256 x 4 (TS)	4.90
82S130 512 x 4 (OC)	6.50
82S23	6.95
82S131	14.95
82S137	14.95

NOTE: WE PROGRAM PROMS

CHARACTER GEN.

2513-001 (5V) Upper	9.50
2513-005 (5V) Lower	10.95
2513-ADM3 (5V) Lower	14.95
MCM6571	11.75
MCM6571A	11.75
MCM6574	14.50
MCM6575	14.50

UARTS/BAUD RATE

TR1602B (5V, 12V)	3.95
AY51013 (5V, 12V)	4.95
AY51014A/1612 (5-14V)	6.95
AY5101A/1863 (5V)	6.95
TMS 6011 (5V, 12V	4.50
IM6402	7.95
IM6403	8.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	9.95
MC14411	11.95
4702	14.95
WD1941	9.95
COM 5016	16.95

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75
HD0165	9.95
74C922	9.95
74C923	9.95

STATIC RAMS

	1-24	25-99	100
21L02 450ns	1.30	1.25	.99
21L02 250ns	1.59	1.55	1.15
2111	3.75	3.85	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114L-250ns. (4045)	6.50	5.95	5.50
2114L-450ns. (4045)	5.50	5.25	4.75
4044 250 ns.	8.95	7.50	6.90
4044 450ns	5.95	5.95	4.75
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125/93425 (45ns.)	9.95	8.35	8.25
6518 1K x 1 CMOS	7.95	7.95	7.25
2147 Low Power 4K Static	19.95	18.95	16.95
93415	9.95	8.95	8.50
TMS4046	11.95	10.95	10.50

SALE 2102 .89

DYNAMIC RAMS

416/4118 16K (16 Pin)			8.75
Set of 8 416's			49.95
4115 8K (16 Pin)			6.95
4050 4K x 1 (18 Pin)			4.95
4060 4K x 1 (22 Pin)			4.95
4096 4K x 1 (16 Pin)			3.95
2104 4K x 1 (16 Pin)			4.75
4027 4K x 1 (16 Pin)			4.95
5261	1.95	1103	1.95
5262	1.95	4008L	4.95
5270	4.95	8606	7.95
5280	4.95	8604	4.95
5290	12.45	8002	1.50

64K RAMS $159.95

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Gold
8	15	32	45
14	19	36	59
16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	1.10
24	38	85	1.20
28	43	1.10	1.49
36	58	1.25	1.69
40	60	1.40	1.89

ZERO INSERTION FORCE
16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

LED READOUTS

Part No.	Size	Color	Description	Price
DL704	.300	Red	Comm. Cathode	99
DL707	.300	Red	Comm. Anode	99
FND357	.357	Red	Comm. Cathode	99
FND501	.500	Red	Comm. Cathode (+1)	99
FND503 (5011)	.500	Red	Comm. Cathode	99
FND507 (5101)	.500	Red	Comm. Anode	99
FND508	.500	Red	Comm. Anode (+1)	99
FND530	.500	Green	Comm. Cathode	149
FND550	.500	Orange	Comm. Cathode	149
FND803 (8001)	.800	Red	Comm. Cathode	175
FND807 (8101)	.800	Red	Comm. Anode	175
HP5082-7340	.600	Red	4 x 7 Hexadecimal	2095
HP5082-7300	.600	Red	4 x 7 Sgl Digit RHD	1895
HP5082-7731	.300	Red	Comm. Anode	.75
TIL305	–	Red	Array 5 x 7	795
TIL308	.270	Red	Numerical Display	1095
TIL309	.270	Red	Numerical Display	995
TIL311	.270	Red	4 x 7 Hexadecimal	1095
MAN2A	.320	Red	Array	595
MAN10A	.270	Red	Alpha Numeric	895
XAN3081	.300	Red	Comm. Anode Right DP	125
XAN3082	.300	Red	Comm. Anode Left DP	125
XAN3083	.300	Red	Overflow, CA, Left DP	125
XAN3053	.300	Red	Comm. Cathode Right DP	125
XAN3051	.300	Green	Comm. Anode Right DP	199
XAN3052	.300	Green	Comm. Anode Left DP	199
XAN3053	.300	Green	Overflow, CA, Left DP	199
XAN3054	.300	Green	Comm. Cathode Right DP	199
XAN3081	.300	Yellow	Comm. Anode, Right DP	210
XAN3082	.300	Yellow	Comm. Anode, Left DP	210
XAN3083	.300	Yellow	Overflow, CA, Left DP	210
XAN3084	.300	Yellow	Comm. Cathode, Right DP	210

IC SPECIAL PURCHASE

LF 13508 JFET Analog Multi 8 bit			8.95
ICM 7045 Precision StopWatch			23.95
ICM 7205 CMOS LED Stopwatch/Timer			19.95
ICM 7207 Oscillator Controller			7.50
ICM 7208 Seven Decade Counter			18.95
ICM 7209 Clock Generator			6.95
ICL 7107 3½ Digit A/D (LED)			14.95
MCT4433P 3½ Digit A/D Converter			13.95
ICL 8211 Voltage Reference			1.95
LM 1850N Ground Fault IC			3/1.00
LM 2900N Quad Amplifier			2/1.00
LM 2917N Freq. to Volt Conv			2/1.99
AY-3-3550 4½ digit DMM			24.95
AY-5-3507 40MHz DVM			9.95
MEM 4963 Mostek Smoke Detector			11.95
27S08 32 x 8 Prom (IM 5600)			2.95
G115M 8 channel Mosfet			1.49
ULN 2003A 7 channel Driver			.99
2101AL-4			1.95
MCM 14505 64 bit Static Ram			6.95
MOC 1003 (4N28) Opto Coupler			3/1.00
SPX33 Opto Coupler			3/1.00
7520/25	.50	LM 387	1.25
1488/1489	2/1.99	LM 3302	3/1.99
MK5014 Calc	3/1.99	LM 4558	3/1.99
74S89	3/1.99	RC 4136	2/1.99
LM323K	4.95	RC 4131	2/1.99
MC1372	8.95	COM 5027	39.95
MM5298-4/A3	2.95	COM 5037	49.95
LM 377	1.25	DAC100	15.95

VERBATIM DISKETTES
100% CERTIFIED ERROR-FREE!

- ★ 35 TRACKS DOUBLE DENSITY, SINGLE-SIDED 5¼

TYPE	DESCRIPTION	PRICE/BOX 10
525-01	Soft Sectored TRS 80 etc	$27.25
525-10	10 Hole Hard NS Apple etc	27.25
525-16	16 Hole Hard Micropolis	27.25

- ★ 40 & 77 TRACK DOUBLE DENSITY – SINGLE SIDED 5¼ "DUAL REINFORCEMENT RING"

577-01	Soft Sectored TRS 80 etc	$32.25
577-10	10 Hole Hard NS Apple etc	32.25
577-16	16 Hole Hard Micropolis	32.25

- ★ 40 TRACKS, DOUBLE SIDED DOUBLE DENSITY 5¼

550-01	Soft Sectored SA 450 MPI 52	$39.50
550-10	10 Hole Hard BASF WANGCO	39.50
550-16	16 Hole Hard Micro2	39.50

- ★ 100% CERTIFIED DISKETTES

FD800-01	Soft Single Density 3740	$33.50
FD800-32	32 Hard Single Density Shug	33.50
FD802-01	Soft Double Density 3740	44.80
FD850-01	Soft Double Sided Double Density 3740	49.80

VOLUME DEALER PRICING AVAILABLE
WE ALSO STOCK DYSAN-CALL

FLOPPY DISK I/O

1771-01 8" & Minifloppy	24.95
uPd372 Nec Floppy	49.95
1781 Dual Floppy	29.95
1791-01 Dual Floppy	36.95
uPd 765 Floppy	49.95

A/D CONVERTERS

8700 8 bit Binary	13.50
8701 10 bit Binary	22.00
8703 8 bit TS	13.50
9400 Dual V to Freq. Conv.	7.25
8750 3½ Digit BCD	13.95
1408L6 6 bit	3.95
1408L8 8 bit	5.95
DAC01 D to A	5.95
DAC08	9.95
DAC 100	15.95

TV CHIPS/SOUND

AY38500-1 6 Games B/W	4.95
AY38515 Color Converter	2.95
AY38603-1 Roadrace Game	8.95
AY38606-1 Wipeout Game	9.50
AY38607-1 Shooting Gallery	8.95
AY38910 Sound Generator	12.95
SN76477 TI Sound Generator	3.95
MM5320/21 TV Synch Gen	9.95
MM5369 Prescaler	3.95
LM1889 RF Modulator	3.95
MM57100 NSC Color TV	6.95
MM57104 Clock Gen	3.75
RF Modulator w/Audio	8.95
M&R Modulator	29.95

WAVEFORM GEN.

8038 Function Gen	3.95
MC4024VCO	2.95
LM566 VCO	1.95
XR2206 Function Generator	5.25

SHIFT REGISTERS

MM500H Dual 25	.50
MM5056N Dual 256	2.95
MM5060N Dual 128	2.95
2510A Dual 100	1.95
2847 Quad 80	4.95
3341 Dual 80	4.95
3251 40 x 9 FIFO	17.95
3357 Quad 80	6.95
9403 16 x 4 FIFO	24.95
9408 10 Bit Sequencer	9.95
3347	5.95

CTS DIPSWITCHES

CTS206-2	1.75	CTS206-7	1.75
CTS206-4	1.75	CTS206-8	1.95
CTS206-5	1.75	CTS206-9	1.95
CTS206-6	1.75	CTS206-10	1.95

CONNECTORS (GOLD)

DB25P (RS232)	3.25
DB25S Female	3.75
Hood	1.25
Set w/Hood, Sale	$7.50
22/44 W/W, S/T, KIM	2.95
43/86 W/W, S/T, MDT	8.50
50/100 S-100 Connector w/w	4.95
50/100 S-100 Connector s/t	3.95

NAKED PC

Z-80 CPU (Ithaca)	$34.95
8080A CPU	34.95
8K Static RAM (Logos)	24.95
16K Static RAM (2114)	29.95
32K Static RAM (2114)	29.95
8K Eprom (2708)	24.95
1702 Eprom Board	30.00
2708/2716 Eprom (Ithaca)	34.95
2708/2716 Eprom (WMC)	30.00
Realtime Clock	34.95
ACP Proto Bd (3M Conn.)	27.95
Vector 8800 Proto	22.20
Vector 8803 1 Slot MB	19.95
ACP Extender w/Conn	18.95
Video Interface (SSM)	31.95
Parallel Interface (SSM)	31.95
13 Slot MotherBoard (WMC)	42.95
9 Slot MotherBoard (WMC)	29.95
8 Slot Mother (expandable)	34.95
Proc-Tech Bare Boards	CALL
WMC Floppy PCB	34.95

COMPUTER SPECIALS

DISCOUNTS!

	LIST	SALE
Apple II Plus w/16K	1195	980.
PET 2001-16N	995	895.
Exidy Sorcerer w/16K		1099.
Cromemco Sys III	8990	8290.
Horizon 1 w/32K		CALL
Pascal Microengine	1995	1595
IPSI 1620 Diablo RO	3295	2695.
Anadex DP 8000	995	875.
Centronics Micro S-1	595.	525.
Soroc IQ 120	995	795.
Teletype Model 43	1349	1150.
HiPlot Plotter	1085	899.
HiPlot Digitizer	795	735.
Intertube II	895	784
Atari 800	999	750.
Atari 400	549	449.
TI 99/4	1150	1025.
Leedex 12" Monitor	149	139
Centronics 737	995	899
Trencom T-100	375	349.
Trencom T-200	595	525.
Sanyo 9" Monitor	220	169
Sanyo 15" Monitor	295	249.
Mot 22 MHz Monitor	296	219.

SOCKET SPECIALS

14 Pin w/w-2L	$ .35
18 Pin w/w-2L	.55
20 Pin w/w-2L	.75
18 Pin s/t	.15
22 Pin s/t	.15

Call for volume pricing

TERMS: Use check, M/C, VISA, AMEX, CB, or COD. COD requires 25% deposit. Charge Orders please include expiration date. Foreign pay U.S. Funds. Order by phone, mail or TWX. MINIMUM $10.00. Please include magazine issue and phone no. SHIPPING: U.S.A. add $2.00 for first 2 lbs. For surface add 30¢ for additional lbs. For air add 70¢ for additional lbs. FOREIGN: Add 10% shipping and handling COD's $1.85 extra. Not responsible for typos. Some items subject to prior sale. We reserve right to limit quantities, some items subject to precious metal adder. Retail pricing may vary from Mail Order. We reserve the right to substitute manufacturer.

RETAIL STORES OPEN MON-SAT

STORE #1 1310 "B" E. Edinger Santa Ana, CA 92705 Showrooms, Retail, Warehouse

STORE #2 674 El Camino Real Tustin, CA 92680 Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1310 E. Edinger (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

RADIO-ELECTRONICS

CIRCLE 2 ON FREE INFORMATION CARD

7400

SN7400N	.19	SN74123N	.59
SN7401N	.22	SN74125N	.39
SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.95
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.69
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	.99
SN7416N	.29	SN74151N	.67
SN7417N	.29	SN74152N	.67
SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.82
SN7423N	.29	SN74156N	.89
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.29	SN74160N	.95
SN7429N	.45	SN74161N	.95
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.29	SN74164N	.97
SN7438N	.29	SN74165N	.97
SN7439N	.29	SN74166N	1.20
SN7440N	.24	SN74167N	1.95
SN7441N	.79	SN74170N	1.69
SN7442N	.57	SN74172N	5.95
SN7443N	.79	SN74173N	.79
SN7444N	.79	SN74174N	.89
SN7445N	.79	SN74175N	.89
SN7446N	.79	SN74176N	.85
SN7447N	.59	SN74177N	.85
SN7448N	.79	SN74179N	1.80
SN7450N	.23	SN74180N	.75
SN7451N	.23	SN74181N	1.75
SN7453N	.23	SN74182N	.75
SN7454N	.23	SN74184N	1.95
SN7459N	.29	SN74185N	1.95
SN7460N	.23	SN74186N	9.95
SN7470N	.39	SN74188N	3.90
SN7472N	.34	SN74190N	1.15
SN7473N	.38	SN74191N	1.15
SN7474N	.36	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.36	SN74194N	.85
SN7479N	4.60	SN74195N	.85
SN7480N	.59	SN74196N	.85
SN7481N	1.10	SN74197N	.85
SN7482N	1.10	SN74198N	1.39
SN7483N	.55	SN74199N	1.39
SN7485N	.65	SN74221N	1.39
SN7486N	.39	SN74251N	.95
SN7489N	1.75	SN74273N	1.05
SN7490N	.39	SN74279N	.89
SN7491N	.65	SN74283N	2.15
SN7492N	.52	SN74284N	3.90
SN7493N	.49	SN74285N	3.90
SN7494N	.72	SN74290N	1.25
SN7495N	.65	SN74298N	.95
SN7496N	.72	SN74365N	.68
SN7497N	3.10	SN74366N	.68
SN74100N	.99	SN74367N	.79
SN74107N	.32	SN74368N	.79
SN74109N	.53	SN74390N	1.90
SN74116N	1.95	SN74393N	1.90
SN74121N	.29	SN74490N	1.90
SN74122N	.39		

CMOS

CD4000	.35	CD4093	.99
CD4001	.35	CD4094	2.95
CD4002	.35	CD4098	2.49
CD4006	1.39	CD4099	2.25
CD4007	.29	MC14408	12.95
CD4008	1.39	MC14409	12.95
CD4009	.49	MC14410	12.95
CD4010	.49	MC14412	12.95
CD4011	.35	MC14415	8.95
CD4012	.29	MC14419	4.95
CD4013	.49	CD4501	.39
CD4014	1.39	CD4502	1.65
CD4015	1.15	CD4503	.69
CD4016	.59	CD4505	8.95
CD4017	1.19	CD4506	.75
CD4018	.99	CD4507	.95
CD4019	.49	CD4508	3.95
CD4020	1.19	CD4510	1.39
CD4021	1.19	CD4511	1.39
CD4022	1.15	CD4512	1.39
CD4023	.38	CD4515	3.95
CD4024	.79	CD4516	1.69
CD4025	.38	CD4518	1.39
CD4027	.65	CD4520	1.39
CD4028	.85	CD4555	4.95
CD4029	1.29	CD4556	.99
CD4030	.45	CD4566	2.25
CD4031	3.25	74C00	.39
CD4032	2.15	74C02	.39
CD4034	3.25	74C04	.39
CD4035	.95	74C08	.49
CD4037	1.95	74C10	.49
CD4040	1.29	74C14	1.65
CD4041	1.25	74C20	.39
CD4042	.95	74C30	.39
CD4043	.85	74C32	.99
CD4044	.85	74C42	1.85
CD4046	1.75	74C48	2.39
CD4047	1.25	74C73	.85
CD4048	.99	74C74	.85
CD4049	.69	74C85	2.49
CD4050	.69	74C89	4.95
CD4051	1.10	74C90	1.85
CD4052	1.10	74C93	1.85
CD4053	1.10	74C95	1.85
CD4055	3.95	74C107	1.19
CD4056	2.95	74C151	2.49
CD4059	9.95	74C154	3.50
CD4060	1.39	74C157	2.10
CD4066	.75	74C160	2.39
CD4069	.35	74C161	2.30
CD4070	.49	74C163	2.39
CD4071	.35	74C164	2.39
CD4072	.35	74C173	2.59
CD4073	.35	74C174	2.75
CD4075	.35	74C175	2.75
CD4076	1.29	74C192	2.39
CD4077	.35	74C193	2.39
CD4078	.35	74C195	2.39
CD4081	.35	74C922	7.95
CD4082	.35	74C923	6.95
CD4085	1.95	MM80C95	1.50
CD4089	2.95	MM80C97	1.25

74LS00

74LS00N	.35	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.89
74LS04N	.39	74LS169N	1.89
74LS05N	.28	74LS170N	1.99
74LS08N	.39	74LS173N	.89
74LS09N	.39	74LS174N	.99
74LS10N	.28	74LS175N	.99
74LS11N	.39	74LS181N	2.20
74LS12N	.39	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	1.25	74LS192N	.98
74LS15N	.39	74LS193N	.98
74LS20N	.26	74LS194N	1.15
74LS21N	.38	74LS195N	.95
74LS22N	.38	74LS196N	.89
74LS26N	.39	74LS197N	.89
74LS27N	.39	74LS221N	1.49
74LS28N	.39	74LS240N	1.95
74LS30N	.26	74LS241N	1.90
74LS32N	.39	74LS242N	1.95
74LS37N	.79	74LS243N	1.95
74LS38N	.39	74LS244N	1.95
74LS40N	.26	74LS245N	4.95
74LS42N	.79	74LS247N	1.10
74LS47N	.79	74LS248N	1.10
74LS48N	.79	74LS249N	1.69
74LS51N	.26	74LS251N	1.79
74LS54N	.35	74LS253N	.98
74LS55N	.35	74LS257N	.98
74LS73N	.45	74LS258N	.98
74LS74N	.59	74LS259N	2.95
74LS75N	.68	74LS260N	.69
74LS76N	.45	74LS261N	2.49
74LS78N	.65	74LS266N	.59
74LS83AN	.99	74LS273N	1.75
74LS85N	1.19	74LS275N	4.40
74LS86N	.45	74LS279N	.59
74LS90N	.75	74LS283N	1.10
74LS92N	.75	74LS290N	1.29
74LS93N	.75	74LS293N	1.95
74LS95N	.88	74LS295N	1.10
74LS96N	.98	74LS298N	1.29
74LS107N	.45	74LS324N	1.75
74LS109N	.45	74LS347N	1.95
74LS112N	.49	74LS348N	1.95
74LS113N	.49	74LS352N	1.65
74LS114N	.55	74LS353N	1.65
74LS122N	.55	74LS363N	1.49
74LS123N	1.19	74LS365N	.99
74LS124N	1.35	74LS366N	.99
74LS125N	.89	74LS367N	.73
74LS126N	.89	74LS368N	.73
74LS132N	.79	74LS373N	2.75
74LS136N	.59	74LS374N	2.75
74LS138N	.89	74LS375N	.69
74LS139N	.89	74LS377N	1.95
74LS145N	1.25	74LS385N	1.95
74LS148N	1.49	74LS386N	.65
74LS151N	.79	74LS390N	1.95
74LS153N	.79	74LS393N	1.95
74LS154N	2.49	74LS395N	1.70
74LS155N	1.19	74LS399N	2.95
74LS156N	.99	74LS424N	2.95
74LS157N	.99	74LS668N	1.75
74LS158N	.75	74LS670N	2.29
74LS160N	.98	81LS95N	1.99
74LS161N	1.15	81LS96N	1.99
74LS162N	.98	81LS97N	1.99
74LS163N	.98	81LS98N	1.99

LINEAR

78H05	5.95	LM1414N	1.90
78M06	1.49	LM1458CN/N	.49
78M G	1.49	MC1488N	1.49
LM105H	.99	MC1489N	1.49
LM108AH	2.95	LM1496N	.89
LM300H	.79	LM1556N	1.50
LM301CN/H	.35	LM1800N	.79
LM304H	.98	LM1820N	.95
LM305H	.89	LM1850N	.95
LM306H	3.25	LM1889N	3.95
LM307CN/H	.29	LM2111N	1.75
LM308CN/H	.98	LM2900N	.99
LM309K	1.49	LM2901N	2.50
LM310CN	1.25	LM2917N	2.95
LM311D/CN/H	.98	CA3013T	2.29
LM312H	1.75	CA3018T	1.99
LM317T	2.75	CA3021T	3.49
LM318CN/H	1.49	CA3023T	2.99
LM319N/H	1.25	CA3035T	2.75
LM320K-XX*	1.49	CA3039T	1.49
LM320T-XX*	1.25	CA3046T	1.29
LM320H-XX*	1.25	LM3053N	1.49
LM323K	4.95	CA3059N	3.25
LM324N	1.25	CA3060N	3.25
LM339N	.95	CA3062N	4.95
LM340K-XX*	1.49	LM3065N	1.49
LM340T-XX*	1.25	CA3080N	1.29
LM340H-XX*	1.25	CA3081N	1.69
LM344H	1.95	CA3082N	1.69
LM348N	1.85	CA3083N	1.99
LM358CN	.98	CA3086N	1.29
LM360N	1.49	CA3089N	2.75
LM372N	1.95	CA3096N	2.49
LM376N	3.75	CA3097N	1.99
LM377N	3.75	CA3130T	2.49
LM380CN/N	1.25	CA3140T	2.49
LM381N	1.79	CA3146N	2.49
LM383T	1.95	CA3160T	1.49
LM386N	1.49	CA3190N	1.95
LM387N	1.49	CA3401N	.69
LM389N	1.95	MC3423N	1.49
NE531V/T	3.75	MC3450N	3.95
NE555V	.39	SG3524N	3.95
NE556N	.98	CA3600N	3.50
NE561T	19.95	LM3900N	.59
NE562B	7.95	LM3905N	1.49
NE565N/H	1.25	LM3909N	.98
NE566H/V	1.75	RC4131N	2.95
NE567V/H	1.50	RC4136N	1.10
NE592N	2.75	RC4151N	4.50
LM702H	2.99	RC4194	4.95
LM709N/H	.29	RC4195	4.40
LM710N/H	.98	ULN2001	1.25
LM711N/H	.39	ULN2003	1.50
LM715N	1.95	SN75450N	.59
LM723N/H	.75	SN75451N	.49
LM733N/H	.98	SN75452N	.49
LM739N	1.15	SN75453N	.49
LM741CN/H	.33	SN75454N	.49
LM741CN-14	.19	SN75491N	.89
LM747N/H	.79	SN75492N	.89
LM748N/H	.39	SN75493N	.89
LM760CN	2.95	SN75494N	.89
LM1310N	1.90		

16K UPGRADE ONLY **$49.95** SPECIFY COMPUTER

ADVANCED COMPUTER PRODUCTS

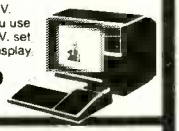
TEXAS INSTRUMENTS INCORPORATED

99/4 PERSONAL COMPUTER

Superior Color, Music, Sound & Graphics – & a Powerful Extended Basic – All Built-In.

Now! Special T.V. Adapter lets you use your existing T.V. set as a computer display.

$499.00 Console only.



BECKMAN Digital Multimeters

MODELS TECH 300 AND TECH 310

AS LOW AS $100

Choice of Models – The TECH 310 has all above features, 7 functions, 29 ranges plus 0.25% Vdc accuracy.
The TECH 300 has a 0.5% Vdc accuracy and all the above features, but without Insta-Ohms™ continuity function or the 10 amp current ranges.

- TECH 300 Digital Multimeter ... $100.
- TECH 310 Digital Multimeter ... $130
- VC-201 Vinyl Carrying Case ... $10.
- DC-202 Deluxe Carrying Case ... $24.
- HV-211 High Voltage Probe ... $35.
- RP-221 RF Probe ... $35
- CI-231 AC Current Clamp ... $42.
- DL-241 Deluxe Test Lead Kit ... $10.
- TL-242 Spare Test Leads ... $6

NEW!

Vista™ **MUSIC MACHINE 9©** WITH 9 VOICES!

- NEW! Uses latest State of the Art LSI Technology
- Requires only one slot for 9 voices
- Uses three AY3-8910's to produce nine voices
- Plays music generated by the ALF Board
- ALF software required
- APPLE™ II compatible

ASSEMBLED AND TESTED ... **$129.95**

FLOPPY DISK DRIVES

MPI B51-5¼", 40 tracks	279.00
Shugart SA400-5¼" 35 tracks	295.00
Shugart 800/801R 8"	475.00
Siemens Shugart Compatible Model FDD-120-8D	429.00
PERSCI Model 277 Dual	1195.00
WaNGO/SIEMENS 5¼" Drive	290.00
MPI B52 5¼" Dual	348.00
WaNGO/SIEMENS 282 Dual 5¼"	395.00
WaNGO/SIEMENS 82	290.00

CONTINENTAL SPECIALTIES

Model LMI-3 40-channel Logic Monitor	585.00
Model LMI-1 Logic Monitor	60.00
Model LMI-2 Logic Monitor	147.00
MMX-100 100 MHz Portable Frequency Counter	149.00
Model LP-1 Digital Logic Probe	50.00
Model LP-2 Economy Logic Probe	28.00
Model LP-3 High Speed Logic Probe	77.00
Model LPK-1 Logic Probe Kit	21.95
Model LTC-1, LTC-2 Logical Analysis Kits	220/250

Proto Clips

14-Pin Clip	PC-14	$ 4.25
16-Pin Clip	PC-16	$ 4.50
24-Pin Clip	PC-24	$ 9.50
40-Pin Clip	PC-40	$14.95

Proto Boards

PB-6	18.95	PB-104	54.00
PB-100	18.00	PB-203	97.00
PB-101	21.00	PB-203A	149.00
PB-102	25.00	PB-203A-Kit	129.00
PB-103	43.00		

SEMICONDUCTORS ☆SPEAK!☆ DIGITALKER™

Speech Synthesis System

The DIGITALKER is a speech synthesis system consisting of multiple N-channel MOS integrated circuits. It contains a speech processor chip (SPC) and speech ROM and when used with external filter, amplifier, and speaker, produces a system which generates high quality speech including the natural inflection and emphasis of the original speech. Male, female, and children's voices can be synthesized.

- Completely independent system, not requiring a processor controller
- Designed to be easily interfaced to most popular microprocessors
- 256 possible addressable expressions
- Male, female, and children's voices
- Natural inflection and emphasis of original speech
- Addresses 128k of ROM directly
- Communicates with static or clocked dynamic ROMs
- TTL compatible
- MICROBUS™ compatible

DIGITALKER™ DT1000. Self contained board that – with just a speaker and a power supply – can recite off any desired combination of 144 words. **$485.00**

DIGITALKER™ DT1050. Chip set for building Digitalker into your own evaluation design. **$79.00**

National Semiconductor

Apple II. 16K or Apple II. Plus $990

DISK SYSTEM SPECIAL

Apple II Plus w/48K Supermod Video Modulator
Disk II w/Controller Integer Based ROM Card.
Reg. $2,220.00, ACP Price $1819.00 SAVE $401.00

Hi-Speed Serial I/O	$189.00	DS65 Digi-Sector	$349.00	Integer ROM Card	$189.00
Centronics Printer I/O	180.00	Apple Graphics Tablet	675.00	Proto Card	21.95
Applesoft II Firmware	189.00	D.C. Hayes Modem II	349.95	M & R Modulator	29.95
Apple Clock	269.00	Disk II w/Controller & Dos 3.3	595.00	Sanyo Cassette	54.95
Introl X-10 System	179.95	Disk II	459.00	16K Upgrade Kit	54.95
Introl X-10 Controller	269.95	Pascal Lang. System	450.00	Desktop Plan	98.00
Alf Music Synthesizer	259.95	Parallel Printer Card	165.00	8" Floppy Controller	350.00
16 Ch. Analog Input	249.95	Communications Card	189.00	Heuristics Speechlab	179.00
2 Ch. Analog Output	164.95	Business Software Pkg.	625.00	Romplus +	169.00
13-Key Keypad	119.95	Corvus 10 Megabyte Drive	4625.00	Supertalker	279.00
Visi-Calc	125.00			Cashier	250.00

NEW APPLE PRODUCTS

- "APPLE FAN" – Cures thermal problems from overcrowded machines designed specifically for Apple ... $49.95
- "BIT 3" – New 80 x 24 Video Board for Apple. Completely compatible with Pascal ... $329.95
- "BAR WAND" Hewlett Packard HEDS-3000 Bar Code interfaced to Apple ... $199.00
- "SEC APPLE A/D" – 8 Channel A/D Interface completely assembled and tested ... $99.50
- "VISTA APPLE 80 TRACK DISK DRIVE" Floppy Add-on for Apple 5¼" 80 TPI ... $459.00
- "APPLE FORTRAN" ... $175.00
- "APPLE CRYPTEXT" for data encryption and security ... $449.00
- "LYNX APPLE MODEM" new modem for direct access ... $289.00
- "82/A2" Graphics Interface Card by Base 2 ... $159.95
- 8" Disk Drives for Apple, Controller, DOS. Two 8" drives cabinet and cable ... $1450.00
- "MICROMODEM" – DC Hayes ... $319.95
- "DIGISECTOR" Converts video input to Hi-Res graphics ... $349.95
- VisiCalc Keypads. Numberic keypad with space, ESC, – and = keys for VisiCalc compatibely ... $169.00
- DOS 3.3 Upgrade Kits 23% more storage in 16-sector format ... $65.00
- Mountain Hardware Music Board, best yet – 16 channels ... $550.00
- Controller 1.1 Revision Kit 20% overall processing speed increase and supports standard printers. Reduced disk handling. Additional error checking. Improved manual. Vendor file expanded ... $145.00
- Pascal Revision Kit Adds executive and chaining capabilities to Pascal environment ... $65.00
- Mountain Hardware Expansion chassis. 8 more slots for Apple. Hardware or software selectable. Includes power supply ... Avail. Soon
- Smart Term Apple 80 x 24 Video Cam ... Avail. Soon
- Symtec X-10 ... Avail. Soon
- Apple Silentype With Apple Intelligent Interface Card ... $549.00
- NEW! California Computer Systems A/PPLE Clock Only ... $124.95
- NEW! Z-80 Softcard for APPLE CP/M ®2 & M. BASIC 5.0 ... $325.00
- NEW! California Microproducts Keypad for APPLE ... $175.00

NEW APPLE SOFTWARE

1. CYBERSTRIKE – Apple II version of Star Raiders from Atari on disk ... $34.95
2. BTB Stock Market Analysis – Hi-Res, Trend Lines, etc. ... $109.95
3. "Star Cruiser" – Apple II version of the number one arcade game, "Galaxy" ... $29.95
4. "Both Barrels" – Hi-Res simulation of Western Gunfight and Skeet Shooting. Same author as Nasir ... $29.95
5. "Apple Tax Planner Package" ... $74.95
6. "How-DOS Tool Kit" ... $64.95
7. WEW! Apple Z-80 CP/M Software ... Call for Price

ATARI® 800 & 400 Personal Computer System

ATARI 800 $825.00
ATARI 400 $449.00

ATARI 800 Includes: Computer Console, BASIC Lang. Cartridge, Education System Master Cartridge, BASIC Language Programming Manual, 800 Operator's Manual w/Notebook, 16K RAM Module, Power Supply, TV Switch Box.

Peripherals		**Education System Cassette Programs**		Spelling	35.00
Disc Drive	599.00	U.S. History	35.00	Basic Electricity	35.00
Printer	499.00	U.S. Government	35.00	Basic Algebra	35.00
Program Recorder	69.00	Supervisory Skills	35.00	**Basic Game and Program Cassettes**	
Software – 8K RAM Cartridges		World History (Western)	35.00	Guide to BASIC Programming	14.00
Education System Master Cartridge	28.00	Basic Sociology	35.00	BASIC Game Programs	19.00
Atari BASIC	55.00	Counseling Procedures	35.00	**Add-On Memory**	
Assembler Debug	55.00	Principles of Accounting	35.00	8K RAM Memory Module	110.00
Basketball	42.00	Physics	35.00	16K RAM Memory Module	225.00
Life	42.00	Great Classics (English)	35.00	**Diskettes**	
Super Breakout™	42.00	Business Communications	35.00	Blank Diskettes	
Music Composer	55.00	Basic Psychology	35.00	Disk File Manager	5.00
Super Bug™	42.00	Effective Writing	35.00	**Accessory Controllers**	
Computer Chess	55.00	Auto Mechanics	35.00	Driving Controller Pair	18.00
Home Finance	55.00	Principles of Economics	35.00	Paddle Controller Pair	18.00
				Joystick Controller Pair	18.00

SINGLE BOARD COMPUTER SELECTION GUIDE

BOARD	PROCESSOR	ACP PRICE	ENCLOSURE	BOARD	PROCESSOR	ACP PRICE	ENCLOSURE
KIM-1	6502	169.00	Add 29.95	SC-SBC100	Z80	239.00	N/A
SYM-1	6502	239.00	Add 39.95	AIM 65	6502	375.00	Add 49.95
Cromemco	Z80	409.00	N/A	Cosmac Vip	1802	199.00	Inc

ACP'S COMPUTER PRODUCTS & GADGETS

You won't believe your earbones... **THE BONE FONE**

- SKIERS
- JOGGERS
- SKATERS
- CYCLERS

You must hear it and feel it to believe it!

AM/FM stereo surrounds and fills your body with sound. No earplugs. You wear it!

$65.95

QUARTZ LCD WATCH WITH SNOOZE ALARM

The looks and functions of the expensive models at an affordable price.

NEW!
6 FUNCTIONS
- HOURS
- MINUTES
- SECONDS
- MONTH
- DATE
- DAY

All in a smart silvertone metal with matching bracelet.

An Outstanding ACP Value

ONLY **$21.95**

LCD CALENDAR CLOCK GEAR SHIFT KNOB

Time and Date Digital Display with Backlight for Night Use.

NEW!

- Full Finger Grip
- Genuine Walnut
- Quartz LCD
- Time, Date, Seconds
- Easily Installed

$26.95

RETAIL STORES OPEN MON-SAT

STORE #1 1310 "B" E. Edinger Santa Ana, CA 92705 Showrooms, Retail, Warehouse

STORE #2 674 El Camino Real Tustin, CA 92680 Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1310 E. Edinger (714) 953-0604
Santa Ana, CA 92705 TWX:910-595-1565

CIRCLE 57 ON FREE INFORMATION CARD

FOR SALE

POWER semiconductors! Darlingtons, voltage regulators, rectifiers, transistors, potentiometers, trimpots, switches, IC's, much more! Thousands of parts in stock! Send 30¢ in stamps for catalog. **POWER ELECTRONIC** 15206 Blackstone, Dolton, IL 60419

SCANNER/monitor accessories—kits and factory assembled. Free catalog. **CAPRI ELECTRONICS,** Route 1R, Canon, GA 30520

FREE catalog, IC's, semi's, parts. **CORONET ELECTRONICS,** 649A Notre Dame W., Montreal, Que., Canada H3C 1H8. U.S. inquiries.

SAVE up to 50% on name brand test equipment. Free catalog and price list. **SALEN ELECTRONICS,** Box 82-M, Skokie, IL 60077

GOVERNMENT surplus receivers, transmitters, snooperscopes, parts, fantastic 72 page catalog 25¢. **MESHNA,** Nahant, Mass. 01908

CABLE TV converters $39.95. Incredible 96-page catalog **free. ETCO,** Box 762, Plattsburgh, NY 12901

MICROWAVE yagi antenna for MDS complete with hardware, type N connector $49.95. **SIGNAL ELECTRONICS,** 4027 18th Avenue, Brooklyn, NY 11218

LASER handbook with burning, cutting, Ruby Reds, Co's, complete plans, books, and parts. Send $4.00 to **FAMCO,** dept re, box 1902, Rochester, NH 03867

TELEVISION downconverters and decoders $99.95 up. Details for stamp. **GW ELECTRONICS,** POB 688, Greenwood, IN 46142

RECONDITIONED test equipment. $1.00 for catalog—**JAMES WALTER TEST EQUIPMENT,** 2697 Nickel, San Pablo, CA 94806

CHEMICALS, apparatus, project books, wide selection. Catalog $1.00 send to: **PIONEER Ltd. Ind,** 14a Hughey St., Nashua, NH 03060

FREE advertising for your product. Booklet explains how, where . . . $4.95 **BALL,** Box 703RE, Duluth, GA 30136

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. TDK D-C180 cassette supplied.

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 and control recorder. Uses recorder mike or remote mike.
2¼ x 1¾ x ¾" $24.95*

Phone call Adapter $24.50*, VOX $24.95*, (* plus $1.00 ea. shipping & handling), 10 hr. Recorder $125.00* (* plus $4.00 shipping & handling). California residents add tax. Mail Order, VISA, M/C, cod's okay, quantity discounts available. Money back guar. Free data.

AMC SALES, Dept. 19 9335 Lubec St., Box 928 Downey, CA 90241, Phone (213) 869-8519

CIRCLE 15 ON FREE INFORMATION CARD

Govt. SURPLUS ELECTRONIC EQUIPMENT CATALOG

New ITEMS . . . New BARGAINS!
FREE *UPON REQUEST!*
Send today for FREE copy of CATALOG WS-80 and Supplement. Dept. RE

FAIR RADIO SALES
1016 E. EUREKA · Box 1105 · LIMA, OHIO · 45802

MEMORY sale, dynamic rams surplus. 16K(4116) set of 8 $29.95 guaranteed. **Free** data sheets. **JJM,** Box 953R, Centereach, NY 11720

"THE Intelligence Library" technical secrets. Books on **Electronic Surveillance, Lock-Picking, Demolitions, Covert Sciences,** etc. One dollar. (refundable): **MENTOR PUBLICATIONS,** Dept. Z, 135-53 Northern Boulvard, Flushing, NY 11354

CABLE TV descramblers and converters. Build or buy. For information send $2.00. **C&D COMPANY,** POB 26, Hudsonville, MI 49426

1802 Newsletter, $17.00 a year, 12 issues, averages 15 pages, back issues available write: **19 FRENCH CRES.,** Regina, Saskatchewan S4R, 6N3

METAL enclosures. Brake bends up to 18" × .060. $21.95 (USA). **"Z",** Box 757A, Silver Springs, FL 32688

SHUGART SA800 8" disc drives slightly used with service manual $225.00, write: **MARIO KLAS,** 215 Osceola Ave., Deer Park, NY 11729. Phone: 516 242-2321

PRINTED circuit boards, custom etching, reasonable, send your artwork to: **GM ENTERPRISES,** 28 Hillside Ave., Prov., RI 02906

SUPREME radio diagram manuals, useful 5 volumes, special only $9! **BEITMAN,** 1760 Balsam, Highland Park, IL 60035

MICROWAVE TV antenna. MDS designed yagi. 18 dB gain $39.95. Details, plans and tech. data for same $3.00. **BETA DESIGN GROUP,** POB 164, Airway Heights, WA 99001

SURPLUS catalog 8,000 items: electronics, stereos, speakers, alarms, tools, games, solar autohome, 8 issues $2.00. **BNF** (R), 119 Foster St., Peabody, MA 01960

POCKET TRS-80 program writing pads, make creating software easy and fun. 50 sheets $2.95 plus $1 postage. **ARCSOFT,** Box 132D, Woodsboro, MD 21798

LIQUIDATING hydrophones, Westinghouse message centers, cabinets, locks, transformers, relays, lenses, capacitors, transistors, etc. Send stamp for list. **HOFFMAN,** 314 So. 7th, Bozeman, MT 59715

MICROWAVE TV downconverters, preamps, parabolic dish antennas, remote tuning. Covers 2000 MHz band. Write for information. **LAB-TRONICS, INC.,** Box 171, Rogers, MN 55374

COMPUTER software, games, useful programs, languages, robots. Free book catalog. **ARCSOFT,** Box 132D, Woodsboro, MD 21798

RESISTORS ¼W, ½W 5% carbonfilms 3¢ ea. **No minimums.** Send for details. Bulk pricing available. **JR INDUSTRIES,** 5834-C Swancreek, Toledo, OH 43614

COMPUTER PARTS

I.C.'S: 2114L-2's, $3.75; 4116-2's, $4.00; 2708's, $6.50; 2716's, $10.00; 74LS240's, $1.50; 74LS374's, $1.50; CCS 16K/5MHz RAM board, **A&T,** $250.00; **TGE** Box 64068, Va Beach, VA 23464

GRAPHIC EQUALIZER

TWELVE bands/channel $100.00 kit still available; see May 1978 R/E cover story or write: **SYMMETRIC SOUND SYSTEMS,** 912 Knobcone PL, Dept. R, Loveland, CO 80537

memory blowout !
2101-4 MEMORY 450ns $1.00 ea
2101-4L MEMORY 450ns $1.50 ea
4116 300ns $3.75 ea
4116 MOSTEK 200ns $4.00 ea
2716 INTEL 5V $12.95 ea
2716 MOT 5V 350ns $12.95 ea

Panel mtd. Air Variable DUAL 0-50PF, 0-10PF SILVER & CERAMIC 99¢ ea 10/$8 100/$65 WHILE THEY LAST !

visit our store
2065 12TH ST. SARASOTA FLORIDA

Call or Write For Low Low Prices On...
COMPUTERS - SUPERBOARD, CIP, C4P, C8P, • ALL ACCESSORIES - PRINTERS, MODEMS, DISC DRIVES, MEMORY, ETC • COMPLETE SYSTEMS • SOFTWARE
CALL US TO SAVE $$

AC Chassis receptacles STOCK UP! 5/$1 100/$15 1000/$100

$11.95 EACH Digital Panel Meter on-a-chip 7106 led or 7106 lcd — YOUR CHOICE —

Transistors GE-220, NPN HIGH VOLTAGE VCEO=160 V IC=0.6A FT=50MHz TO-92 PACKAGE 4/$1

2N2222A TO-18 transistors 5/$1 100/$18

Alarm Clock Chip MK50250 $2.50 INCLUDES DATA

NUTS! 4-40 or 6-32 ⅛ LB(OVER 300 PCS) only 99¢

SINGLE WINDING TAPPED WINDING SOME W/SECONDARIES ASSORTED SHIELDED POT CORE 3/$1 88MH Tuneable Inductors

Parts by the Strip 3 FEET Approx 100 Parts $1 9 feet $2.50 A-3910 1/2 LB

85¢ 0-10 BCD Thumbwheel Switch

solid carbide pc drill bits .055" $1.50 EACH D-0550

JUMBO LEDS yellow red green YOUR CHOICE 6/$1.

MA-6008 CAR CLOCK QUARTZ CONTROLLED WITH MM5369, LED DISPLAYS, CLOCK CHIP COMPLETE AND READY TO RUN! REQUIRES 12V DC. $4.50 UNBELIEVEABLE!

VHF-TV RF Oscillator TUNES CH 2-13 IN 2 RANGES. USED AS BASIS FOR RF MODULATORS, CHECK TV TUNER, WIRELESS MIKES, ECT TUNING VIA AIRVARIABLE $1.95 O-2311

Ceramic Trimmer 3-13pf 0.3" DIA 49¢ea. 10/$4.50 100/$40.

molex pins STRIPS OF 12 16 STRIPS 192 PINS 99¢ CAN BE MADE INTO ALMOST ANY SIZE IC SOCKET

6/$1 lighted ROCKER SWITCH DPDT 12-24V BULB 1-3/8" BETWEEN MTG HOLES. 1-1/2" HIGH X 3/4" WIDE FREE WOOD GRAIN COVER PLATE WITH EACH SWITCH

ADM-3A RECONDITIONED JUST LIKE NEW VARIOUS OPTIONS-NO CHOOSING $475.00 "HOT" DEAL ALL MERCHANDISE 100% GUARANTEED

PL-259 CABLE PLUG 79¢ SO-239 CHASSIS MTD. SOCKET 79¢ 35¢ RG-58 REDUCER

Dipswitches MFG BY CTS-TOP QUALITY

POSITIONS		PRICE
4	B-7004	$1.10
6	B-7006	$1.20
7	B-7007	$1.40
8	B-7008	$1.50

LOUD WARNING HORN 99¢

¼" STEREO PHONE JACKS B-3014 2-CONDUCTOR BY SWITCHCRAFT 39¢ 10/$3.50

EPSON Hi-Speed PRINTER LOW COST DOT MATRIX PRINTER WITH 40, 66, 80, OR 132 COLUMNS, UPPER AND LOWER CASE WITH DESCENDERS, BI-DIRECTIONAL PRINTING W/LOGIC SEEKING AUTO LINE FEED VERTICAL TAB, FORM FEED AND HORIZONTAL TAB CENTRONICS PARALLEL INTERFACE. $625-

MAIL ORDERS TO: DIAMONDBACK ELECTRONICS COMPANY P.O. BOX 12095 SARASOTA, FLA. 33578

FREE CATALOG minimum order $5. PLEASE INCLUDE SUFFICIENT POSTAGE FLORIDA RESIDENTS ADD 4% SALES TAX PHONE ORDERS 813-953-2829 COD'S, MASTERCARD & VISA ACCEPTED

Etchant Ammonium Persulfate $1.95 H-2240 LB (makes 2 gal) FAST & EASY PC BOARD ETCHANT. JUST ADD WATER

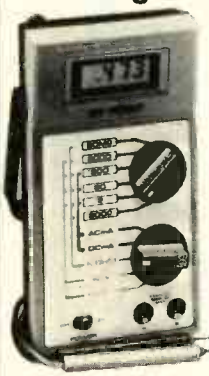
0.1Ω 5W RESISTORS 10/$3.50 39¢ EA. 100/$29

CIRCLE 49 ON FREE INFORMATION CARD

Radio Shack — America's Parts Place™

No Minimum Order! No Waiting! Low Prices! All Prime Devices!

Sensitive, 20-Range LCD Digital Multimeter



- *10-Megohm Input*
- *Easy-to-Read 0.4" Digits*
- *Overload Protected*

79.95

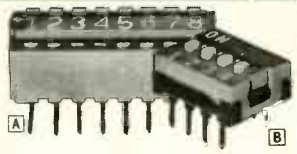
With Leads and Instructions

Features liquid crystal display with over-range and low battery indicators, auto polarity and auto zero-adjust. Volts: 0-500 AC, 0-1000 DC in 8 ranges. AC and DC Current: 0-200 mA in 6 ranges. Resistance: 0-20MΩ in 6 ranges. Requires 9V battery or adapter. **22-198** **79.95**

AC Adapter. U.L. listed. **273-1431** **4.95**

Carrying Case for Above. 22-153 ..... **6.95**

Miniature SPST DIP Switches



Low As **1.49**

Perfect for digital or low current applications. .100 x .300" DIP centers. Socket or PCB mounting.

Positions	Fits	Cat. No.	Each
A Eight	16-Pin Socket	275-1301	1.99
B Four	8-Pin Socket	275-1304	1.49

Matched Infrared Emitter/Detector

Save 30%

Reg. 1.99 **1.39**

Ideal for isolation or communications. LED source rated 20 mA at 1.7VDC. Sensitive photo-transistor detector.

276-142 ..... **Sale 1.39**

Snap-In 12-Volt Lamp Assemblies

Pkg. of 2 **1.89**

One red, one green. Mount quickly in ½" dia. hole. Long 4" leads. Long-life bulbs included.

272-332 ..... **Pkg. 2/1.89**

Sale!! Archer® Cordless Power Wire-Wrapping Tool

Save 23%

Reg. 21.95 **16.88**

- *Easier, Faster & More Reliable Than Soldering*
- *Trigger-Action On/Off*

Save $5.07 and start wiring like a pro! This motorized tool makes a perfect wrap every-time. Positive indexing assures identical wraps on .025" square posts. Unwraps, too! Features built-in wire stripper/cutter, durable carbon-steel tip. Requires 2 "C" batteries (RS #23-124 ni-cads recommended) or adapter/charger.

276-1571 ..... **Sale 16.88**

AC Adapter/Charger. U.L. Listed. **273-1454** **5.95**

Stereo Reverb Project-Board™

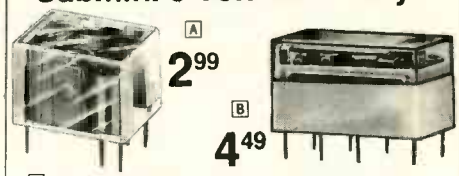
NEW!

9.95

Echo, reverb and phase shift effects for musical instrument amps and stereo systems. Includes predrilled, labeled board, instructions, and parts list. PARTS EXTRA—all available at Radio Shack, or use those you already have and save!

277-132 ..... **9.95**

Submini 5-Volt DIP Relays



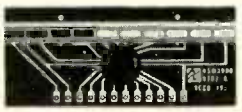
A **2.99**

B **4.49**

A SPDT. For PC boards and sockets with .100 x .300" centers. Contacts: 1 Amp at 125VAC. Coil: 56Ω. ⅜x⅝x⁷⁄₁₆". **275-216** **2.99**

B DPDT. Fits 16-pin DIP socket. 1 Amp contacts. 50Ω coil. **275-215** **4.49**

LED VU Meter Module



9.95

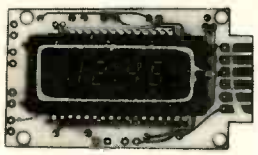
- *Ultra-Fast*
- *Pre-Wired!*

NEW!

Great audio system "upgrader"! 10-element red display has moving point or bar graph option. Requires 12VDC. With applications data. 2x⅞x1¼".

277-1009 ..... **9.95**

12-Hour Auto Clock Module



Save 27%

Reg. 21.95 **15.95**

± 0.5 Sec/Day Accuracy!

Equip your vehicle with this pre-wired quartz-controlled digital clock—and save $6.00! Easy-to-read 0.3" green fluorescent display blanks automatically when ignition is shut off to minimize battery drain. Complete—just add switches! With data.

277-1003 ..... **Sale 15.95**

"Music Synthesizer" Sound Generator IC

Save 20%

Reg. 4.49 **3.59**

SN76477. Creates music, gunshots, explosions, phasers—and much more! Line-level output. With data. 28-pin DIP. **276-1765** ..... **Sale 3.59**

Semiconductor Guide

NEW!

Only **2.99**

Archer® Semiconductor Replacement Guide. Over 118,000 substitution listings plus detailed data on LEDs, ICs, diodes, more! 1981 edition. 264 pages. **276-4004** **2.99**

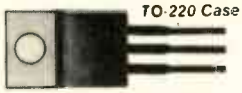
Mini 12V Buzzer

NEW! 1.69

Fits almost anywhere, really gets attention! 1 1⁄16" mtg. centers. Leads for easy hookup.

273-055 ..... **1.69**

Voltage Regulators

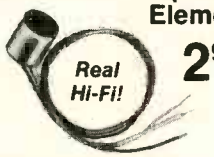


NEW! 3.99 Each

Adjustable over 0-37V range.

Type	Cat. No.	Each
LM317T (Pos.)	276-1778	3.99
LM337T (Neg.)	276-1779	3.99

Electret Microphone Element



2.99

Omnidirectional, 30 to 15,000 Hz response! 4-10VDC. 7⁄16x⅜" dia. Leads for easy hookup.

270-092 ..... **2.99**

Low-Leakage Electrolytics

NEW! Low As 49¢ Each

35WVDC. Radial leads for PC board mounting. Replace tantalum types in many applications.

µF	Cat. No.	Each	µF	Cat. No.	Each
.1	272-1415	.49	1.0	272-1419	.49
.22	272-1416	.49	2.2	272-1420	.59
.47	272-1417	.49	3.3	272-1421	.59
.68	272-1418	.49	4.7	272-1422	.59
...	.....	....	10.0	272-1423	.59

WHY WAIT FOR MAIL ORDER DELIVERY?
IN STOCK NOW AT OUR STORE NEAR YOU!

Retail prices may vary at individual stores and dealers.

Radio Shack®

A DIVISION OF TANDY CORPORATION • FORT WORTH, TEXAS 76102
OVER 7000 LOCATIONS IN 40 COUNTRIES

CIRCLE 3 ON FREE INFORMATION CARD

100 W 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.I.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: IV 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 **$69.50** 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

2 WATT AUDIO AMP

Pre assembled units. All you need is to hook up the speaker and the volume control. Supply voltage from 9~ 15V D.C. measures only 2" x 3½", making it good for portable or discrete applications. Comes with hook up data.

BUY 2 FOR **$4.99**

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**

NEW MARK V 15 STEPS LED POWER OUTPUT INDICATOR KIT

All functions same as Mark IV but this is with heavy duty aluminum front plate and case. Can be easily slot into the front panel of your auto, truck or boat. Operates on 12V DC.

$41.50 EACH 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 lumination of the lantern.

$10.50 EA

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 100Mz and 10KHz.

$32.50 PER KIT

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Suply 6 18V DC
ONLY $6.00 EACH

PROFESSIONAL PANEL METERS

Type MU-52E

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.**

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
$2.50

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!

SANYO HYBRID AUDIO POWER AMPLIFIER I.C.

Typical ratings
Operating case temp. 85°C.
T.H.D. = 0.5% f = 20~20KHZ
Input resistance Po = 0.1W 30KΩ
Power band width 20HZ~20KHZ
Freq. response 10HZ~100KHZ
Output resistance = 8Ω
With built in protection circuit.
All units come with data sheet.

PART	OUTPUT (W)	SUPPLY VOLTAGE	PRICE
STK040	10W+10W Stereo	±16V D.C.	**$14.50**
STK041	15W+15W Stereo	±20V D.C.	**$18.50**
STK043	20W+20W Stereo	±22V D.C.	**$22.50**
STK054	23 WATTS	±23V D.C.	**$13.50**
STK056	30 WATTS	±22V D.C.	**$18.50**
STK050	50 WATTS	±35V D.C.	**$26.50**
STK070	70 WATTS	±42V D.C.	**$32.50**
STK1050	100 WATTS	±50V D.C.	**$40.50**

PROFESSIONAL FM WIRELESS MICROPHONE

TECT 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 6¼" 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 neded. 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.

SANYO UHF VARACTOR TUNER

For UHF CH 14~83
Tuning voltage + 1V~+ 28V/D.C. Input impedance 75 OHM. I.F. band width 7~16 MHZ. Noise figure 11.5 dB MAX. Size 2⅝" x 1¼" x ¾". Supply voltage 15V D.C. Sound I.F. = 58.0 MHZ. Video I.F. = 62.5 MHZ

All units are brand new from Sanyo.
MODEL 115-B-405A
$35.00 EACH

CIRCLE 20 ON FREE INFORMATION CARD

FLUORESCENT LIGHT DRIVER 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!

With Case Only
$6.50 Per Kit

SUPER FM WIRELESS MIC KIT — MARK III

This new designed circuit uses high FEQ. 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.

FMC-105
$11.50 PER KIT

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

MAIN AMP (15W x 2)
Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not included). Power band with (KF 1% ± 3dB). Voltage gain 33dB. 20Hz - 20KHz.

Super Buy
Only $18.50

SPACE WAR SOUND GENERATOR BOARD

Brand new preassembled module for a toy factory. The board gives out 6 different selectable space sound with LED light effect. Sounds include UFO take-off, space gun blast, wave, and space chime. 7 LED on the board will work with the sound. Requires 9V battery to operate. Speaker not included.
SPECIAL **$3.99** EACH SPEAKER **$1.25** EACH

ELECTRONIC PIEZO BEEP BUZZER

Unique surplus ⅞" Dia. piezo ceramic disc on circuit board gives a distinct high freq. buzz. Unit contains an I.C., 2 caps, 6 resistors and is already preassembled. Requires 9V battery to operate.
SPECIAL 2 FOR **$2.99**

2 BIT COUNTER, WARBLE PULSE ALARM BOARD

This new assembly easily converts to a counter, stop watch, warble and pulse alarm generator by adding a few components. We supply the data and typical applications. Requires 9V battery to operate.
SPECIAL 2 FOR **$1.99**

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

BATTERIES

PK/$10.00
2 PKS/$19.00

NICKEL CADMIUM BATTERY PACK 'D' SIZE

ILLUSTRATED
LESS COVER

Output: 3.6 Volts @ 3.0 Amp/Hour. Consists of three each, 1.2 Volt "D" size Nickel Cadmium Cells stacked and plastic film encapsulated. Tabs are provided at each end for electrical connections. The individual cells can be cut apart if desired. Rated recharge rate is 30 mA, 14-18 hours. Size: 1¼" dia. x 7" long. New. Shpg. Wt. each pack, 1 lb.

"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

NI-CD BATTERY SALE

12V Pack 450 MZ/HR Size 3" x 1" x 2"
$8.00 PER PACK

4 AA Pack 450 MA/HR
$3.50 PER PACK

All above batteries are used but late date code and we guarantee to take back all bad ones for exchange.

ELECTRONIC PIN BALL MACHINE

That sounds and plays like the real thing. All units are brand new but without the case. Functions of the game include double flipper control, kicker control, 1-4 players, 3 speed ball control, tilt switch, automatic score, extra bonus cave and many more. All solid state with LED panel, no moving parts. Requires 9V battery to operate, speaker not included.

A perfect gift for yourself or friends.
SPECIAL **$8.99** EACH
SPEAKER **$1.25** EACH

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.

$1.75 ea. **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 condensor 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

±4 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
4 FOR $6.00

RECHARGEABLE BATTERIES
LIMITED QUANTITY AVAILABLE

SUB MINIATURE TOGGLE SWITCH 6 AMP 125V A.C.

SPDT	$1.20
SPST MOMENTARY	$1.40
DPDT	$1.80
DPDT MOMENTARY	$1.80
DPDT (CENTER OFF)	$2.20
3PDT	$2.20
3PDT (CENTER OFF)	$2.50
4PDT	$2.80
4PDT (CENTER OFF)	$3.80

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, 2 AMP 24V x 2 **$8.50**

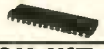
0-30 Power Supply **$10.50 each**

I.C. TEST CLIPS

Same as the E-Z clips With 20" Long Leads In Black and Red Colors **$2.75 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.**

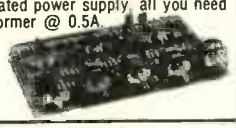
LOW TIM DC STEREO PRE-AMP KIT TA-10 20

Incorporates brand-new D.C. design that gives a frequency response from 0Hz — 100KHz ±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 ±0.5dB • RIAA deviation: ±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 ±10dB @ 50Hz/treble ±10dB @ 15Hz • Power supply: ±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'former
$4.50 ea.



SOLID STATE ELECTRONIC BUZZER

Mini size 1" x ¾" x ¾"
Supply voltage 1.5V - 12V
Ideal for Alarm or Tone Indicator

$1.50 each

FORMULA INTERNATIONAL INC.

11/80

	SHIPPING AND HANDLING CHARGES Under $50.00 purchase	Over $50.00 purchase
Inside California	10%	5%
Outside Calif. (includes Mexico & Canada)	15%	10%
Overseas	25%	20%

Minimum Order $10.00/Calif. Residents Add 6% Sales Tax
Phone Orders Accepted on Visa or MC ONLY, NO C.O.D./Store Hours 10-7 Mon. thru Sat.

12603 CRENSHAW BLVD., HAWTHORNE, CA 90250
PHONE: (213) 973-1921 • (213) 679-5162

Send $1.00 For Detailed Catalogue

PAY TV DECODER

continued from page 54

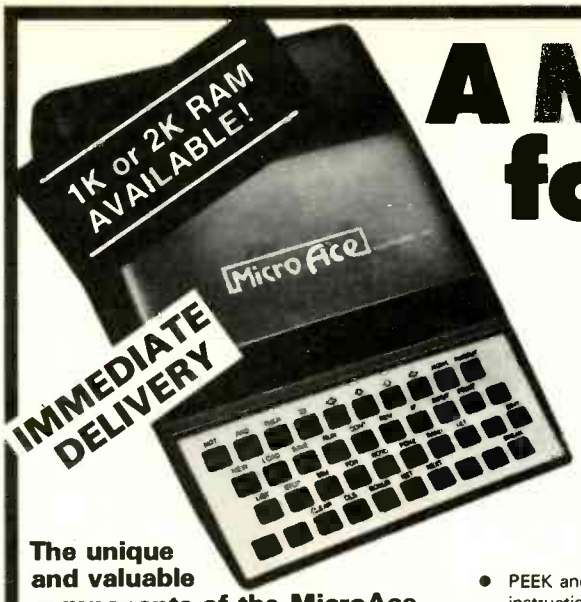
desired output frequency according to Table 1.

7. Adjust the slug of L2 for a frequency of 4.50 ± .05 MHz.
8. If a TV-field-strength meter is available, the output level may be checked. The level should be 2000 microvolts ± 6 db for the video carrier, and 100 microvolts ± 6 db for the audio carrier. Those levels are affected by the setting of R21.

That completes the adjustment procedure of the adapter board. At this point, you should be receiving a good-quality signal on TV2. If not, go back over the adjustments carefully—especially the adjustments of R6, R7, and R8. Those control the stability of the picture. With the scope probe connected to point "V", note the relationship between the video waveform and the behavior of the image on TV2.

Finally, the importance of a good antenna for the modified TV set cannot be overemphasized. Because of the scheme used to transmit the horizontal-timing element (the pilot carrier) the system is very susceptible to multipath reflections (i.e., ghosts). With this adaptor, multipath signals will not only show up as ghosts; they will also cause tearing of the picture. The time spent in getting a good, snow-free, ghostless picture will be worth it—not only for receiving nonstandard signals, but for normal broadcasts as well.

Your modified TV may also be used to feed a central distribution system. That can be done by using a 2-set splitter as a combiner, as shown in Figs. 11-b and -c. However, for best results a vestigial-sideband filter such as a Plessey SW300 or Crystal Technology CTI-55B should be installed at the output of TV1. That filter removes the high-frequency component of the lower sideband of the output signal and thus eliminates co-channel interference. The PC board has been designed to accommodate one of those filters (FL1). If it is used, remove R29 and select the appropriate jumper for channel 3 or 4 as shown in Fig. 6. **R-E**



Licenced by Sinclair Research Ltd.

A Microcomputer for everyone at a Micro Price

The MicroAce - a new generation of miniature computers

A COMPLETE COMPUTER for $149.00 for 1K Kit

Post and Packing FREE

(Add 6% Tax for Shipments inside California)

The unique and valuable components of the MicroAce

The MicroAce is not just another personal computer. Quite apart from its exceptionally low price, the MicroAce has two uniquely advanced components: the powerful BASIC interpreter, and the simple teach yourself BASIC manual.

The unique versatile BASIC interpreter offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the MicroAce eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability — takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The MicroAce also has string input — to request a line of text when necessary. Strings do not need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

'Excellent value' indeed!

For just $149.00 (including handling charge) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or color); everything!

Yet the MicroAce really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The MicroAce is programmed in BASIC, and you can use it to do quite literally anything, from playing chess to managing a business.

The MicroAce is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done: connect it to your TV ... link it to the mains adaptor ... and you're ready to go.

Fewer chips, compact design, volume production-more power per Dollar!

The MicroAce owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the MicroAce 1K byte RAM (expandable to 2K on board) is roughly equivalent to 4K bytes in a conventional computer — typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the MicroAce is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.

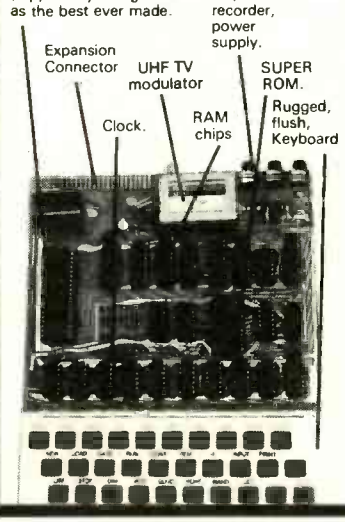
The MicroAce teach-yourself BASIC manual.

If the features of the BASIC interpreter mean little to you-don't worry. They're all explained in the specially-written book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming-from first principles to complex programs. (Available separately-purchase price refunded if you buy a MicroAce later.)

A hardware manual is also included with every kit.

The MicroAce Kit: $149.00 with IK COMPLETE $169.00 with 2K

Demand for the MicroAce is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. If you are unsuccessful in constructing your kit, we will repair it for a fee of $20.00, post and packing FREE. Of course, you may return your MicroAce as received within 14 days for a full refund. We want you to be satisfied beyond all doubt — and we have no doubt that you will be.



Your MicroAce kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs-all manufactured by selected world-leading suppliers.
- New rugged keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVEd and LOADed on to a portable cassette recorder.)
- Mains adaptor of 600 mA at 9VDC nominal unregulated.
- FREE course in BASIC programming and user manual.

JOIN THE REVOLUTION - DON'T GET LEFT BEHIND - ORDER YOUR MICRO ACE NOW!!

Send Check, Money Order or quote your Credit Card No. to:
MicroAce 1348 East Edinger, Santa Ana, California, Zip Code 92705.
or phone (714) 547 2526 quoting your Credit Card Number.

Quantity	Description	Unit Price	TOTAL
	MicroAce Kit 1K	$149.00	
	MicroAce Kit 2K	$169.00	
	Manual	$10.00	
	1K Upgrade Kit	$29.00	
Shipments inside California add 6% TAX		**TOTAL**	

☐ Amex.
☐ Diners
☐ Check
☐ Money Order
☐ Master Charge
☐ Visa

Card No. _____

Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____


7400

SN7400N	.25			SN74156N	.79
SN7401N	.20			SN74157N	.69
SN7402N	.25	SN7472N	.29	SN74160N	.89
SN7403N	.25	SN7473N	.35	SN74161N	.89
SN7404N	.25	SN7474N	.35	SN74162N	.89
SN7405N	.29	SN7475N	.49	SN74163N	.89
SN7406N	.35	SN7476N	.35	SN74164N	.89
SN7407N	.35	SN7479N	5.00	SN74165N	.89
SN7408N	.29	SN7480N	.50	SN74166N	1.25
SN7409N	.29	SN7482N	.99	SN74167N	2.79
SN7410N	.25	SN7483N	.69	SN74170N	1.95
SN7411N	.29	SN7485N	.89	SN74172N	4.95
SN7412N	.35	SN7486N	.35	SN74173N	1.39
SN7413N	.40	SN7489N	1.75	SN74174N	.99
SN7414N	.69	SN7490N	.49	SN74175N	.89
SN7416N	.29	SN7491N	.59	SN74176N	.79
SN7417N	.29	SN7492N	.45	SN74177N	.79
SN7420N	.25	SN7493N	.45	SN74179N	1.49
SN7421N	.29	SN7494N	.69	SN74180N	.79
SN7422N	.45	SN7495N	.69	SN74181N	2.25
SN7423N	.29	SN7496N	.69	SN74182N	.79
SN7425N	.29	SN7497N	3.00	SN74184N	2.49
SN7426N	.29	SN74100N	1.49	SN74185N	2.49
SN7427N	.25	SN74107N	.35	SN74190N	1.25
SN7429N	.39	SN74109N	.39	SN74191N	1.25
SN7430N	.25	SN74116N	1.95	SN74192N	.89
SN7432N	.29	SN74121N	.39	SN74193N	.89
SN7437N	.25	SN74122N	.55	SN74194N	.89
SN7438N	.40	SN74123N	.59	SN74195N	.69
SN7439N	.25	SN74125N	.49	SN74196N	.89
SN7440N	.20	SN74126N	.49	SN74197N	.89
SN7441N	.89	SN74132N	.75	SN74198N	1.49
SN7442N	.59	SN74136N	.75	SN74199N	1.49
SN7443N	1.10	SN74141N	.99	SN74221N	1.25
SN7444N	1.10	SN74142N	3.25	SN74251N	.99
SN7445N	.89	SN74143N	3.49	SN74276N	1.95
SN7446N	.79	SN74144N	3.49	SN74279N	.79
SN7447N	.69	SN74145N	.79	SN74283N	1.49
SN7448N	.79	SN74147N	1.95	SN74284N	3.95
SN7450N	.20	SN74148N	1.29	SN74285N	3.95
SN7451N	.20	SN74150N	1.25	SN74365N	.69
SN7453N	.20	SN74151N	.69	SN74366N	.69
SN7454N	.20	SN74152N	.69	SN74367N	.69
SN7459A	.25	SN74153N	.79	SN74368N	.69
SN7460N	.20	SN74154N	1.25	SN74390N	1.49
SN7470N	.29	SN74155N	.79	SN74393N	1.49

74LS

74LS00	.29			74LS192	1.15
74LS01	.29			74LS193	1.15
74LS02	.29	74LS92	.75	74LS194	1.15
74LS03	.29	74LS93	.75	74LS195	1.15
74LS04	.35	74LS95	.99	74LS197	1.19
74LS05	.35	74LS96	1.15	74LS221	1.19
74LS08	.29	74LS107	.45	74LS240	1.95
74LS09	.35	74LS109	.45	74LS241	1.95
74LS10	.29	74LS112	.45	74LS242	1.95
74LS11	.75	74LS113	.49	74LS243	1.95
74LS12	.35	74LS114	.49	74LS244	1.95
74LS13	.59	74LS122	.89	74LS245	2.95
74LS14	.99	74LS123	1.25	74LS247	1.19
74LS15	.35	74LS125	.89	74LS248	1.19
74LS20	.29	74LS126	.55	74LS249	1.19
74LS21	.35	74LS132	.99	74LS251	1.49
74LS22	.35	74LS133	.89	74LS253	.99
74LS26	.35	74LS136	.49	74LS257	.89
74LS27	.35	74LS138	.89	74LS258	.99
74LS28	.35	74LS139	.89	74LS260	.69
74LS30	.29	74LS151	.89	74LS266	.69
74LS32	.35	74LS153	.89	74LS273	1.95
74LS33	.59	74LS154	1.75	74LS279	.75
74LS37	.45	74LS155	1.19	74LS283	1.09
74LS38	.49	74LS156	1.19	74LS290	.99
74LS40	.35	74LS157	.89	74LS293	.99
74LS42	.89	74LS158	.99	74LS298	1.25
74LS47	.89	74LS160	1.15	74LS352	1.29
74LS48	1.15	74LS161	1.15	74LS353	1.29
74LS49	1.15	74LS162	1.15	74LS365	.75
74LS51	.29	74LS163	1.15	74LS366	.75
74LS54	.29	74LS164	1.25	74LS367	.75
74LS55	.29	74LS165	1.25	74LS368	.75
74LS73	.45	74LS168	1.19	74LS373	1.95
74LS74	.45	74LS169	1.19	74LS374	1.95
74LS75	.59	74LS170	2.49	74LS375	.89
74LS76	.45	74LS173	1.39	74LS386	.69
74LS78	.49	74LS174	.99	74LS393	2.49
74LS83	.89	74LS175	.99	74LS399	2.49
74LS85	1.25	74LS181	2.95	74LS670	2.49
74LS86	.45	74LS190	1.25	81LS95	1.95
74LS90	.59	74LS191	1.25	81LS97	1.95

74S

74S00	.50			74S244	3.25
74S02	.50			74S251	1.45
74S03	.50	74S133	.55	74S253	1.45
74S04	.55	74S134	.69	74S257	1.35
74S05	.55	74S135	1.19	74S258	1.35
74S08	.50	74S136	1.75	74S260	.79
74S09	.50	74S138	1.35	74S280	2.95
74S10	.50	74S139	1.35	74S287*	4.95
74S11	.50	74S140	1.15	74S288*	4.95
74S15	.50	74S151	1.35	74S373	3.49
74S20	.50	74S153	1.35	74S374	3.49
74S22	.50	74S157	1.35	74S387*	5.95
74S30	.50	74S158	1.35	74S471*	19.95
74S32	.55	74S174	1.59	74S472*	19.95
74S40	.55	74S175	1.59	74S473*	19.95
74S51	.50	74S188	4.95	74S474*	21.95
74S64	.50	74S194	1.95	74S475*	21.95
74S65	.50	74S195	1.95	74S570*	7.95
74S74	.79	74S196	3.95	74S571*	7.95
74S86	.79	74S240	2.95	74S572*	19.95
74S112	.79	74S241	2.95	74S573*	19.95
74S113	.79	74S242	3.25	74S940	3.15
74S114	.79	74S243	3.25	74S941	3.15

* LIMITED AVAILABILITY ON THESE PROMS

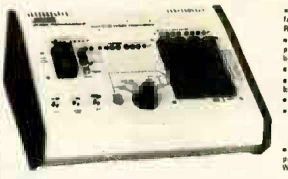
CA–LINEAR

CA3013H	2.15			CA3089N	3.75
CA3023H	3.25			CA3096N	3.95
CA3039H	1.35			CA3130H	1.39
CA3046N	1.30	CA3081N	2.00	CA3140H	1.25
CA3059N	3.25	CA3082N	2.00	CA3160H	1.25
CA3060N	3.25	CA3083N	1.60	CA3401N	.59
CA3080H	1.25	CA3086N	.85	CA3600N	3.50

CD–CMOS

CD4000	.39			CD4082	.39
CD4001	.39			CD4093	.99
CD4002	.39			CD4098	2.49
CD4006	1.19			CD4506	.75
CD4007	.25	CD4041	1.49	CD4507	.99
CD4009	.49	CD4042	.99	CD4508	3.95
CD4010	.49	CD4043	.89	CD4510	1.39
CD4011	.39	CD4044	.89	CD4511	1.29
CD4012	.25	CD4046	1.79	CD4514	3.95
CD4013	.49	CD4047	2.50	CD4515	2.95
CD4014	1.39	CD4048	1.35	CD4516	1.49
CD4015	1.19	CD4049	.49	CD4518	1.79
CD4016	.59	CD4050	.69	CD4519	.89
CD4017	1.19	CD4051	1.19	CD4520	1.29
CD4018	.99	CD4052	1.19	CD4526	1.79
CD4019	.49	CD4053	1.19	CD4528	1.79
CD4020	1.19	CD4056	2.95	CD4529	1.95
CD4021	1.39	CD4059	9.95	CD4543	2.79
CD4022	1.19	CD4060	1.49	CD4562	11.95
CD4023	.29	CD4066	.79	CD4566	2.79
CD4024	.79	CD4068	.39	CD4583	2.49
CD4025	.23	CD4069	.45	CD4723	1.95
CD4026	2.95	CD4070	.55	CD4724	1.95
CD4027	.69	CD4071	.49	MC14409	14.95
CD4028	.89	CD4072	.49	MC14410	14.95
CD4029	1.49	CD4073	.39	MC14411	14.95
CD4030	.49	CD4075	.39	MC14412	11.95
CD4035	.99	CD4076	1.39	MC14419	4.95
CD4040	1.49	CD4081	.39	MC14433	13.95

JE608 PROGRAMMER
2708 EPROM PROGRAMMER

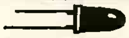
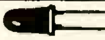


- 3 separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2"-2") for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip
- Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board
- Rapid checking verification of programmed data changes.
- User may move data from a master to RAM's or write into RAM's with keyboard entries.
- Allows manual stepping manipulation (up and down) at any address location.
- Stand alone EPROM Programmer consisting of: A 19 key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W.
- Compact desk top enclosure: Color coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¾"H x 11"W x 8¾"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program, for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer Board with 25 IC's and including power supplies of: -5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel Board are separate assemblies within the system.

JE608K KIT $399.95
JE608A Assembled and tested $499.95

DISCRETE LEDS

XC556R	.200" red	5/$1	MV50	.085" red	6/$1	XC111R	.190" red	5/$1
XC556G	.200" green	4/$1	XC209R	.125" red	5/$1	XC111G	.190" green	4/$1
XC556Y	.200" yellow	4/$1	XC209G	.125" green	4/$1	XC111Y	.190" yellow	4/$1
XC556C	.200" clear	4/$1	XC209Y	.125" yellow	4/$1	XC111C	.190" clear	4/$1
XC22R	.200" red	5/$1	XC526R	.185" red	5/$1			
XC22G	.200" green	4/$1	XC526G	.185" green	4/$1			
XC22Y	.200" yellow	4/$1	XC526Y	.185" yellow	4/$1			
MV10B	.170" red	4/$1	XC526C	.185" clear	4/$1			

INFRA-RED LED
¼"x ⅛"x 1/16" flat
IRL — 5/$1

DISPLAY LEDS

C.A. — Common Anode C.C. — Common Cathode

Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95
MAN 2	5x7 D.M.—red	.300	4.95
MAN 3	C.C.—red	.125	.25
MAN 52	C.A.—green	.300	1.25
MAN 54	C.C.—green	.300	1.25
MAN 71	C.A.—red	.300	.75
MAN 72	C.A.—red	.300	.75
MAN 74	C.C.—red	.300	1.25
MAN 82	C.A.—yellow	.300	.49
MAN 84	C.C.—yellow	.300	.99
MAN 3620	C.A.—orange	.300	.49
MAN 3630	C.A.—orange ± 1	.300	.99
MAN 3640	C.C.—orange	.300	.99
MAN 4610	C.A.—orange	.400	.99
MAN 6610	C.A.—orange—DD	.560	.99
MAN 6630	C.A.—orange ± 1	.560	.99
MAN 6640	C.C.—orange—DD	.560	.99
MAN 6650	C.C.—orange ± 1	.560	.99
MAN 6660	C.A.—orange	.560	.99
MAN 6710	C.A.—red—DD	.560	.99
MAN 6750	C.C.—red ± 1	.560	.99
MAN 6780	C.C.—red	.560	.99
DL704	C.C.—red	.300	1.25
DL707	C.A.—red	.300	1.25
DL728	C.C.—red	.500	1.49

Type	Polarity	Ht	Price
DL741	C.A.—red	.600	1.25
DL746	C.A.—red ± 1	.630	1.49
DL747	C.A.—red	.600	1.49
DL750	C.C.—red	.600	1.49
DL33B	C.C.—red	.110	.35
FND358	C.C. ± 1	.357	.99
FND359	C.C.	.357	.75
FND503	C.C. (FND500)	.500	.99
FND507	C.A. (FND510)	.500	.99
HDSP-3401	C.A.—red	.800	1.50
HDSP-3403	C.C.—red	.800	1.50
5082-7613	C.C., R.H.D.—red	.300	1.25
5082-7620	C.A., L.H.D.—yel.	.300	1.25
5082-7623	C.C., R.H.D.—yel.	.300	1.25
5082-7730	C.A., L.H.D.—red	.300	.99
5082-7731	C.A., R.H.D.—red	.300	1.25
5082-7750	C.A., L.H.D.—red	.430	1.75
5082-7751	C.A., R.H.D.—red	.430	1.25
5082-7760	C.C., R.H.D.—red	.430	1.75
5082-7300	4x7 sgl. dig. RHD	.600	22.00
5082-7302	4x7 sgl. dig. LHD	.600	22.00
5082-7304	Overnge. char. (±1)	.600	19.95
4N28	Photo Xsistor Opto-Isol.		.99
LIT-1	Photo Xsistor Opto-Isol.		.69
MOC3010	Optically Isol. Triac Driver		1.25

POTENTIOMETERS

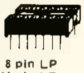
$2.95 each
2 Watt @ 70°C ± 10%
7/8" Slotted Shaft
Linear Taper
Meets Mil-R-94

Part No.		
CMU 1021	RV4NAY SD - 102A	1K
CMU 5021	RV4NAY SD - 502A	5K
CMU 1031	RV4NAY SD - 103A	10K
CMU 2531	RV4NAY SD - 253A	25K
CMU 5031	RV4NAY SD - 503A	50K
CMU 1041	RV4NAY SD - 104A	100K
CMU 1052	RV4NAY SD - 105A	1Meg

$1.35 each
3/4 Watt @ 70°C
15 turn pot. Linear taper. Printed circuit mount.

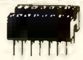
Part No.	Part No.	Part No.
830P- 50ohm	830P- 5K	830P-100K
830P-100ohm	830P-10K	830P-200K
830P-500ohm	830P-20K	830P-500K
830P-1K	830P-50K	830P-1Meg
830P-2K		

LOW PROFILE (TIN) SOCKETS



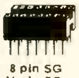
	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)



	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD



	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	22.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	28.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	9.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	11.10
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.50
8212CPA	Volt Ref/Indicator	2.50

* INTERSIL'S EVALUATION KITS

74C

74C00	.39			74C195	1.59
74C02	.39			74C221	1.95
74C04	.39			74C240	2.25
74C08	.39	74C106	.75	74C244	2.25
74C10	.39	74C107	1.89	74C373	2.49
74C14	.75	74C151	2.95	74C374	2.59
74C20	.39	74C154	3.95	74C901	.89
74C30	.39	74C157	2.25	74C903	1.15
74C42	1.39	74C160	1.69	74C911	10.95
74C48	1.95	74C161	1.60	74C912	10.95
74C73	.79	74C162	1.49	74C915	1.69
74C74	.79	74C163	1.69	74C917	10.95
74C85	1.95	74C164	1.59	74C922	5.49
74C86	.99	74C173	1.39	74C923	5.75
74C89	6.95	74C174	1.39	74C925	7.50
74C90	1.29	74C175	1.39	74C926	7.50
74C93	1.29	74C192	1.69	80C95	.79
74C95	1.59	74C193	1.69	80C97	.79

LINEAR

LH0002CN	6.85			NE570N	4.95
LM10CLH	4.50			LM702H	.79
LM11CLH	4.75			LM703CN	.89
LH0070-OH	6.05	LM340T-5	1.25	LM709N	.29
TL071CP	.79	LM340T-12	1.25	LM710N	.79
TL072CP	1.39	LM340T-15	1.25	LM711N	.79
TL074CN	2.49	LM341P-5	.75	LM723N	.69
LH0082CD	35.80	LM341P-12	.75	LM733N	1.00
TL082CP	1.19	LM341P-15	.75	LM739N	1.19
TL084CN	2.19	LM342P-5	.69	LM741CN	.35
LH0094CO	36.80	LM342P-12	.69	MC1741SCG	3.00
LM300H	.99	LM342P-15	.69	LM747N	.79
LM301CN	.35	LM348N	1.25	LM748N	.59
LM302H	1.95	LM350K	5.75	LM1014N	2.75
LM304H	1.95	LF351N	.60	LM1310N	1.95
LM305H	.99	LF353N	1.00	LM1458CN	.59
LM307CN	.45	LF355N	1.10	LM1488N	1.25
LM308CN	1.00	LF356N	1.10	LM1489N	1.25
LM309H	1.95	LM358N	1.00	LM1496N	1.95
LM309K	1.25	LM359N	1.79	LM1556V	1.75
LM310CN	1.75	LM370N	4.49	LM1800N	2.95
LM311H	.90	LM373N	3.25	LM1877N-9	3.25
LM312H	2.49	LM377N	2.95	LM1889N	3.20
LM317MP	1.15	LM380N	1.25	LM1896N	1.75
LM317T	1.75	LM381N	1.95	LM2002T	1.49
LM317K	3.95	LM382N	1.79	LM2877P	2.05
LM318CN	1.95	LM384N	1.95	LM2878P	2.25
LM319N	1.95	LM386N-3	1.29	LM2896P-1	2.25
LM320K-5	1.35	LM387N	1.45	LM3189N	2.95
LM320K-12	1.35	LM389N	1.35	LM3900N	.69
LM320K-15	1.35	LM392N	.69	LM3905CN	1.25
LM320T-5	1.25	LF398N	4.00	LM3909N	1.15
LM320T-12	1.25	LM399H	5.00	LM3914N	3.95
LM320T-15	1.25	TL494CN	4.49	LM3915N	3.95
LM323K-5	5.95	TL496CP	1.75	LM3916N	3.95
LM324N	.99	NE510A	6.00	RC4136N	1.25
LM329DZ	.65	NE529A	4.95	RC4151NB	3.95
LM331N	3.95	NE531H	3.95	RC4194TK	5.95
LM334Z	1.30	NE536H	6.00	RC4195TK	5.49
LM335Z	1.40	NE540H	6.00	KB4428	4.25
LM336Z	1.75	NE544N	4.95	KB4429	5.95
LM337T	1.95	NE550A	1.30	LM4500A	3.25
LM337MP	1.15	NE555V	.39	ICL8038B	4.95
LM338K	6.95	LM556N	.99	LM13080N	1.29
LM339N	.99	NE564N	3.95	LM13600N	1.49
LM340K-5	1.35	LM565N	1.25	75138N	1.95
LM340K-12	1.35	LM566CN	1.95	75450N	.89
LM340K-15	1.35	LM567V	1.25	75451CN	.39

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5ea.	10 Ohm 27 Ohm	12 Ohm 33 Ohm	15 Ohm 39 Ohm	18 Ohm 47 Ohm	22 Ohm 56 Ohm	50pcs.	$1.95
ASST. 2	5ea.	68 Ohm 180 Ohm	82 Ohm 220 Ohm	100 Ohm 270 Ohm	120 Ohm 330 Ohm	150 Ohm 390 Ohm	50pcs.	$1.95
ASST. 3	5ea.	470 Ohm 1.2K	560 Ohm 1.5K	680 Ohm 1.8K	820 Ohm 2.2K	1K 2.7K	50pcs.	$1.95
ASST. 4	5ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	50pcs.	$1.95
ASST. 5	5ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	50pcs.	$1.95
ASST. 6	5ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	50pcs.	$1.95
ASST. 7	5ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	50pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)						$10.95 ea.

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage — Add 5% plus $1 Insurance

Spec Sheets — 25¢
Send 41¢ Postage for your
FREE 1981 JAMECO CATALOG

NEW 1981 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME
(415) 592-8097

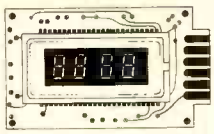
MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

2/81

CIRCLE 14 ON FREE INFORMATION CARD

National Semiconductor Clock Modules

12VDC AUTOMOTIVE/ INSTRUMENT CLOCK



APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto-display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete – just add switches and lens.

MA1003 Module $16.95

MA1023 .7" Low Cost Digital LED Clock Module	8.95
MA1026 .7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036 .3" Low Cost Digital LED Clock/Timer	6.95
MA1002 .5" LEO Display Dig. Clock & Xformer	9.95

National Semiconductor RAM SALE

MM5290N-4 (MK4116/UPO416) . . $4.95 each
16K DYNAMIC RAM-(250NS)
(8 EACH $39.95) (100 EACH $450.00/lot)

MM5290J-2 (MK4116/UPD416) . . $6.95 each
16K DYNAMIC RAM (150NS)
(8 EACH $49.95) (100 EACH $550.00/lot)

MM5298J-3A . . . . . $3.25 each
8K DYNAMIC RAM (LOW HALF OF MM5290J) 200NS
(8 EACH $23.95) (100 EACH $250.00/lot)

MM2114-3 . . . . . $5.95 each
4K STATIC RAM (300NS)
(8 EACH $43.95) (100 EACH $450.00/lot)

MM2114L-3 . . . . . $6.25 each
4K STATIC RAM (LOW POWER 300NS)
(8 EACH $44.95) (100 EACH $475.00/lot)

EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact – only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E $79.50

Jumbo 6-Digit Clock Kit

- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE747 . . . . . $29.95

6-Digit Clock Kit

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701 . . . . . $19.95

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 . . . . . $14.95

ADAPTER BOARD —Adapts to JE200— ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XFMR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 . . . . . $12.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	7.95
DP8253	Prog. Interval Timer	14.95
DP8255	Prog. Peripheral I/O (PPI)	9.95
DP8257	Prog. DMA Control	19.95
DP8259	Prog. Interrupt Control	14.95
DP8275	Prog. CRT Controller	49.95
DP8279	Prog. Keyboard/Display Interface	19.95
DP8300	Octal Bus Receiver	6.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	14.95
MC6802CP	MPU with Clock and RAM	19.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	10.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus Trans.(MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	13.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	15.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MC6502	MPU w/Clock (6K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	16.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	19.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	19.95
INS8900	CPU—16-Bit	29.95
TMS9900JL	MPU—16-Bit	49.95

SHIFT REGISTERS

MM509H	Dual 25-Bit Dynamic	.50
MM503H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402	256-Bit Dynamic	3.95
MM5013	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	.89
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	3.95
2518V	Hex 32-Bit Static	4.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Pass Filter	19.95
AF122-1CJ	Touch Tone Low Pass Filter	19.95
LM308AH	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	4.95
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	300K BAUD UART	5.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
2111.02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114-3	1024x4 Static 300ns	7.49
2114L-3	1024x4 Static 300ns Low Power	7.95
2117	16,384x1 Dynamic 550ns (house marked)	4.95
4116 (UPD416)	16K Dynamic 250ns	4.95
MM2147J	4096x1 Fast 70ns	19.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.25
MM5280/2107	4096x1 Dynamic	4.95
MM5290J-2(4116)	16K Dynamic 150ns (UPD416)	6.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	4.95
7489	16x4 Static	1.75
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-4SNL	4K Static	14.95
TMS4045	1024x4 Static	14.98

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	9.95
TMS2716	16K EPROM (-5V, +5V, +12V)	19.95
2716 Intel (2516) TI	16K EPROM (Single +5V)	17.95
2732 Intel (2532) TI	32K EPROM	49.95
2758	8K EPROM (450ns) (Single +5V)	7.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	4.95
82S115	4096 Bipolar PROM	19.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	4.95
82S185	8K PROM	29.95

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95
2516N	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

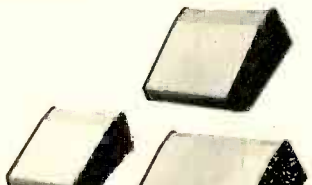
SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.98
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
CDP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

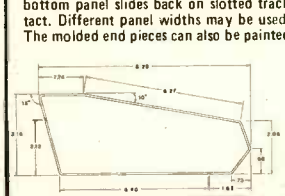
AY-5-9400	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53200N	Push Button Pulse Dialer	7.95
MM57499N	96/144-Key Serial Keyboard Encoder	8.95

DESIGNERS' SERIES
Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end-pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top/bottom panels .080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:
The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

$10.00 Min. Order – U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage – Add 5% plus $1 Insurance

Spec Sheets – 25¢
Send 41¢ Postage for your FREE 1981 JAMECO CATALOG

NEW 1981 CATALOG

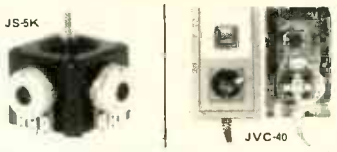
Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS – WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

2/81

JOYSTICKS



JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case	$5.95

AC and DC Wall Transformers

Ideal for use with clocks, games, power supplies or any other type of AC or DC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95
AC1000	117V/60Hz	12 VAC 1 amp	$5.95
DV9200	117V/60Hz	9 VDC 200mA	$3.25
DC 900	120V/60Hz	9 VDC 500mA	$3.95

CONNECTORS

DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80
16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
★ 8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
★ Documentation for Conversion

TRS-16K2	*150 NS	$49.95
TRS-16K4	*250 NS	$39.95

JE610 ASCII
Encoded Keyboard Kit

The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and –12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK	(as pictured above)	$124.95
JE610 Kit	62-Key Keyboard, PC Board, & Components (no case)	$ 79.95
K62	62-Key Keyboard (Keyboard only)	$ 34.95
DTE-AK	(case only – 3¼"Hx11"Wx8¾"D)	$ 49.95

JE600
Hexadecimal Encoder Kit

FULL 8-BIT
LATCHED OUTPUT
19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¾"W x 8¾"D

JE600/DTE-HK	(as pictured above)	$99.95
JE600 Kit	19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case)	$59.95
K19	19-Key Keyboard (Keyboard only)	$14.95
DTE-HK	(case only – 3½"Hx8¼"Wx8¾"D)	$44.95

CIRCLE 58 ON FREE INFORMATION CARD

DIGI-KEY CORPORATION 800-346-5144

In Mn., Ak., Hi. Call 218-681-6674

VISA

Capacitors•Real-Time Clock/Calendar• E F Johnson •Terminal Strips•T.I. Connectors•Wire Wrapping Supplies•CMOS•Rectifiers•Powerace•Sams Books•Diamond Tools•Panavice AP Products•Batteries•ZNR's•Books•Zenier Diodes•Breadboarding•Wire•Buzzers•Vises •Templates•Diodes•Switches•Drafting Aids•Soldering Supplies•Edge Connectors•IC Socket •Enclosures•Resistors & Resistor Networks•Hardware•Power Supplies•Hobby Blox•Phono Plugs & Jacks•Integrated Circuits•Optoelectronics•Lamps•Multimeter•LED's•Data Books Microprocessor & Support•Luxo Lamps•Clock Bezels•PC Layout Supplies•Lithium Batteries•Tantalum Capacitors•Time-Temperature Clock•A D & D/A•Nickle-Cadmium Batteries Electrolytic Capacitors•Potentiometers•Car Clock•Transistors•Home Clock Kits•Tools • Fuse Holder Boards•Ungar Products•Heat Sinks & Accessories•Solder Wick•AND MORE

master charge

DIGI-KEY — DIGI-KEY — DIGI-KEY — The Big DIGI-KEY Discount makes a Big Price Difference (SEE BELOW) — DIGI-KEY — DIGI-KEY

INTEGRATED CIRCUITS

7400 TTL	74LS00 TTL	4000 CMOS	LINEAR I.C.'S
7400N .32	74LS00N .36	4000 .36	LF351N .57
7401N .32	74LS01N .36	4001 .31	LF353N 1.40
7402N .32	74LS02N .36	4002 .36	LF356N 1.48
7403N .32	74LS03N .36	4006 1.36	LF357N 1.48
7404N .35	74LS04N .36	4007 .36	LF13741N .76
7405N .35	74LS05N .36	4008 1.12	LM301AN .58
7407N .41	74LS08N .36	4009 .56	LM307N .68
[illegible]	[illegible]	[illegible]	[illegible]

A/D & D/A CONVERTERS & MISCELLANEOUS — [illegible]

MEMORY — [illegible]

INTERFACE I.C.'S — [illegible]

MICROPROCESSORS — [illegible]

DIP I.C. INSERTION TOOLS WITH PIN STRAIGHTENER

CMOS-SAFE DIP IC EXTRACTOR TOOL

INSERTION & EXTRACTION KIT

5% CARBON FILM RESISTORS
1/4 WATT RESISTOR ASSORTMENTS

RS125 ... $9.90

RS225 ... $9.90

1/2 WATT RESISTORS ASSORTMENTS

RS150 ... $9.90

RS250 ... $9.90

ZNR
PANASONIC TRANSIENT SURGE ABSORBER

Part No						
CO-7241	216 264	150	200	395	.88	7.40
C1-0201	185 225	130	170	340	1.04	8.70
C1-0251	198 242	140	180	360	1.04	8.70
C1-0241	216 264	150	200	395	1.04	8.70
C1-4201	185 225	130	170	340	1.21	10.10
C1-4221	198 242	140	180	360	1.21	10.10
C1-4241	216 264	150	200	395	1.21	10.10
C2-0201	185 225	130	170	340	1.38	11.50
C2-0221	198 242	140	180	360	1.38	11.50

MOLEX I.C. SOCKET PINS

.95/C 9.10/M 42.00/5M 300.00/50M

TEXAS INSTRUMENTS I.C. SOCKETS

SOLDER TAIL DIP SOCKETS

- Low profile
- Face grip design for maximum rentention force
- Redundant contact points
- Your choice — tin or gold
- Texas Instruments quality

TIN INLAY SOLDER TAIL — [illegible]

GOLD INLAY SOLDER TAIL — [illegible]

WIRE WRAP DIP SOCKETS

- Standard profile
- Universal mounting and packaging capabilities
- Contacts accommodate .025" through .031" rectangular or round dual in-line leads
- Wire wrap posts held to true position of .015" providing a true position of .020" on boards for efficient automatic wire wrapping
- Your choice — tin or gold
- Texas Instruments quality

TIN PLATED WIRE WRAP — [illegible]

GOLD INLAY WIRE WRAP — [illegible]

SILICON TRANSISTORS

Part	1	10	100	1000
2N3904	.20	1.79	16.25	146.25
2N3906	.20	1.79	16.25	146.25
[illegible]				

ITT RECTIFIERS

[illegible]

ITT SILICON ZENER DIODES

[illegible]

Call or Write for your Free DIGI-KEY Catalog

HOBBY-BLOX
THE NEW MODULAR CIRCUIT BUILDING SYSTEM

BASIC INTEGRATED CIRCUIT STARTER PACK

INTEGRATED CIRCUIT STARTER PACK COMPONENTS

BASIC DISCRETE COMPONENT STARTER PACK

DISCRETE COMPONENT STARTER PACK COMPONENTS

TRAY · DISTRIBUTION STRIPS · 2x36 TERMINAL STRIPS · BLANK PANEL PACK · BUS STRIP · 5x36 TERMINAL STRIP · L.E.D. STRIP · DISCRETE COMPONENT STRIP · BINDING POST STRIP · TRAY EXTENDER CLIPS · CONTROL PANEL PACK · SPEAKER PANEL PACK · BATTERY HOLDER PACK · VERTICAL TRAY PACK

SUPER-STRIPS
UNIVERSAL BREADBOARDING ELEMENTS WITH SOLDERLESS PLUG-IN TIE POINTS

POWERACE

For complete AP Products specifications get your FREE DIGI-KEY catalog today

TEXAS INSTRUMENTS GOLD EDGEBOARD CONNECTORS

Solder Tab · Solder Eye · Wire Wrap

RELIABLE, COST EFFICIENT CONTACT DESIGN

H4 SERIES .100"x.200" EDGEBOARD CONNECTORS — [illegible]

H4 SERIES .125"x.250" EDGEBOARD CONNECTORS — [illegible]

H4 SERIES .156"x.200" EDGEBOARD CONNECTORS — [illegible]

ELECTRONIC HARDWARE KIT

CAT. NO. 1000 KIT $14.95

NEW MA1032 Clock
Digital LCD Clock Module

- Operates from a single 1.5V Battery
- 0.5" LCD Display

Instructions included in All Orders

- User selectable 12 or 24-hour mode
- 24-hour alarm with ON OFF control
- Presetable 59-minute sleep timer with reset to zero
- 9 minute snooze timer
- Fast/Slow setting controls
- Seconds display
- 90 mA hour battery will typically last one year
- Minimum external parts required for travel clock/clock radio
- Backlighted Display

Catalog No	Description	Cost
MA1032M	LCD Clock Module only	$24.95
MA1032C	Switch for MA1032M	$2.85
MA1032P	MA1032M, MA1032C, & AA battery holder	$28.20

TIME-TEMPERATURE PROGRAMMABLE MODULE
USER PROGRAMMABLE FOR:

- 12 or 24 Hour Display
- °F and or °C on outside virtually any number of temperature sensors
- Fixed or flashing colon format
- 50 60 Hz line frequency operation

MA 1026 by National Semiconductor

FEATURES:

[illegible]

THE "PROGRAMMABLE" CLOCK MODULES
USER PROGRAMMABLE FOR:

NEW! Two Giant Sizes — 0.7" and 0.84"

FEATURES:

MA1023 0.7" HIGH DIGITS — [illegible]

MA1020 0.84" HIGH DIGITS — [illegible]

DIGITAL CLOCK BEZEL
THE XMAS DIGITAL DISPLAY BEZEL

WITH RED FILTER

UNIVERSAL SIZE

Be Sure to Order the Proper Adapter for Your Digital Clock

DIGI-CLOCK KIT

- 12 VDC — Ideal for Car, Van or Boat!

Part No. 5001K ONLY $24.95

Do you need spacers, Banana plugs and jacks, or tip plugs and jacks? You can get these and more E. F. JOHNSON products from DIGI-KEY

HEAT SINKS from TO-92 2W coolers to TO-3 100W sinks.

PANASONIC ELECTROLYTIC CAPACITORS

Axial

Value uF	WV D.C.	1	10	100	1	10	100
22	16.3	.18	1.54	12.83			
33	16.3	.20	1.68	14.04	.14	1.12	9.31
47	16.3	.21	1.74	14.48	.14	1.16	9.59
100	16.3	.22	1.83	15.22	.16	1.33	11.05
220	16.3	.28	2.34	19.53	.21	1.78	14.80
[illegible]							

PANASONIC METALLIZED POLYESTER CAPACITORS

NEW! KIT 170 METALIZED POLYESTER CAPACITORS. Price includes convenient divided plastic box with bin guide for easy storage and quick access. ASSORTMENT OF 17 POPULAR VALUES PANASONIC QUALITY. CAT. NO. P-KIT ONLY $54.95

[illegible]

PANASONIC K SERIES CAPACITORS

[illegible]

PANASONIC POLYESTER CAPACITORS
100 VDC plus minus 10% TOLERANCE

NEW! KIT 150 POLYESTER CAPACITORS. Price includes convenient divided plastic box with bin guide for easy storage and quick access. ASSORTMENT OF 15 POPULAR VALUES PANASONIC QUALITY. CAT. NO M-KIT ONLY $34.95

[illegible]

MINI-BOX KIT

140 CAPACITORS. Price includes convenient divided plastic box with bin guide for easy storage and quick access. ASSORTMENT OF 14 POPULAR "MINI-BOX" CAPACITORS. CAT. NO. 3050P-Kit ONLY $35.95

PANASONIC ELECTROLYTIC KIT

150 CAPACITORS. Price includes convenient divided plastic box with bin guide for easy storage and quick access. ASSORTMENT OF 15 POPULAR CAPACITORS. Cat. No P6200 Kit ONLY $35.95

E. F. JOHNSON PLUG & JACK KIT

150 COMPONENTS. Price includes convenient divided plastic box with bin guide for easy storage and quick access. ASSORTMENT OF 150 POPULAR JACKS & PLUGS. Cat. No. J100-Kit ONLY $69.95

PANASONIC DISC CAPACITORS

NEW! KIT 310 DISC CAPACITORS. Prices includes convenient divided plastic box with bin guide for easy storage and quick access. ASSORTMENT OF 18 POPULAR VALUES PANASONIC QUALITY. CAT NO DN-KIT ONLY $24.95

[illegible]

PANASONIC RESIN DIPPED TANTALUM CAPACITORS

NEW! KIT 180 TANTALUM CAPACITORS. Price includes convenient divided plastic box with bin guide for easy storage and quick access. ASSORTMENT OF 15 POPULAR VALUES PANASONIC QUALITY. CAT. NO. T-KIT ONLY $79.95

[illegible]

KEY Precut/Prestripped Wire
Precut Prestripped 100 Wire Package · Bulk Wire Wrap Wire

[illegible]

30 AWG Kynar Insulated in Bulk Continuous Length

Part No	Color	Length	Cost
100 RD	Red	100 feet	$3.10
100 BK	Black	100 feet	3.10
100 BU	Blue	100 feet	3.10
500 RD	Red	500 feet	13.50
500 BK	Black	500 feet	13.50
500 BU	Blue	500 feet	13.50
1000 RD	Red	1000 feet	23.75
1000 BK	Black	1000 feet	23.75
1000 BU	Blue	1000 feet	23.75

The Digi-Key volume discount and Service charges are simple to apply. Most items sold by Digi-Key may be combined for a volume discount. Items that are not discountable are identified by the suffix-ND following the part number. After writing your order, total all of the discountable items and apply the appropriate discount. To this subtotal, add the non-discountable items. Then add the Service charge. We pay all shipping and insurance to addresses in the U.S.A., Canada and Mexico when payment accompanies order.

WHEN ORDERING BY PHONE, CALL: 1-800-346-5144 (Mn., Ak., Hi., call 218-681-6674) By mail send your order to: DIGI-KEY, Highway 32 South, Thief River Falls, MN 56701

You may pay by check, money order, Master Charge, VISA or C.O.D. **DIGI-KEY GUARANTEE:** Any parts or products purchased from Digi-Key that prove to be defective will be replaced or refunded if returned within 90 days from receipt with a copy of your invoice.

SERVICE	CHARGES	VOLUME DISCOUNT	
$ 0.00-$ 9.99	Add $2.00	$ 0.00-$ 99.99	NET
$ 10.00-$25.00	Add $0.75	$ 100.00-$249.99	Less 10%
$ 25.00-$49.99	Add $0.50	$ 250.00-$499.99	Less 15%
$ 50.00-$99.99	Add $0.25	$ 500.00-$999.99	Less 20%
$100.00 & Up	No Charge	$1000.00 & Up	Less 25%

CIRCLE 35 ON FREE INFORMATION CARD

Fall '80 TEST EQUIPMENT Electronic Component Catalog

FREE 128 Page Book

We carry the Following:

TEST EQUIPMENT
- B & K
- LEADER
- VIZ
- BECKMAN
- HITACHI
- GLOBAL SPECIALTIES
- DATA PRECISION
- HICKOK

ELECTRONIC COMPONENTS
- JAPANESE & MOTOROLA Transistors IC's, FET, Diodes
- Capacitors
- Resistors
- Connectors, Cables

TOOLS
- Weller, Ungar, Xcellite, Vaco, etc.

- Over 10 million components in stock to serve you
- Over 20,000 sq. ft. of warehouse in the East & West
- NO MINIMUM/NO SHIPPING on orders over $100

FUJI-SVEA®
P.O. Box 40325 Cincinnati OH 45240
Dept. Radio-Electronics

CALL TOLL FREE
800-421-2841
Local: 513-874-0220
Telex: 182 392

Name _____ Phone _____
Company _____
Address _____
City _____ State _____ Zip _____

CIRCLE 34 ON FREE INFORMATION CARD

More CFR Spectaculars!!!

Parallel Input 'Correspondence' SELECTRIC TYPEWRITER/PRINTER TRS-80 COMPATABLE

Prices Are Subject to Change on All Items.

Features:
- 15" Frame, 132 Columns
- Takes Std. Office 'Golf-Ball' Elements
- Parallel TTL Input
- IBM 745 Printer Mechanism
- Upper & Lower Case ASCII In!
- Used, Reconditioned Terminals
- Ideal for Word Processing
- Use as a Typewriter, Too!

Complete, Ready to Use **Only $659.00!!ea.**

Replacement Line Cord Included; No Type Element Included
*Add $20.00 for Handling & Packaging, Pay Shipping When Delivered

IBM Technical Data for 'Selectric' ..... $20.00ea.
—GET OUR BARGAIN-PACKED PERIPHERAL FLYER!!—

DAISY KSR ASCII TERMINALS

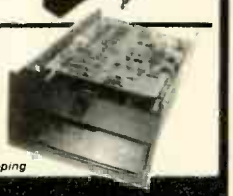
Featuring:
- 15" Frame, 132 & 156 Columns
- 15 & 30 Characters/Second
- Dual Pitch (10, 12 Chars./Inch)
- Diablo "Hytype" Printer
- Plotter Function w/ 1/60"H & 1/48"V Steps
- Simple RS-232-C ASCII I/O

CASE STYLE MAY DIFFER

Includes Operator's Instructions, Schematics, Etc.
Add $40 for Shipping Crate. Pay Shipping on Delivery.
System 75 Daisy Terminals ... $1499.00ea.

BARGAIN "FLOPPY" DRIVES

Removed from service, built by MPI Div. of Control Data. 9400 Series, takes Shugart-type 8" diskettes. Good cond., may need some service. Incl.: data, schematics, etc.



Only ..... $229.00ea.
Buy 3 and SAVE BIG! 3/$599.00 Plus Shipping

CFR Associates, Inc.

MAIL ORDERS: Box 144, Newton, N.H. 03858
PHONE ORDERS: 617/372-8536 (Sorry, No Collect Calls) Mastercharge & VISA Welcome
WAREHOUSE: 18 Granite St. Haverhill, Mass. 01830

CIRCLE 45 ON FREE INFORMATION CARD

HOT NEWS!

FEATURING THE BARGAINS OF THE MONTH!!!

POLY PAKS Is The World's Largest ELECTRONIC DISCOUNT **SUPERMARKET**

Bargain #1 — TEAC 3" ILLUMINATED VU METERS

- For Use With Tape Decks, Amplifiers, Mixers, Etc.

$7.99

Features include: heavy-duty 1 volt basic movement, 12 volt offset lighting, and large bold legends for easy reading at a glance. Each is calibrated -20 to 0 Db (Black), +1 to +3 Db (Red), Plus 0-100% S/N scale (Black).

style: completely clear plastic lens over white faceplate. Each comes with "crimp-on" ring terminals and four 5/8" long mt. studs. Size: 3-1/8" x 2-3/4" x 1-1/2"

Cat No. 6749 Wt: 6 oz.s

Bargain #2 — CLINTON COMPUTER -TYPE 12" CRT

Features include, Electrostatic Focusing, Aluminized Phosphorus-Gray Screen, and standard 7-pin base. The tube typically operates at a heater voltage of 12.6V @ 150 mA and G2 voltage of 400V. Wt: 11 lbs.

Cat. No. 6751

- Used for Computer Terminals, Oscilloscopes, etc.
- 90% Electromagnetic Deflection

$35.95

- Bonded Screen for Max. Safety

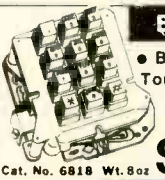
Bargain #3 — Veeder-Root 6 DIGIT COUNTER

ONLY $4.98

Non-resettable, 6-Digit counters run from 0 to 999999. Electro mechanical assembly requires 115 VAC, 60 Hz, 6 watts. Speed: 1000 counts/minute. 3/8" x 2" window reveals black digits on white background. Gray, wrinkle-finish metal case measures 3-1/4 x 2-1/2 x 1-5/8". 10" insulated wire leads have quick-connect type spade terminals. Cat. No. 5113 Wt. 2 lbs.

Bargain #4 — TOUCH TONE KEY PAD

Complete electromechanical switching assembly features 12 SPST momentary switches in a 3 x 4 matrix configuration with standard telephone pad spacing. Key caps are pre-numbered 0 thru 9, * and #, in white on gray background. Also includes gold-flashed contacts, angle mounting bracket, and 8 insulated, color-coded leads w/spade type connectors. 100's of applications including standard telephone replacement. Constructed of shock-resistant thermoplastic and metal. Size: 2-1/4" x 3-1/4" x 1-1/4"



Cat. No. 6818 Wt. 8 oz

- Build Your Own Touch-Tone Dialer Hex Encoder

$7.88

Bargain #5 — "BLOCK" FANS • 115 VAC!

- Lightweight!
- Only 4 1/16" sq. 1 1/2" deep!

$10.99

For cooling, flushing, heating and ventilating! Quiet & dependable. Lightweight, flame retardant 3 blades or better (sorry, no choosing). Removed from new equipment.

Cat. No. 3108 Wt. 2 lbs.

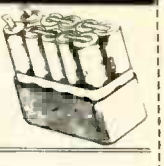
Bargain #6 — NICKEL CAD BATTERY PAK

- 10 "AA" Size Cells Connected In Series
- Comes In 2-7/8" x 1-1/8" x 2" Insulated Plastic Case. (Picture Shown Less Top Half Of Case)
- Easily Accessible Top Mounted Solder Tab Leads
- For Use With Radios, Tape Recorders, Communications Equipment, etc.

Ship. Wt. 9 oz. Cat. No. 6676

- 12.5 VOLT 600 mA

$11.24



Send For Our FREE Catalog Today!

Featuring the Largest Selection and the Lowest Prices on a wide variety of quality electronic products, including: Computer Peripherals, Solar Devices, Speakers, Audio Equipment, and much much more! Take advantage of our 25 years as America's foremost supplier of discount electronics.

For Faster Service Order By Phone 1-617-245-3828

ORDERING INSTRUCTIONS

Indicate in adjacent brackets the quantity of Bargains desired:

Cat.No. 6749 1( ) Cat.No. 6751 2( ) Cat.No. 5113 3( )
Cat.No. 6818 4( ) Cat.No. 3108 5( ) Cat.No. 6676 6( )

- Complete Coupon Section
- Cut Out Along Dotted Line and Mail Ad to

Poly Paks, P.O. Box 942, RE2 SOUTH LYNNFIELD, MA. 01940

POLY PAKS INC.

Total Amount of Order $ _____
Please Add $2 each for Postage & Handling

NAME _____
ADDRESS _____
CITY _____
STATE _____ ZIP _____
Enclosed is ☐ CHECK, ☐ MONEY ORDER
Charge my ☐ MASTERCARD ☐ VISA
ACCT. # _____ EXP. DATE ____
☐ *Send me your FREE catalog*

CIRCLE 43 ON FREE INFORMATION CARD

INTERNATIONAL ELECTRONICS UNLIMITED

CERAMIC CAPACITORS

1pf	22pf	56pf	120pf	270pf		.0047uf	.030uf
5pf	27pf	68pf	150pf	390pf	.001uf	.01uf	.050uf
7pf	33pf	82pf	180pf	470pf	.0015uf	.015uf	.1uf
10pf	47pf	100pf	220pf	600pf	.003uf	.022uf	
1pf - .050uf				.1uf			

Total	EA.	PK-10	PK-100	EA.	PK-10	PK-100
1-1000	$.20	$ .95	6.50	.25	1.25	9.00
1000-	.20	.85	6.00	.25	1.10	8.00

CERAMIC CAPACITOR KIT
CK-c2 5ea. of the above values $11.50
CK-c3 10ea. of the above values 20.50

POLYESTER FILM CAPACITORS - 100V ± 10%

	EA.	PK-10	PK-100		EA.	PK-10	PK-100
.001uf	$.15	.95	6.50	.033uf	$.20	1.00	10.00
.0015uf	.15	.95	7.50	.047uf	.20	1.15	10.50
.0022uf	.15	.95	7.50	.068uf	.25	1.30	12.00
.0033uf	.15	.95	7.50	.1uf	.30	1.75	13.50
.0047uf	.15	.95	7.50	.15uf	.35	2.25	14.00
.0068uf	.15	.95	7.50	.22uf	.40	2.55	20.00
.01uf	.15	.95	7.50	.33uf	.45	2.75	25.00
.015uf	.15	.95	7.50	.47uf	.50	3.50	30.00
.022uf	.15	.95	7.50				

TOTAL QTY. 1000 pcs. -10%, 5000 pcs. -15%

POLYESTER CAPACITOR KIT
5 ea of the above values $14.95

TANTALUM CAPACITORS — solid dipped ± 20%

	10			10			10
.1uf/35V	.30	.25	4.7uf/16V	.38	.30	22uf/16V	.50	.40
.22uf/35V	.30	.25	4.7uf/25V	.45	.35	22uf/35V	.60	.55
.33uf/35V	.30	.25	6.8uf/6V	.35	.28	33uf/6V	.55	.45
1uf/20V	.30	.25	6.8uf/16V	.45	.39	33uf/10V	.60	.50
1.5uf/20V	.30	.25	10uf/20V	.42	.35	47uf/6V	.60	.50
2.2uf/20V	.35	.25	15uf/6V	.42	.35	47uf/15V	.65	.55
2.2uf/35V	.38	.28	15uf/20V	.50	.40	56uf/6V	.85	.75
3.3uf/35V	.40	.30	TANTALUM CAPACITOR ASST. 5ea. of above -			$37.50		

ELECTROLYTIC CAPACITORS - axial

	1-9	10-99	100-		1-9	10-99	100-
1u/16V	.13	.11	.09	22u/16V	.15	.13	.11
1u/30V	.14	.12	.10	22u/50V	.16	.14	.12
1u/160V	.17	.15	.12	33u/25V	.18	.16	.14
2.2u/25V	.14	.12	.10	47u/25V	.18	.16	.14
2.2u/50V	.14	.12	.10	50u/25V	.18	.16	.14
2.2u/63V	.14	.12	.10	100u/10V	.18	.16	.14
3.3u/250V	.16	.14	.12	150u/25V	.22	.20	.17
4.7u/10V	.14	.12	.10	220u/16V	.23	.21	.18
5u/25V	.12	.10	.08	220u/25V	.25	.22	.20
10u/16V	.13	.11	.10	470u/35V	.33	.29	.26
10u/25V	.14	.12	.10	1000u/35V	.89	.85	.80
10u/50V	.15	.13	.11	1000u/50V	1.00	.95	.90
10u/150V	.18	.16	.14				

SOCKETS — LOW PROFILE, SOLDER TAIL

	ea	100
8 pin	.20	.18 pk-10 .16ea
14 pin	.25	.21 pk-10 .19
16 pin	.26	.22 pk-10 .20
18 pin	.32	.28 pk-8 .26
24 pin	.48	.45 pk-3 .38
28 pin	.65	.60 pk-3 .55
40 pin	.75	.70 pk-2 .63

TRANSISTORS

2N3904 NPN TO-92 $.25ea 10/$1.65 25/$3.25 100/$12.00
2N3906 PNP TO-92 $.25ea 10/$1.65 25/$3.25 100/$12.00
2N2222A NPN TO-18 $.45ea 10/$3.50 25/$8.00 100/$29.50

DIODES

1N4148 (1N914) 400mw 15/$1.00 100/$5.00 1000/$40.00
1N4001 50PIV 12/$1.00 100/$7.00 1000/$60.00
1N4007 1000PIV 10/$1.25 100/$11.00 1000/$10.00

VOLTAGE REGULATORS — 10% OFF ON $25.00, 15% OFF ON $50.00

LM320T-5	Negative 5 V reg (7905)	1.19
LM320T-12	Negative 12 V reg (7912)	1.19
LM320T-15	Negative 15 V reg (7915)	1.19
LM340T-5	Positive 5 V reg (7805)	1.19
LM340T-8	Positive 8 V reg (7808)	1.19
LM340T-12	Positive 12 V reg (7812)	1.19
LM340T-15	Positive 15 V reg (7815)	1.19

DISCRETE LED'S

JUMBO LED
.20"dia, diffused
Red, Clear or White 10/$1.00 25/$2.00 100/$8.00
Green or Yellow 7/$1.00 25/$2.85 100/$9.75
SUBMINITURE LED
.125"dia, diffused
Red or Clear 10/$1.00 25/$2.00 100/$8.00
Green or Yellow 7/$1.00 25/$2.85 100/$9.75

TTL — 10% OFF ON $25.00, 15% OFF ON $50.00

7400	$.18	7464	.30	74155	.50
7401	.18	7465	.30	74156	.64
7402	.18	7470	.49	74157	.60
7403	.18	7472	.32	74158	.75
7404	.20	7474	.18	74160	.70
7405	.25	7475	.49	74161	.79
7406	.20	7476	.49	74162	.85
7407	.20	7480	.35	74163	.85
7408	.27	7482	.25	74164	.85
7409	.27	7483	.58	74166	.85
7410	.18	7485	.50	74170	1.50
7415	.29	7486	.42	74173	1.25
7416	.20	7489	1.75	74174	1.05
7417	.20	7490	.59	74175	.85
7420	.20	7491	.64	74176	.70
7425	.39	7492	.59	74177	.70
7426	.35	7493	.35	74180	.35
7427	.25	7494	.59	74181	1.85
7430	.25	7495	.35	74182	.35
7432	.20	7496	.35	74189	.50
7437	.20	74105	.48	74190	1.15
7438	.18	74107	.35	74191	1.15
7440	.18	74121	.35	74192	.50
7441	.59	74122	.39	74193	.79
7442	.35	74123	.39	74194	.85
7443	.55	74125	.50	74195	.69
7444	.60	74126	.50	74196	.80
7445	.50	74132	.75	74197	.75
7446	.59	74141	.35	74198	1.40
7448	.59	74145	.50	74199	1.25
7450	.18	74148	1.25	74S200	3.75
7451	.22	74150	1.35	74279	.65
7453	.18	74151	.50		
7454	.18	74153	.35		
7460	.18	74154	1.45		

8000 (Signetics)
8263 2.95 8267 1.75 8281 .95

9000 Series
9601 .25 9602 .29

CMOS — 10% OFF ON $25.00, 15% OFF ON $50.00

4000 Series		CMOS			
4000	$.25	4020	1.14	4050	.45
4001	.39	4021	.95	4051	1.15
4002	.25	4022	.95	4066	.79
4006	.95	4023	.30	4069	.39
4007	.39	4024	.75	4071	.29
4008	.95	4025	.22	4072	.39
4009	.46	4027	.59	4073	.39
4010	.45	4028	.85	4078	.39
4011	.45	4030	.49	4081	.39
4012	.25	4035	.95	4082	.30
4013	.59	4040	1.15	4518	1.25
4014	.95	4041	1.20	4528	1.50
4015	.95	4042	.95	4585	1.50
4016	.64	4043	.85	4901	.59
4017	1.08	4046	1.69		
4018	.95	4049	.45		

LINEAR CIRCUITS — 10% OFF ON $25.00, 15% OFF ON $50.00

LM300H	$ .30	LM565N	.55
LM301CN	.28	LM565H	1.39
LM302H	.28	LM566H	1.69
LM304H	80	LM566CN	1.45
LM307CN	.32	LM567CN	1.19
LM307H	.40	LM703H	.59
LM308CN	.45	LM703CN	39
LM309H	1.05	LM709N	29
LM309K	1.15	LM709H	.39
LM310CN	.75	LM710N	.45
LM310H	.75	LM711N	.35
LM311CN	.39	LM723H	.59
LM318CN	1.45	LM723N	.49
LM319N	1.20	LM733H	.45
LM320K-5	.95	LM739N	.45
LM320K-5.2	.95	LM741CN	.29
LM320K-15	.95	LM741	29
LM322N	.45	LM741CH	45
LM324N	1.19	LM747H	79
LM339N	.25	LM747N	69
LM340K-6	.95	LM748CN	.25
LM340K-8	.95	LM1310N	2.50
LM340K-12	.95	LM1414N	.35
LM340K-15	.95	LM1456CN	1.29
LM340K-24	.95	LM1458CN	.55
LM370N	.95	LM1496N	.89
LM372N	1.25	LM1800N	2.40
LM376CN	.30	ULN2208	79
LM380N	1.19	ULN2209	.79
LM380CN	.45	CA3046N	1.29
LM381N	1.75	CA3081N	1.25
LM382N	1.75	CA3082N	1.25
LM385K	.49	LM3900N	.45
LM386CN	.99	LM7524N	.45
LM387CN	99	LM7525N	.45
NE546A	1.79	LM7535	.99
NE550A	1.25	8038B	3.79
LM555CN	.45	75450N	.35
LM556N	.79	75451CN	.35
LM560N	2.95	75452CN	.35
		75453CN	.35
		75454CN	.35
		75491N	.75
		75492N	.85

IMMEDIATE DELIVERY OF QUALITY RESISTORS — Rohm QUALITY RELIABILITY

METAL FILM RESISTORS,

METAL FILM ±1%
RN60 (R.Ohm CRB60FY) 1/4watt
Low temp coef - 50ppm/°C
.138"dia X .355"long (body)
color banded

total quantity	ea	pk-10	pk-25	pk-100	pk-250
1-999	$.25	1.00	2.00	7.50	17.50
1000-	.20	.90	1.80	7.00	16.25
5000-	.20	.85	1.70	6.50	15.00
10000-	.20	.80	1.55	6.00	13.75

10 or more resistors - not individually packaged - mixed - specify any assortment of values $.15ea

VALUES STOCKED (ohms)
Standard 1% metal film values from 10 ohm to 1.21M 1/4 watt

10.0	12.1	14.7	17.8	22.6	27.4	33.2	40.2	48.7	59.0	71.5	88.7
10.2	12.4	15.0	18.2	23.2	28.0	34.0	41.2	49.9	60.4	73.2	90.9
10.5	12.7	15.4	18.7	23.7	28.7	34.8	42.2	51.1	61.9	75.0	93.1
10.7	13.0	15.8	19.1	24.3	29.4	35.7	43.2	52.3	63.4	76.8	95.3
11.0	13.3	16.2	19.6	24.9	30.1	36.5	44.2	53.6	64.9	80.6	97.6
11.3	13.7	16.5	20.0	25.5	30.9	37.4	45.3	54.9	66.5	82.5	
11.5	14.0	16.9	20.5	26.1	31.6	38.3	46.4	56.2	68.1	84.5	
11.8	14.3	17.4	22.1	26.7	32.4	39.2	47.5	57.6	69.8	86.6	

and multilples of 10 of the above values to 1.21M
i.e. 10.0 100 1.0K 10.0K 100K 1M etc

METAL FILM RESISTORS

METAL FILM ±1%
RN55 (R.Ohm CRB14FY) 1/8watt
Low temp coef - 50ppm/°C
.094"dia X .225"long (body)
color banded

total quantity	ea	pk-10	pk-50	pk-100	pk-500
1-999	$.25	1.00	4.00	7.50	35.00
1000-	.20	.90	3.60	7.00	32.50
5000-	.20	.85	3.40	6.50	30.00
10000-	.20	.80	3.10	6.00	27.50

10 or more resistors - not individually packaged - mixed - specify any assortment of values $.15ea

VALUES STOCKED (ohms) 1/8 watt

10.0	27.4	75.0	348	1.74K	5.11K	11.0K	20.5K	31.6K	54.9K	140K	324K
10.2	28.7	78.7	402	1.87K	5.36K	11.3K	21.0K	32.4K	57.6K	147K	332K
11.0	30.1	84.5	475	1.96K	5.49K	11.5K	21.5K	33.2K	60.4K	150K	348K
11.5	31.6	90.9	487	2.05K	5.76K	12.1K	22.1K	34.8K	64.9K	158K	374K
12.1	33.2	100	499	2.21K	6.04K	12.4K	22.6K	36.5K	68.1K	165K	402K
13.0	35.7	107	604	2.43K	6.49K	12.7K	23.2K	37.4K	69.8K	174K	432K
14.0	37.4	121	649	2.49K	6.81K	13.0K	23.7K	39.2K	75.0K	182K	453K
14.7	40.2	127	715	2.74K	7.15K	13.3K	24.3K	40.2K	76.8K	191K	464K
15.0	43.2	137	750	2.87K	7.50K	14.0K	24.9K	41.2K	82.5K	200K	475K
16.2	45.3	150	909	3.01K	8.25K	14.7K	25.5K	43.2K	90.9K	205K	1M
17.4	47.5	165	1.00K	3.16K	8.66K	15.0K	26.1K	45.3K	95.3K	210K	
18.2	49.9	191	1.02K	3.32K	9.09K	15.4K	26.7K	46.4K	100K	221K	
19.1	54.9	200	1.10K	3.57K	9.53K	16.2K	27.4K	47.5K	105K	232K	
20.0	57.6	210	1.21K	4.22K	9.76K	16.9K	28.0K	48.7K	110K	249K	
22.1	60.4	232	1.27K	4.53K	10.0K	17.4K	28.7K	49.9K	115K	255K	
23.2	64.9	249	1.30K	4.75K	10.2K	18.2K	29.4K	51.1K	121K	287K	
24.9	68.1	301	1.47K	4.87K	10.5K	19.1K	30.1K	52.3K	130K	294K	
26.1	71.5	316	1.50K	4.99K	10.7K	20.0K	30.9K	53.6K	137K	301K	

CARBON FILM RESISTORS

CARBON FILM ±5%
1/4watt (R.Ohm R25)
.095"dia X .250"long (body)
1/2watt (R.Ohm R50)
.146"dia X .354"long (body)

total quantity	PRICING ea	1/4 & 1/2 watt pk-10	pk-100	pk-1000
1-999	$.10	.45	2.00	
1000-	.10	.40	1.80	15.00
5000-	.10	.30	1.70	14.50
10000-	.10	.25	1.55	13.00

25 or more resistors - not individually packaged - mixed - specify any assortment of values $.04ea

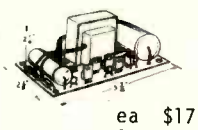
VALUES STOCKED (ohms)

.5	3.9	16	68	300	1.2K	5.1K	22K	91K	390K	1.6M	*6.2M
1.0	4.3	18	75	330	1.3K	5.6K	24K	100K	430K	1.8M	*6.8M
1.1	4.7	20	82	360	1.5K	6.2K	27K	110K	470K	2.0M	*7.5M
1.2	5.1	22	91	390	1.6K	6.8K	30K	120K	510K	2.2M	*8.2M
1.3	5.6	24	100	430	1.8K	7.5K	33K	130K	560K	2.4M	*9.1M
1.5	6.2	27	110	470	2.0K	8.2K	36K	150K	620K	2.7M	*10M
1.6	6.8	30	120	510	2.2K	9.1K	39K	160K	680K	3.0M	*11M
1.8	7.5	33	130	560	2.4K	10K	43K	180K	750K	3.3M	*12M
2.0	8.2	36	150	620	2.7K	11K	47K	200K	820K	3.6M	*13M
2.2	9.1	39	160	680	3.0K	12K	51K	220K	910K	3.9M	*15M
2.4	10	43	180	750	3.3K	13K	56K	240K	1.0M	4.3M	(* 1/2w
2.7	11	47	200	820	3.6K	15K	62K	270K	1.1M	4.7M	only)
3.0	12	51	220	910	3.9K	16K	68K	300K	1.2M	5.1M	
3.3	13	56	240	1.0K	4.3K	18K	75K	330K	1.3M	5.6M	
3.6	15	62	270	1.1K	4.7K	20K	82K	360K	1.5M		

POWER SUPPLY KIT

+5V, +12V, +15V
A regulated power supply using a 115V/29V CT transformer, 3-LM340T and 3-LM320T regulators to supply the above voltages. Heat sink provided for +5V

PARTS INCLUDED
Transformer
6 regulators
PC board
4 diodes
Capacitor 1000 uf
Capacitor 500 uf
3 capacitors 10 uf

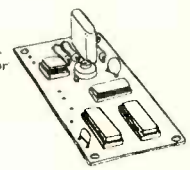


ea $17.50
10- 16.00
25- 15.00
+ shipping

CRYSTAL CONTROLLED TIME BASE KIT

Produces accurate 1hz, 10hz and 60hz outputs--three of the most popular frequencies for any piece of test equipment. The crystal frequency output may be tuned with a frequency counter for increased accuracy. All outputs are buffered. The input voltage range is 5-18VDC. Low power requirement permits the use of a 9V battery as the power source for a convenient laboratory unit. The completed board is designed to fit the PCB slots of Hammond case 1591DGY which IEU stocks.

PARTS INCLUDED
%15369 divider
4049 buffer
2-4018 counter
3-12pf var. cap
47pf cap
.1uf cap
2-120ohm res
1kohm res
3.57954 Mhz crystal
PC board (1 5/8" X 3")



$15.50ea
10-24 13.75ea
25- 12.50ea

Payment by check, M.O., UPS/COD, M/C or VISA. Add $1.25 for shipping/handling in U.S, Canada and Mexico. Additional charge for UPS COD or BLUE LABLE. Other Countries $1.25 + 5% of order total. California residents add sales tax. Minimum order $10.00
SCHOOLS AND GOVERNMENT ORDERS ACCEPTED ON OFFICIAL PURCHASE ORDERS.

INTERNATIONAL ELECTRONICS UNLIMITED
435 First St Suite 19
Solvang, Ca 93463
805-688-2747

4Kx16 MEMORY BOARD with 64 IC chips (2102) in sockets. Super deal at $50 the complete board.

$29 AUTO SECURITY SYSTEM alarm system $7.00

SPACE MAN toy module PC board w/musical IC synthesizer chip. ROM has 5 programs, wierd noises blinking LEDs $3.00 each

DATA STATION CONSOLE w/keyboard 9 inch monitor, power supply. Logic boards broken. $80 Send for details on this one.

Computer video monitor chassis 9 inch, 12 volt used $40
Computer video monitor chassis 12 inch. new $50
FLOPPY DISC DRIVE 8" by MPI, used $ 175
FLOPPY DISC DRIVE 8" Shugart, used 225
FLOPPY DISC DRIVE 5¼" Shugart, used 175

PIN BALL GAME, solid state, hand held, visual and audio, bumpers, flippers, etc. LED scoring and up to 4 players. Complete PC module w speaker $10.00

TOUCH PAD solid state w/LSI chip. Bell system compatible. For computers & phones $24.00

12 VOLT GEL-CELLS 2.5 AH $14.00 5 AH $17.00

12 INCH CRT bonded face plate. New with specs. Made for computers. $35.00

WALKY TALKIES Govt surplus used condition. 47-55.4 mc range. With schematics. Govt AN/PRC-6 $25 each 2 for $45. Ant. $5 each

ASCII KEYBOARD parallel $50
RED LED's . . . . . 10 for $1.00

MIN ORDER $10.00

Shipping extra on all merchandise

Meshna Inc., PO Box 62, E. Lynn, Mass. 01904

CIRCLE 16 ON FREE INFORMATION CARD

DON'T FORGET

USE YOUR READER SERVICE CARD

XENON STROBE TUBE & TRIGGER COIL

STROBE LIGHT SCHEMATICS INCLUDED

C24081 $1.75

LED Flasher Kit

C23287 $2.49

SOUND EFFECTS GENERATOR BASIC KIT

NOW IT'S POSSIBLE TO BUILD YOUR OWN SOUND EFFECTS GENERATOR WITHOUT SPENDING A FORTUNE. WE SUPPLY YOU WITH THE T176477 SOUND CHIP PLUS AN ETCHED AND DRILLED GLASS EPOXY PC BOARD WITH SCHEMATIC AND LAYOUT INSTRUCTIONS. THIS BOARD MAKES IT SIMPLE TO BUILD A GENERATOR CAPABLE OF PHASER SOUNDS, LOCOMOTIVE, SIRENS, AIRPLANES, CLOCKS, ETC. DOES NOT REQUIRE DIP SWITCHES OR OTHER EXPENSIVE/UNUSUAL COMPONENTS. YOU SUPPLY A FEW STANDARD RESISTORS, CAPACITORS, SWITCHES, POTS, SPEAKER, 2N2222 TRANSISTOR AND 9V BATTERY.

C23883 ONLY $5.95 BASIC KIT CONTAINING T176477, PC BOARD AND INSTRUCTIONS.

2N2222 TRANSISTOR FOR ABOVE C2388A .39 EACH

ELECTRONIC WARNING FLASHER KITS

3VDC MODEL C23207 $6.95

6VDC MODEL C23808 $8

12VDC MODEL C23876 $10.95

ELECTRONIC STROBOSCOPE KIT

SALE

TREMENDOUS AID FOR TROUBLESHOOTING OR DEMONSTRATING OPTICAL PHENOMENA. OPTICALLY STOPS MOTION OF FANS, WHEELS, PULLEYS, FLYWHEELS, ETC. THE STROBOSCOPE OPERATES FROM STANDARD 115VAC AND FEATURES BRIGHT XENON FLASH TUBE AND IC DESIGN. CONTINUOUSLY VARIABLE FLASH RATE FROM 100-5000RPM. THE KIT COMES WITH ALL COMPONENTS INCLUDING PC BOARD, LINE CORD AND KNOB. DOES NOT INCLUDE CASE. SIZE OF BOARD: 3 1/2"W x 4 3/4"L.

C24070 SALE $29.95

120 VAC Xenon Strobe Kit

C23071 $7.50

Wheel of Fortune

C23888 $8.99

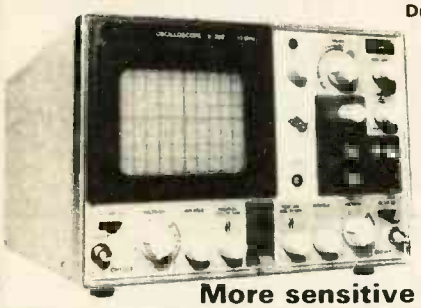
CHANEY electronics inc.

- Minimum Ad order $6.00
- Please include $1.50 for postage
- Visa, MC accepted
- Phone orders are welcome

P.O. BOX 27038, DENVER, CO. 80227 (303) 781-5750

Send for our free giant catalog of unique items.

CIRCLE 10 ON FREE INFORMATION CARD



Dual Trace Oscilloscope
HITACHI 30 MHz

- TV sync-separater circuit
- High-sensitivity 1mV/div (5MHz)
- Sweep-time magnifier (10 times)
- Z-axis input (Intensity modulation)
- Signal delay line
- X-Y operation
- Trace Rotation

Model V3028
$995

More sensitive to your input

8080A
MICRO-PROCESSOR $5.95

EPROM

2708	2716 (5 Volt)
$9.90	$11.99

2114L (450 nS) $5.95

4116 (200 nS) $3.99

POWER SUPPLY
5 Volt 3 Amp
APS 5-3

1-9	$42.50
10 up	$40.65
25 up	$38.85

CRT CONTROLLER
5037P $35.00
25 UP $25.00 100 up $19.00

MOTOROLA 6800 SERIES

MC6800P	$13.90	MC6850P	$ 6.84
MC6801L1	65.84	MC6852P	7.33
MC6802P	19.90	MC6854P	30.72
MC6808P	13.90	MC6860P	12.92
MC6809P	45.39	MC6862P	16.76
MC6821P	7.33	MC6875L	10.68
MC6828P	20.75	MC6880AP	3.14
MC6840P	12.22	MC6881P	8.91
MC6843P	45.39	MC6882AL	6.13
MC6844P	45.39	MC6885P	2.72
MC6845P	41.20	MC6886P	2.72
MC6846P1	39.90	MC6887P	2.72
MC6847P	16.06	MC6888P	2.72
MC6850CP	9.27	MC6889P	3.14

Intersil LED or LCD 3½ DIGIT PANEL METER KITS

BUILD A WORKING DPM IN ½ HOUR WITH THESE COMPLETE EVALUATION KITS

Test these new parts for yourself with Intersil's low cost prototyping kits, complete with A/D converter and LCD display (7106) or LED display (7107). Kits provide all materials, incl PC board, for a functioning panel meter.

ICL7106EV (LCD) . . . . $34.46 ICL7107EV (LED) $28.76

PORTABLE thandar OSCILLOSCOPE

Model SC110
Only $369

- DC—10MHz
- 2" Diagonal CRT
- LIGHT WEIGHT (2 lbs)
- SMALL SIZE (10 x5.8"x12")
- ULTRA LOW POWER CONSUMPTION
- AUTOMATIC CIRCUIT POWER DOWN FOR UNUSED SECTIONS

ANCRONA

Send check or Money Order to: P.O. Box 2208R Culver City, CA 90230. California residents add 6% sales tax. Minimum Order $10.00. Add $2.00 to cover postage and handling. Master Charge and VISA welcomed. Please include your charge card number, interbank number and expiration date.

PHONE ORDERS (213) 641-4064

DATA PRECISION
Performance in the field.

3½ DIGIT HAND HELD DIGITAL MULTIMETERS

Model 936 $179

HANDY
TOUGH
VISIBLE
BEST BUY
ACCURATE
VERSATILE
EXPANDABLE
HI/LO EXCITATION

Model 935 $159

★ 10% ★ DISCOUNT COUPON

Bring this **COUPON** into one of our stores or mail to our Mail Order address shown below and receive a **10% DISCOUNT** on purchases from this Ad of $50.00 or more.

Offer EXPIRES on February 28, 1981

NAME .....
ADDRESS .....
CITY ..... STATE .....
ZIP ..... PHONE NO. .....

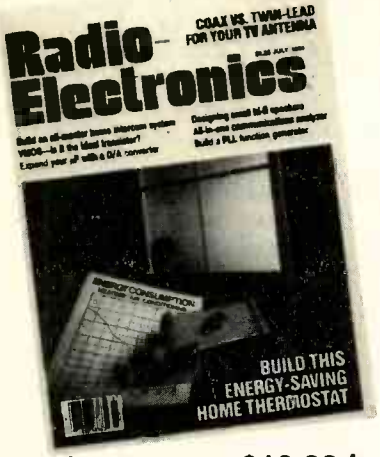
Coupons accepted only with full name and address filled in

VISIT A STORE NEAR YOU TODAY - We stock a large selection of Technical Books, Discrete Components, Integrated Circuits, Test Equipment and Electronic Supplies.

ATLANTA	CULVER CITY	HOUSTON	PORTLAND	SANTA ANA	SUNNYVALE	TUCSON
3330 Piedmont Rd. N.E.	11080 Jefferson Blvd.	2649 Richmond	1125 N.E. 82nd Ave.	1300 E. Edinger Ave.	1054 E. El Camino Real	4518 E. Broadway
Atlanta, GA 30305	Culver City, CA 90230	Houston, TX 77098	Portland, OR 97220	Santa Ana, CA 92705	Sunnyvale, CA 94087	Tucson, AZ 85711
(404) 261-7100	(213) 390-3595	(713) 529-3489	(503) 254-5541	(714) 547-8424	(408) 243-4121	(602) 881-2348

CIRCLE 67 ON FREE INFORMATION CARD

READ THIS!



And put up to $10.00 in your pocket.

You can save up to $10 when you subscribe to RADIO-ELECTRONICS—and have the best electronics magazine of all delivered to your home, before it runs out on the newsstand! Every page of every issue is packed with electronics news and excitement you won't want to miss. **Make sure you get every issue, and mail the money-saving coupon today! Get all the excitement, every month.**

Subscribe to Radio-Electronics and . . .

for added savings, enclose your payment and you get TWO EXTRA ISSUES per year.

Clip this coupon—MAIL TODAY!

Get the Best—Every Month! Mail Today!

YES! please send me

- ☐ **Payment enclosed, 14 issues for $13.00** (You save $4.50 off newsstand price.)
- ☐ **Payment enclosed, 28 issues for $25.00** (Save More! $10.00 off newsstand price.)
- ☐ **Bill me, 1 year—12 issues only $13.00** (You save $2.00 off newsstand price.)
- ☐ **Bill me, 2-years—24 issues only $25.00** (Save more! $5.00 off newsstand price.)

Extra shipping: Canada $3.00 per year, all other countries $5.00 per year.

☐ Check here if this is a new subscription.
☐ Check here if you are extending or renewing your subscription.

(please print)

Name _____

Address _____

City _____ State _____ Zip Code _____

Mail to: Radio-Electronics
P.O. Box 2520,
Boulder, Colorado 80322

Allow 6-8 weeks for delivery of first issue.

40B1

CPU's & SUPPORT CHIPS

8080A	5.95
8085A	12.95
AMD 2901	13.95
8205	3.95
8212	2.70
8216	2.90
8226	2.75
8228	4.50
8251	6.95
8259	6.95
8257 (AM9517)	8.95
Z80A SIA	17.95
8275	16.95
FD1791	34.95

RAM's

2114L-3	3.95
4116-3	3.75
4116-2	6.75
21L02-3	.99
2102-4	.90
MK4027-3	3.50
MK4096-11	2.95
TMS4045-25	6.50
MS4050NL	3.95
2101-1	2.45
2107B/5280	1.75
MM5270	3.45
MK40089	1.95

UART's

AYS-1013	3.75
16028	3.95
AY3-8500	1.95
PT1482B	3.25

ROM's

2708	6.95
2716	12.95
2516	15.95
2532	29.95
8223	3.95
82S23	2.95
82S112	7.95
82S123	4.95
82S126	2.95
82S129	3.25
82S130	3.45
82S131	3.95
AM9218C	6.95

INTERFACE & DRIVERS

1488	1.40
1489	1.25
8130	2.50
8131	2.50
8830	2.50
8833	2.50
8834	2.00
8837	2.00
8838	2.00
8T380	2.00

PRINTED CIRCUIT BOARD
4" x 6" DOUBLE SIDED EPOXY BOARD 1/16" thick
$.60 ea. . . . . 5/$2.60

EPOXY-GLASS VECTOR BOARD
1/16" thick with 1/10" spacing
4½" x 6½" $1.95

DATEL'S DAC-08BC
8 bit DAC — $9.95

8" DISKETTES HARD SECTOR
$1.75, 10/$16.00

74S00	.30	74S30	.40	74S151	1.25
74S02	.30	74S32	.40	74S157	1.25
74S04	.40	74S86	.60	74S158	1.25
74S05	.45	74S89	1.90	74S174	1.40
74S08	.40	74S112	.85	74S257	1.50
74S11	.35	74S133	1.40	74S258	1.40
74S15	.40	74S140	1.00	74S374	2.50
74S20	.40	74S163	1.10		

7 WATT LD 65 LASER DIODE IR $8.95
25 watt Infra Red Pulse (SG 2006 equiv.) Laser Diode (Spec sheet included) $24.95

2N3820 P FET	$ .45
2N 5457 N FET	$ .45
2N2646 UJT	$ .45
ER 900 TRIGGER DIODES	4/$1.00
2N 6028 PROG. UJT	$ .65

TTL REED RELAY — SPST 5V 20ma $1.00

CLOCK CHIPS

MM5387AA	$5.95
MM5314	$4.75
MM5316	$4.95

TANTALUM CAPACITORS

.22UF 35 V	5/$1.00	10UF 10V	$ .40
.47UF 35 V	5/$1.00	22UF 10V	$ .30
.68UF 35 V	5/$1.00	15UF 16V	3/$1.00
1UF 35V	5/$1.00	30UF 6V	5/$1.00
2.2UF 20V	5,$1.00	33UF 20V	$ .60
3.3UF 20V	4/$1.00	100UF 15V	$ .70
4.7UF 15V	5/$1.00	150UF 15V	$ .95
6.8UF 35V	3/$1.00		

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS	$ 7.50
Si 1020 G 20 WATTS	$13.75
Si 1050 G 50 WATTS	$26.90

200 PRV 1A LASCR .95

RS232 CONNECTORS

DB 25P male	$3.25
DB 25S female	$4.25
HOODS	$1.50

C/MOS

4001	.25	4027	.45	4081	.25	74C74	.50
4002	.25	4028	.60	4082	.25	74C76	.70
4006	.85	4029	.95	4093	.75	74C83	1.30
4007	.27	4030	.35	4099	1.75	74C85	1.40
4008	.80	4034	2.25	4501	.95	74C86	.50
4009	.45	4035	.97	4510	.75	74C90	.90
4010	.45	4040	.90	4511	.75	74C93	.95
4011	.25	4042	.65	4514	1.95	74C151	1.75
4012	.25	4043	1.00	4515	1.85	74C157	1.75
4013	.37	4044	.75	4516	1.00	74C160	1.20
4014	.70	4046	.90	4518	1.20	74C161	1.15
4015	.65	4049	.45	4520	.70	74C163	1.15
4016	.37	4050	.45	74C00	.27	74C165	1.25
4017	.70	4051	.80	74C02	.27	74C173	1.30
4018	.80	4052	1.10	74C04	.40	74C174	1.30
4019	.45	4053	1.10	74C08	.30	74C175	1.20
4020	.70	4066	.70	74C10	.27	74C192	1.30
4021	.90	4069	.25	74C14	1.20	74C901	.80
4022	1.00	4071	.35	74C20	.27	74C926	6.95
4023	.25	4072	.25	74C32	.45		
4024	.55	4076	.80	74C73	.75		
4025	.25	4077	.35				

SPECIAL VALUE
8" SOFT SECTOR DISCS

Made by Magnetic Periferals with documentation

115V AC, +5V DC at 1A, +24V DC at 1A, −5/−12V DC at .3A

Single sided, single density

144,000 bytes of data after formating

14 lbs. shipping weight

Used in good condition

Shugart and IBM format compatible

$250.00

SPECIALS GOOD THRU FEBRUARY 1981

CRYSTALS $3.45 ea.

2.000 MHz	6.144 MHz
4.000 MHz	8.000MHz
3.000 MHz	10.000 MHz
3.57 MHz	18.000 MHz
5.000 MHz	18.432 MHz
6.000 MHz	20.000 MHz

RIBBON CABLE FLAT (COLOR CODED) #30 WIRE
16 cond. - .40/per foot
40 cond. - .75/per foot
50 cond. - .90/per foot

MINIATURE MULTI-TURN TRIM POTS
100, 5K, 10K, 20K, 250K . . . $.75 each . . . 3/2.00

NO. 30 WIRE WRAP WIRE SINGLE STRAND
100' $1.40

ALCO MINIATURE TOGGLE SWITCHES

MTA 106 SPDT	$1.05
MTA 206 DPDT	$1.70
MTA 206 P-DPDT CENTR OFF	$1.85
MSD 206 P-DPDT CENTER OFF LEVER SWITCH	$1.85

SCR's

	1.5A	6A	35A	110A
100	.46	.60	1.40	
200	.70	.80	1.90	9.00
400	1.20	1.40	2.60	12.00
600		1.80	3.60	15.00

TRIAC's

PRV	1A	10A	25A
100	.45	.80	1.55
200	.84	1.30	2.10
400	1.30	1.90	3.10
600	2.00	2.75	4.30

FP 100 PHOTO TRANS	$ .50
RED, YELLOW OR GEEN LARGE LED's. .2"	6/$1.00
RED/GREEN BIPOLAR LED's	$ .55
MLED52 R LED	$ .75
MRD14B PHOTO DARL XTOR	$ .75
TIL-118 OPTO-ISOLATOR	$ .75
IL-5 OPTO-ISOLATOR	$ .80
1 WATT ZENERS: 3.3, 4.7, 5.1, 5.6, 6.8, 8.2, 9.1, 10, 12, 15, 18, or 22V	6/$1.00

SFC 3301 — 50 PRV 30A
FAST RECOVERY DIODE (35ns) . . $2.25

SILICON POWER RECTIFIERS

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.35	.90	3.70	5.00
200	.07	.20	.40	1.30	4.25	6.50
400	.09	.25	.65	1.50	6.50	9.60
600	.11	.30	.80	2.00	8.50	12.50
800	.15	.35	1.00	2.50	10.50	16.50
1000	.20	.45	1.25	3.00	12.50	20.00

IN 4148 (IN914) . . . . . 15/$1.00
.1 or .01 uf 25V ceramic disc. capts. 16/$1.00, 100/$5.00

REGULATORS

LM317T	$1.75	LM305G	$ .75
LM337	$2.50	340K-12, 15 or 24V	$1.50
323K-5V 3A	$5.75	340T-5, 6, 8, 12, 15	
79HGKC-5V at 5A	6.95	18 or 24V	$1.10
723	$ .50	320M5	$ .75
350T-5, 12, or 15V	$1.10	LAS1412 + 12V 3A	$3.95

LED READOUTS

FCS 8024 - 4 digit C.C. 8" display	$5.95	FND 359 L.A.	$ .60
FND 503 C.C. .5"	$ .85	DL-707 C.A. .3"	$ .75
FND 510 C.A. .5"	$ .85	DL 747 C.A. .6"	$1.50
DL-704-.3" C.C.	$ .85	HP3400 .8" CA	$1.95
		HP3405 .8" CC	$1.95

TRANSISTOR SPECIALS

2N1303 PNP GE TO-5	3/$1.00
2N1307 PNP GE TO-5	$ .40
2N404A PNP GE TO-5	3/$1.00
HEP G6014 — PNP GE TO-3	$ .85
TIP 121 — NPN Si SWITCHING	$ .95
2N6233-NPN SWITCHING POWER	$1.95
MRF-8004 a CB RF TRANSISTOR NPN	$ .75
2N3772 NPN Si TO-3	$1.00
2N4908 PNP Si TO-3	$1.00
2N5086 PNP Si TO-92	4/$1.00
2N3137 NPN Si RF	$ .55
2N3919 NPN Si TO-3 RF	$1.50
2N1420 NPN Si TO-5	3/$1.00
2N3767 NPN Si TO-66	$ .70
2N2222 NPN Si TO-18	5/$1.00
2N2907 NPN Si TO-18	4/$1.00
2N3055 NPN Si TO-3	$ .60
2N3904 NPN Si TO-92	6/$1.00
2N3906 PNP Si TO-92	6/$1.00
2N5296 NPN Si TO-220	$ .55
2N6109 PNP S. TO-220	$ .55
TIP 31B NPN Si TO-220	$ .60
TIP 32B PNP Si TO-220	$ .65
TIP 34 PNP Si	$ .95

TTL IC SERIES

7400	.17	7450	.17	74161	.80
7401	.17	7472	.35	74162	1.20
7402	.17	7473	.35	74163	.96
7403	.17	7474	.42	74164	.85
7404	.24	7475	.49	74165	.85
7405	.24	7476	.45	74166	1.05
7406	.33	7480	.45	74167	1.35
7407	.35	7483	.60	74170	1.60
7408	.27	7485	.75	74173	1.30
7409	.24	7486	.42	74174	.85
7410	.17	7489	1.60	74175	.75
7411	.22	7490	.50	74176	.75
7412	.22	7491	.55	74177	.75
7413	.42	7492	.50	74180	.75
7414	.90	7493	.50	74181	1.90
7416	.33	7494	.60	74190	1.20
7417	.37	7495	.60	74191	1.20
7420	.17	7496	.60	74192	.79
7425	.35	74107	.35	74193	.79
7426	.33	74121	.35	74194	.85
7427	.36	74122	.39	74195	.65
7430	.17	74123	.42	74196	.85
7432	.27	74125	.45	74197	.87
7437	.27	74126	.45	74279	.96
7438	.27	74145	.75	74325	2.25
7440	.17	74150	1.10	74365	.80
7441	.85	74151	.65	74367	.80
7442	.50	74153	.55	74368	.65
7445	.70	75154	1.10	74390	1.50
7446	.75	74155	.75	75325	1.50
7447	.75	74157	.65	75491	1.05
7448	.75	74160	.85	8T98	1.10

FULL WAVE BRIDGE

PRV	2A	6A	25A
100			1.40
200	.80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

DIP SOCKETS

8 PIN	.17	22 PIN	.30
14 PIN	.20	24 PIN	.35
16 PIN	.22	28 PIN	.40
18 PIN	.25	40 PIN	.60

74LS SERIES

74LS00	.22	74LS139	.70
74LS01	.22	74LS151	1.19
74LS02	.22	74LS153	1.19
74LS03	.22	74LS156	1.19
74LS04	.27	74LS157	.85
74LS05	.27	74LS160	1.00
74LS08	.27	74LS161	1.00
74LS09	.27	74LS162	1.00
74LS10	.25	74LS163	1.00
74LS11	.35	74LS164	1.00
74LS12	.35	74LS168	1.25
74LS13	.60	74LS169	1.75
74LS14	.80	74LS170	1.70
74LS15	.35	74LS173	.80
74LS20	.30	74LS174	1.00
74LS21	.25	74LS175	1.00
74LS22	.25	74LS181	2.50
74LS26	.35	74LS190	1.25
74LS27	.45	74LS191	1.15
74LS28	.45	74LS192	.90
74LS30	.30	74LS193	.90
74LS32	.40	74LS195	.90
74LS37	.35	74LS196	.90
74LS38	.35	74LS197	.90
74LS40	.40	74LS240	1.60
74LS42	.56	74LS241	1.60
74LS47	.75	74LS242	1.60
74LS51	.25	74LS243	1.60
74LS54	.25	74LS244	1.80
74LS73	.60	74LS245	2.25
74LS74	.85	74LS251	1.29
74LS75	.75	74LS253	1.00
74LS76	.45	74LS257	.90
74LS83	.95	74LS258	.90
74LS85	1.10	74LS259	1.50
74LS86	.45	74LS266	.70
74LS90	.90	74LS273	1.35
74LS92	.90	74LS279	.70
74LS93	.90	74LS290	.80
74LS107	.47	74LS293	.80
74LS112	.45	74LS365	.80
74LS113	.45	74LS366	.80
74LS114	.55	74LS367	.80
74LS123	.75	74LS368	.80
74LS125	.90	74LS373	1.50
74LS126	.90	74LS375	.95
74LS132	.60	74LS377	1.50
74LS136	.90	74LS386	.50
74LS138	.75	74LS393	1.50

LINEAR CIRCUITS

LM201	.75	LM348	.90	711CH	.40
LM301/748	.30	LM358	.70	LM1310	1.95
741CV	.30	LM361	1.75	LM1808	1.75
741C	.35	LM377	1.80	LM1810	2.20
747	.50	LM382	.90	LM1889	1.95
1458	.50	LM386	.80	CA758	1.75
4136	.95	LM387	1.25	CA3018	1.95
3900	.56	LM553	2.25	CA3046	.85
LM307	.30	LM565	.45	CA3078	1.50
LM308	.75	LM567	.95	CA3080	.95
LM324	.95	566	.95	CA3088	.95
LM339	1.10	568	1.25	CA3094	2.25
LF355	1.25	587	1.10	NE540L	2.50
LM370	1.50	702	.95	8038CC	3.90
LM311	.75	703	.95	N556A	1.50
LM318	1.20	709	.35		
		710	.45		

POSTAGE RATES: ADD 10% FOR ORDERS UNDER $20.00. ADD 5% FOR ORDERS BETWEEN $20.00 AND $50.00. ADD 3% FOR ORDERS ABOVE $50.00

TERMS: FOB CAMBRIDGE, MASS. SEND CHECK OR MONEY ORDER. MINIMUM TELEPHONE, C.O.D. PURCHASE ORDER OR CHARGE $20.00 MINIMUM MAIL ORDER $5.00.

SEND $.25 FOR OUR CATALOG FEATURING TRANSISTORS & RECTIFIERS. 145 HAMPSHIRE ST., CAMBRIDGE, MASS. 02139

SOLID STATE SALES
P.O. BOX 74D
SOMERVILLE, MASS. 02143

TEL. (617) 547-7053

WE SHIP OVER 95% OF OUR ORDERS THE DAY WE RECEIVE THEM

1-800-343-5230

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

MOVING?

Don't miss a single copy of **Radio-Electronics.** Give us:

Six weeks' notice

Your old address and zip code

Your new address and zip code

ATTACH LABEL HERE

name (please print)

address

city state zip code

Mail to: Radio-Electronics
SUBSCRIPTION DEPT., P.O. BOX 2520,
BOULDER, COLO. 80322

A LIFETIME GUARANTEE AND 11 OTHER REASONS TO BUY AN "OPTOELECTRONICS" FREQUENCY COUNTER

1. SENSITIVITY: Superb amplifier circuitry with performance that can't be matched at twice the price. Average sensitivity of better than 15 mV from 10 Hz to 500 MHz on every model and better than 30 mV from 500 MHz to 1.1 GHz on the Series 8010A and 8013.

2. RESOLUTION: 0.1 Hz to 12 MHz, 1 Hz to 50 MHz, 10 Hz over 50 MHz.

3. ALL METAL CASES: Not only are the heavy gauge aluminum cases rugged and attractive, they provide the RF shielding and minimize RFI so necessary in many user environments.

4. EXTERNAL CLOCK INPUT/OUTPUT: Standard on the 8010/8013 series and optional on the 7010 series is a buffered 10 MHz clock time base input/output port on the rear panel. Numerous uses include phase comparison of counter time base with WWVB (U.S. National Bureau of Standards). Standardize calibration of all counters at a facility with a common 10 MHz external clock signal, calibrate scopes and other test equipment with the output from precision time base in counter, etc., etc.

5. ACCURACY: A choice of precision to ultra precision time base oscillators. Our ± 1 PPM TCXO (temperature compensated xtal oscillator) and ± 0.1 PPM TCXO are sealed units tested over 20-40°C. They contain voltage regulation circuitry for immunity to power variations in main instrument power supply, a 10 turn (50 PPM) calibration adjustment for easy, accurate setability and a heavily buffered output prevents circuit loads from affecting oscillator. Available in the 8010 and 8013 series is our new ultra precision micro power proportional oven oscillator. With ± .05 PPM typical stability over 10-45°C, this new time base incorporates all of the advantages of our TCXO's and virtually none of the disadvantages of the traditional ovenized oscillator: Requires less than 4 minutes warm-up time, small physical size and has a peak current drain of less than 100 ma.

6. RAPID DISPLAY UPDATE: Internal housekeeping functions require only .2 seconds between any gate or sample time period. At a 1 second gate time the counter will display a new count every 1.2 seconds, on a 10 second gate time a new count is displayed every 10.2 seconds. (10.2 seconds is the maximum time required between display updates for any resolution on any model listed).

7. PORTABILITY: All models are delivered with a 115 VAC adapter, a 12 VDC cord with plug and may be equipped with an optional ni-cad rechargeable battery pack installed within its case. The optional Ni-Cad pack may be recharged with 12 VDC or the AC adapter provided.

8. COMPACT SIZES: State-of-the-Art circuitry and external AC adapters allowed design of compact easy to use and transport instruments.
Series 8010/8013: 3" H x 7-1/2" W x 6-1/2" D
Series 7010: 1-3/4" H x 4-1/4" W x 5-1/4" D

9. MADE IN U.S.A.: All models are designed and manufactured at our modern 13,000 square foot facility at Ft. Lauderdale, Florida.

10. CERTIFIED CALIBRATION: All models meet FCC specs for frequency measurement and provided with each model is a certificate of NBS traceable calibration.

11. LIFE TIME GUARANTEE: Using the latest State-of-the-Art LSI circuitry, parts count is kept to a minimum and internal case temperature is only a few degrees above ambient resulting in long component life and reliable operation. (No custom IC's are used.) To demonstrate our confidence in these designs, all parts (excluding batteries) and service labor are 100% guaranteed for life to the original purchaser. (Transportation expense not covered).

12. PRICE: Whether you choose a series 7010 600 MHz counter or a series 8013 1.3 GHz instrument it will compete at twice its price for comparable quality and performance.

MODEL 7010A 600 MHz

MODEL 8010A/8013 1.1 GHz/1.3 GHz

MODEL	RANGE (From 10 Hz)	10 MHz TIME BASE			AVG. SENSITIVITY		GATE TIMES	RESOLUTION			EXT. CLOCK INPUT/OUTPUT	SENSITIVITY CONTROL	NI-CAD BATTERY PAC
		STABILITY	AGING	DESIGN	10 Hz to 500 MHz	500 MHz to 1.1 GHz		12 MHz	50 MHz	Max. Freq.			
7010A	600 MHz	± 1 PPM	1 PPM/Y	TCXO*	15 mV	N/A	(3) 1, 1, 10 sec			10 Hz (600 MHz)	YES OPTIONAL	NO	YES OPTIONAL
7010 1A		± 0.1 PPM											
8010A	1.1 GHz	± 1 PPM	1 PPM YR	TCXO*	15 mv	30 mV	(4) .01, 1, 1, 10			10 Hz (1.1 GHz)	YES STANDARD	YES	YES OPTIONAL
8010 1A		± 0.1 PPM											
8010 05A		± .05 PPM		OCXO**									
8013 1	1.3 GHz	± 0.1 PPM	1 PPM/YR	TCXO*	15 mV	30 mV	(4) .01, 1, 1, 10 sec			10 Hz (1.3 GHz)	YES STANDARD	YES	YES OPTIONAL
8013 05		± .05 PPM		OCXO**									

*TCXO = Temperature Compensated Xtal Oscillator **OCXO = Proportional Oven Controlled Xtal Oscillator

SERIES 7010A

#7010A	600 MHz Counter - 1 PPM TCXO	$199.95
#7010.1A	600 MHz Counter - 0.1 PPM TCXO	$249.95
OPTIONS:		
#78-H	Handle/Tilt Bail (not shown)	$2.95
#Ni-Cad-701	Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	$19.95
#EC-70	External Clock Input/Output	$35.00
#CC-70	Carry Case - Padded Black Vinyl	$9.95

SERIES 8010A/8013

#8010A	1.1 GHz Counter - 1 PPM TCXO	$399.00
#8010.1A	1.1 GHz Counter - 0.1 PPM TCXO	$450.00
#8010.05A	1.3 GHz Counter - .05 PPM Oven	$499.00
#8013.1	1.3 GHz Counter - 0.1 PPM TCXO	$550.00
#8013.05	1.3 GHz Counter - .05 PPM Oven	$599.00
OPTIONS		
#Ni-Cad 801	Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	$49.95
#CC-80	Carry Case - Padded Black Vinyl	$ 9.95

ACCESSORIES

#TA-100	Telescope antenna with right angle BNC	$ 9.95
#P-100	Probe, 50 Ohm, 1X	$13.95
#P-101	Probe, Lo-Pass Audio Usage	$16.95
#P-102	Probe, Hi-Z General Purpose	$16.95
#LFM-1110	Low Frequency Multiplier X 10, X 100, X1000 For High Resolution of Audio Freq.	$119.95

Optoelectronics inc
5821 N.E. 14th Avenue, Fort Lauderdale, Florida 33334

1-800-327-5912
FROM FLORIDA (305) 771-2051/2

TERMS: Orders to U.S. and Canada, add 5% for shipping, handling and insurance to a maximum of $10.00. All other orders add 15%. C.O.D. collection fee $2.00. Florida orders add 4% state tax. Personal checks must clear before goods are shipped.

CIRCLE 8 ON FREE INFORMATION CARD

IF YOU OWN A RADIO, THIS MICROPHONE WILL LET YOU TRANSMIT FURTHER AND CLEARER OR WE'LL GIVE YOU YOUR MONEY BACK!

Guaranteed to out perform any mic on any radio!

A speech processor microcircuit, designed by us, that eliminates splatter, boosts power and recharges its own battery. A patented American invention made in an American town.

CHECK OUT THE EXCLUSIVE FEATURES!

- CLIPS ANYWHERE
- PROCESSES SPEECH WITH COMPUTER CIRCUIT
- SOUND SENSITIVE 2 INCHES OR 2 FEET
- NOISE CANCELLING
- TWO MICS WITH ONE SWITCH
- FRESH CHARGE WITH NO BATTERIES

YOUR 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.

$44.50 Suggested Retail

AMERICAN ANTENNA
ELGIN, ILLINOIS 60120

...Sold exclusively by 3500 American K40 Dealers throughout the U.S. & Canada.

CIRCLE 18 ON FREE INFORMATION CARD