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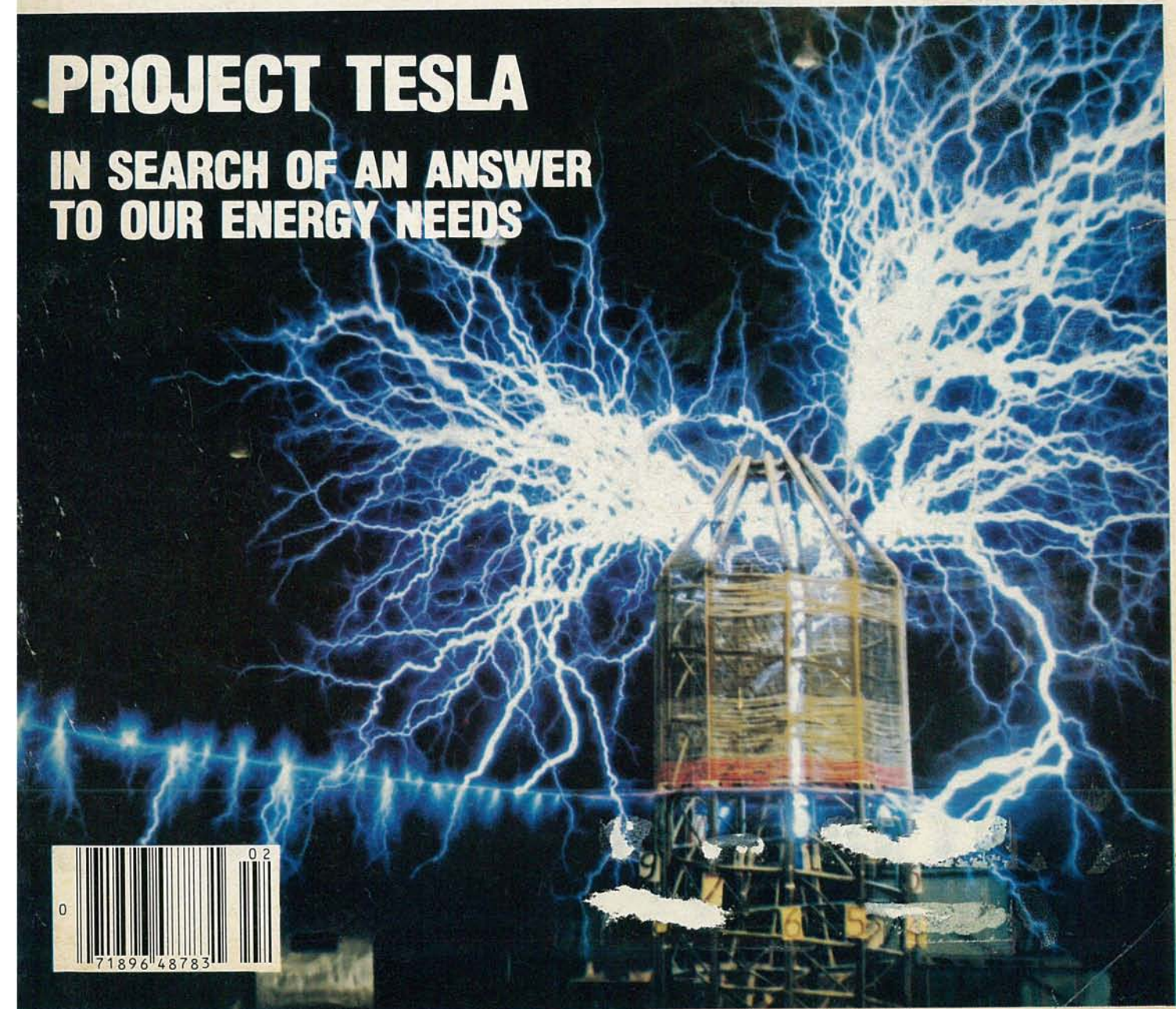
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TO OUR ENERGY NEEDS



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CIRCLE 23 ON FREE INFORMATION CARD



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.

26 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 _____



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

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"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

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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 Wendenover 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
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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.

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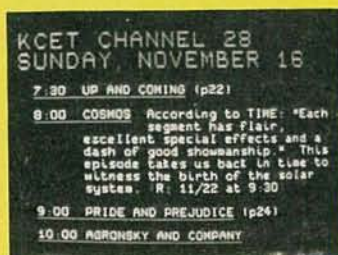
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looking ahead

TELETEXT STARTS



VIDEODISC SCORECARD

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.

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.

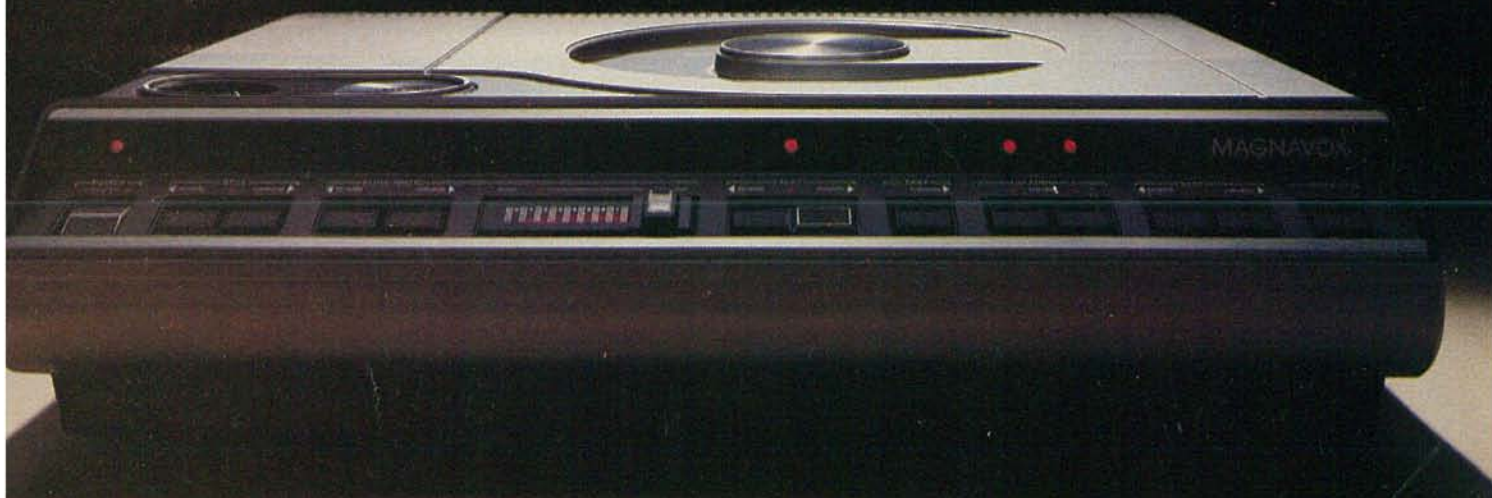
ONE COMPANY'S PROJECTS

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.

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



Simulated TV picture

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.

"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

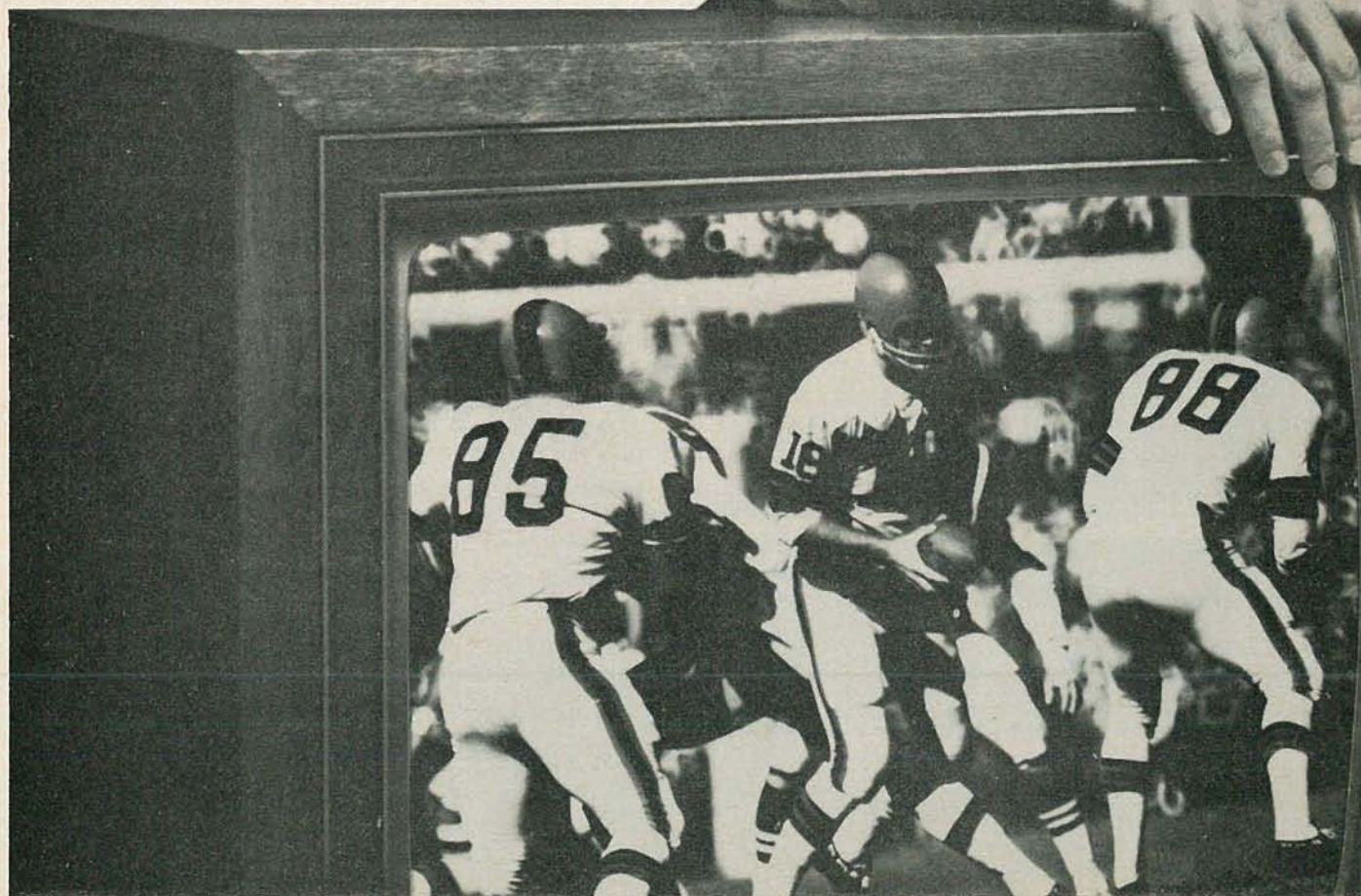
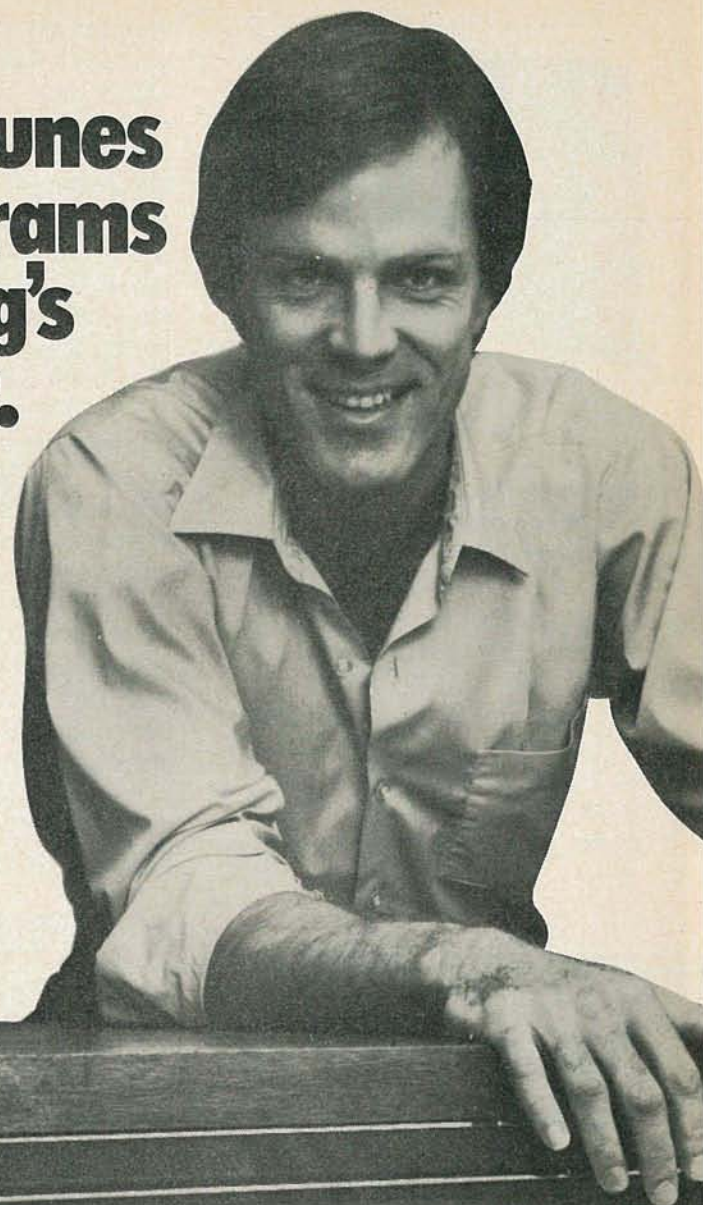


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New from NRI!
25" color TV that tunes
DIAGONAL
by computer, programs
an entire evening's
entertainment.

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.

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., Denver, 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.

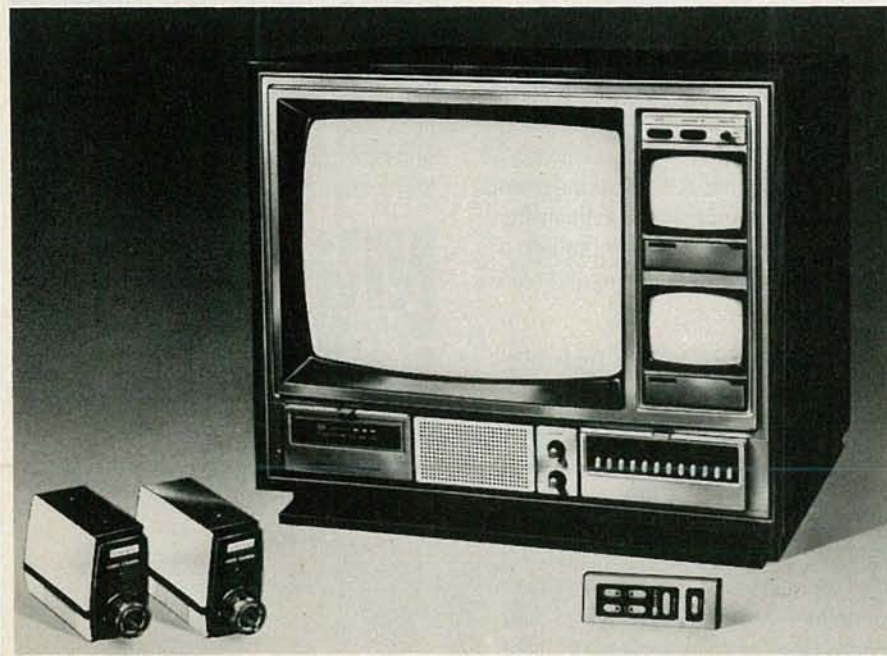
The educational sessions featured renowned management specialist, Dick Co., and technical seminars by top training specialists of several major manufacturers. The all-day "Electronics Derby" trade show also featured new avenues available to servicers as well as the latest in new products and service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



SAMPO MODEL 9519 TRI-SCREEN TELEVISION

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.

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RE 2-1

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.

Authoritative 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 terrific 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 Phoenix, 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, Phoenix 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.

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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.

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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.



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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 Appellate 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.

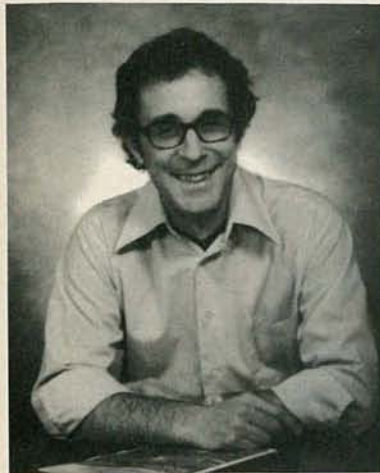
The same court confirmed the defendant's right to a jury trial, because of the fine that might be imposed on the motorist for a radar-detector infraction. That decision was considered important by radar-detector promoters, who feel that "the time and expense to the state in preparing for jury trials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

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"The beat covered by Creative Computing is one of the most important, explosive and fast-changing."—Alvin Toffler



David Ahl, Founder and
Publisher of Creative Computing

You might think the term "creative computing" is a contradiction. How can something as precise and logical as electronic computing possibly be creative? We think it can be. Consider the way computers are being used to create special effects in movies—image generation, coloring and computer-driven cameras and props. Or an electronic "sketchpad" for your home computer that adds animation, coloring and shading at your direction. How about a computer simulation of an invasion of killer bees with you trying to find a way of keeping them under control?

Beyond Our Dreams

Computers are not creative per se. But the way in which they are used can be highly creative and imaginative. Five years ago when *Creative Computing* magazine first billed itself as "The number 1 magazine of computer applications and software," we had no idea how far that idea would take us. Today, these applications are becoming so broad, so all-encompassing that the computer field will soon include virtually everything!

In light of this generality, we take "application" to mean whatever can be done with computers, *ought* to be done with computers or *might* be done with computers. That is the meat of *Creative Computing*.

Alvin Toffler, author of *Future Shock* and *The Third Wave* says, "I read *Creative Computing* not only for information about how to make the most of my own equipment but to keep an eye on how the whole field is emerging.

Creative Computing, the company as well as the magazine, is uniquely light-hearted but also seriously interested in all aspects of computing. Ours is the magazine of software, graphics, games and simulations for beginners and relaxing professionals. We try to present the new and important ideas of the field in a way that a 14-year old or a Cobol programmer can under-

stand them. Things like text editing, social simulations, control of household devices, animation and graphics, and communications networks.

Understandable Yet Challenging

As the premier magazine for beginners, it is our solemn responsibility to make what we publish comprehensible to the newcomer. That does not mean easy; our readers like to be challenged. It means providing the reader who has no preparation with every possible means to seize the subject matter and make it his own.

However, we don't want the experts in our audience to be bored. So we try to publish articles of interest to beginners and experts at the same time. Ideally, we would like every piece to have instructional or informative content—and some depth—even when communicated humorously or playfully. Thus, our favorite kind of piece is accessible to the beginner, theoretically non-trivial, interesting on more than one level, and perhaps even humorous.

David Gerrold of *Star Trek* fame says, "*Creative Computing* with its unpretentious, down-to-earth lucidity encourages the computer user to have fun. *Creative Computing* makes it possible for me to learn basic programming skills and use the computer better than any other source.

Hard-hitting Evaluations

At *Creative Computing* we obtain new computer systems, peripherals, and software as soon as they are announced. We put them through their paces in our Software Development Center and also in the environment for which they are intended—home, business, laboratory, or school.

Our evaluations are unbiased and accurate. We compared word processing printers and found two losers among highly promoted makes. Conversely, we found one computer had far more than its advertised capability. Of 16 educational packages,

only seven offered solid learning value.

When we say unbiased reviews we mean it. More than once, our honesty has cost us an advertiser—temporarily. But we feel that our first obligation is to our readers and that editorial excellence and integrity are our highest goals.

Karl Zinn at the University of Michigan feels we are meeting these goals when he writes, "*Creative Computing* consistently provides value in articles, product reviews and systems comparisons... in a magazine that is fun to read."

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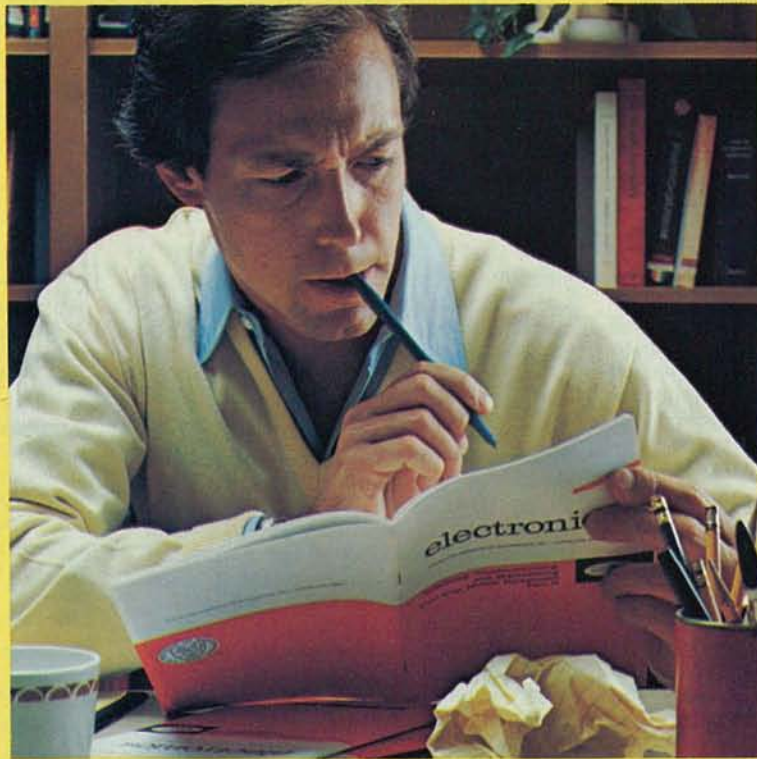
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Why CIE? CIE is the largest independent home study school that specializes exclusively in electronics. Nothing else. CIE has the electronics course that's right for you.

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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.

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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 compatible 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 technicians 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.)

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CIRCLE 24 ON FREE INFORMATION CARD

The fifth number in the first group was for the amount of cloud cover in $\frac{1}{10}$ —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°C.

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. Unfortunately, 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 1-7/8ths 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 μ F to 1.0 μ F 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



Wire for Wire-wrapping



Cut to length and pre-stripped on both ends

AWG (0.25MM) KYNAR WIRE INSULATION DIAMETER .0195 INCH (0.50MM) STRIP-OFF LENGTH BOTH ENDS 1 INCH (25MM) 500 WIRES PER PACKAGE	AWG 30 (0.25MM) KYNAR WIRE				AWG 28 (0.32MM) KYNAR WIRE				AWG 26 (0.40MM) KYNAR WIRE			
	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500	BLUE PART NO.	WHITE PART NO.	YELLOW PART NO.	PRICE PER 500
1	30B-010	30W-010	30Y-010	4.88	28B-010	28W-010	28Y-010	5.25	26B-010	26W-010	26Y-010	5.75
1.5	30B-015	30W-015	30Y-015	5.19	28B-015	28W-015	28Y-015	5.63	26B-015	26W-015	26Y-015	6.23
2	30B-020	30W-020	30Y-020	5.50	28B-020	28W-020	28Y-020	6.00	26B-020	26W-020	26Y-020	6.68
2.5	30B-025	30W-025	30Y-025	5.82	28B-025	28W-025	28Y-025	6.38	26B-025	26W-025	26Y-025	7.13
3	30B-030	30W-030	30Y-030	6.13	28B-030	28W-030	28Y-030	6.75	26B-030	26W-030	26Y-030	7.60
3.5	30B-035	30W-035	30Y-035	6.44	28B-035	28W-035	28Y-035	7.13	26B-035	26W-035	26Y-035	8.05
4	30B-040	30W-040	30Y-040	6.75	28B-040	28W-040	28Y-040	7.50	26B-040	26W-040	26Y-040	8.50
4.5	30B-045	30W-045	30Y-045	7.07	28B-045	28W-045	28Y-045	7.87	26B-045	26W-045	26Y-045	8.98
5	30B-050	30W-050	30Y-050	7.38	28B-050	28W-050	28Y-050	8.25	26B-050	26W-050	26Y-050	9.43
6	30B-060	30W-060	30Y-060	8.00	28B-060	28W-060	28Y-060	9.00	26B-060	26W-060	26Y-060	10.35
7	30B-070	30W-070	30Y-070	8.63	28B-070	28W-070	28Y-070	9.75	26B-070	26W-070	26Y-070	11.25
8	30B-080	30W-080	30Y-080	9.25	28B-080	28W-080	28Y-080	10.50	26B-080	26W-080	26Y-080	12.18
9	30B-090	30W-090	30Y-090	9.88	28B-090	28W-090	28Y-090	11.25	26B-090	26W-090	26Y-090	13.55
10	30B-100	30W-100	30Y-100	10.50	28B-100	28W-100	28Y-100	12.00	26B-100	26W-100	26Y-100	14.00

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500 ft roll	R30B-050	R30W-050	R30Y-050	10.40	R28B-050	R28W-050	R28Y-050	12.85	R26B-050	R26W-050	R26Y-050	13.80
1000 ft roll	R30B-100	R30W-100	R30Y-100	16.82	R28B-100	R28W-100	R28Y-100	21.16	R26B-100	R26W-100	R26Y-100	23.15

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CIRCLE 25 ON FREE INFORMATION CARD

FEBRUARY 1981

23

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/cross-hatch 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 μ V to 100 mV into 75 ohms; 10 μ V to 200 mV into 300 ohms). An IF output is also provided at 45.75 MHz at a level of 5 μ V 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 "super-pulse"—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 cross-hatch 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

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LM 308	.90	LM 1391	1.50
LM 310	1.05	LM 1414	2.25
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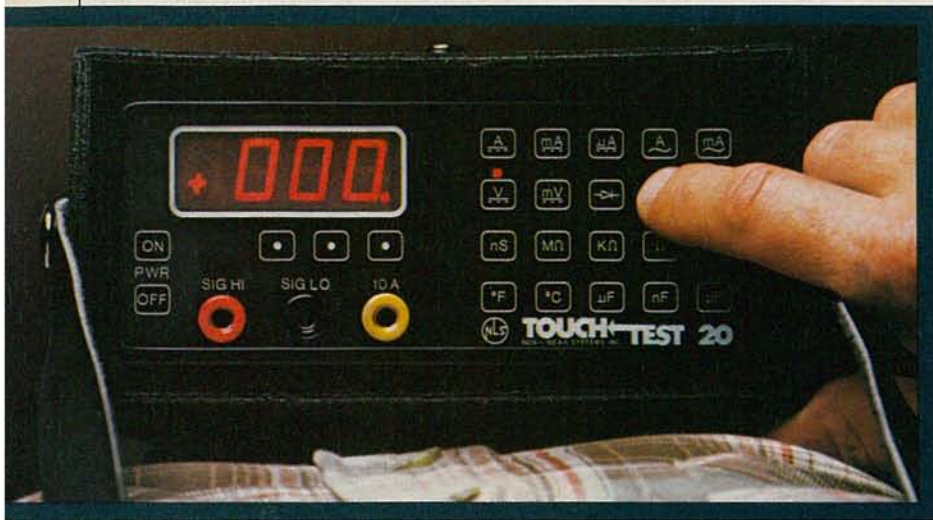
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Non-Linear Systems introduces the 2 lb. 4 oz. test lab.



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 beep and a visual blip to let you know.



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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 μ V to 750 VRMS, 6 ranges.
DC Voltage	10 μ V to 1000 VDC, 6 ranges.
AC Current	10 μ A to 10 A, 4 ranges.
DC Current	0.01 μ A 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 200 μ F, 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
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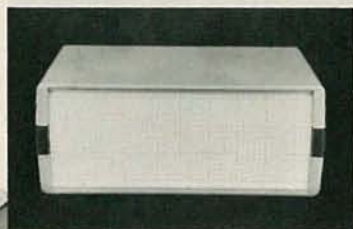
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EQUIPMENT REPORTS

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**

Triplet Model 3400 Digital VOM



CIRCLE 102 ON FREE INFORMATION CARD

TODAY PRACTICING TECHNICIANS, 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

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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 μ Sec/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)

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

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.



Simulated TV Reception



Digital Multimeter

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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.

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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 Triplet. 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.

Triplet 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. Triplet 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 Triplet *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

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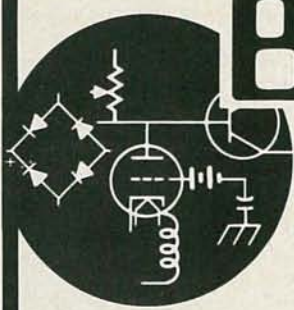
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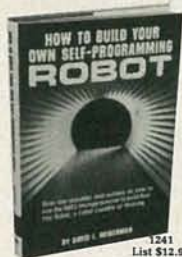
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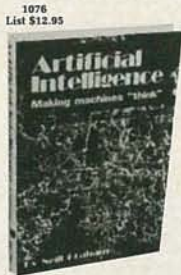
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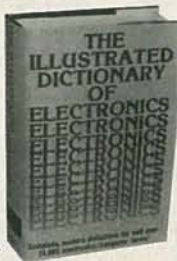
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RE-281

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 DIVISION 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 measures capacitances from 1 pF to 2000 μ F in eight ranges, and displays the value on a 3 1/2" 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 μ F, 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.

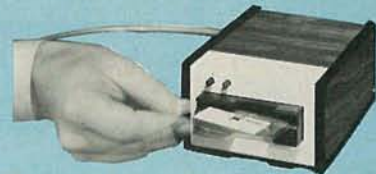
The short test leads have banana plugs and clips. Special sockets are provided just above the test-lead jacks, for inserting the leads of very small capacitors. Those have spring contacts. The small amount of capacitance of the test leads can be neutralized by using the ZERO ADJUST control on the front 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.

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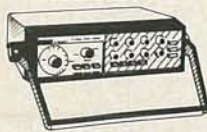
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EQUIPMENT REPORTS
continued from page 34

device designed for that specific purpose. The *Stringy Floppy* is a 4x6x2 1/2 inch self-contained unit. The circuitry, which also acts as a keyboard debouncer for the TRS-80, uses an EPROM (Erasable Programmable Read-Only Memory), 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 transferring old programs to *Stringy Floppy* wafers. Wafers? Yes, the *Stringy Floppy* uses 2 3/4 x 1 1/2 x 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 62 1/2 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 continuous 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 through 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

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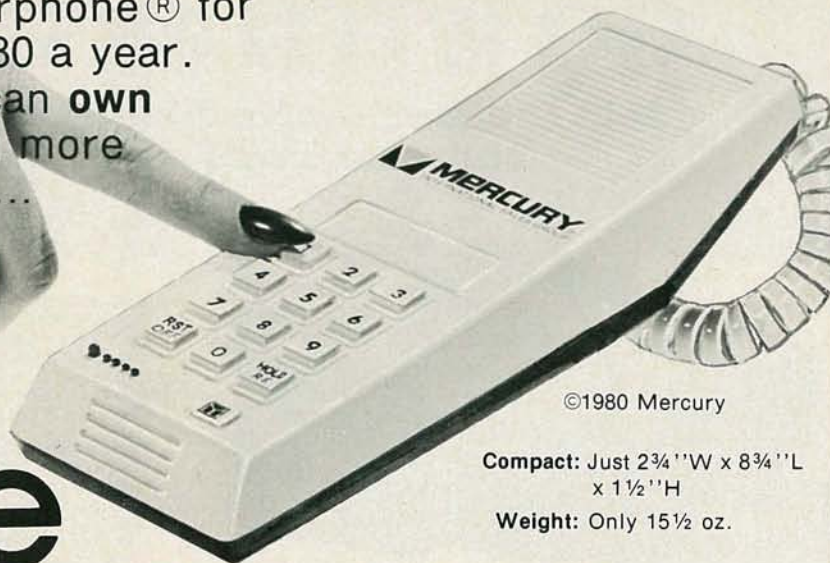
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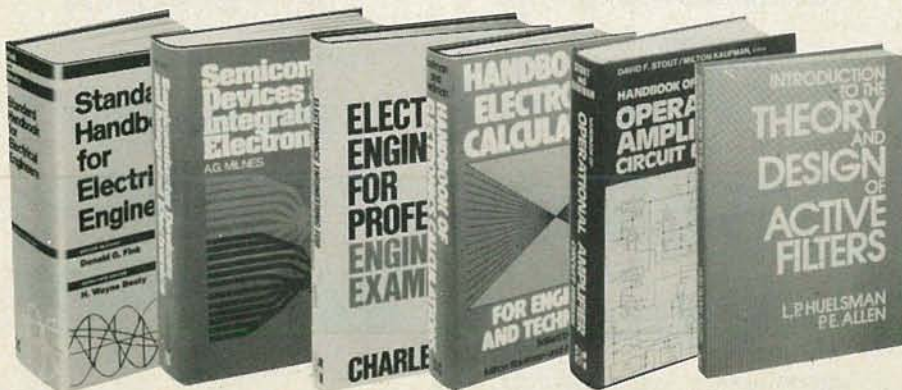
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EQUIPMENT REPORTS

continued from page 36

Although the *Stringy Floppy* does not have the speed or versatility of 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 buses are \$289.50 and \$250.00, respectively. From Exatron Corporation, 3559 Ryder Street, Santa Clara, CA 95051. **R-E**

Eico Model 330 Signal Generator



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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 ($7\frac{1}{2} \times 8\frac{1}{2} \times 5$ 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**

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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.

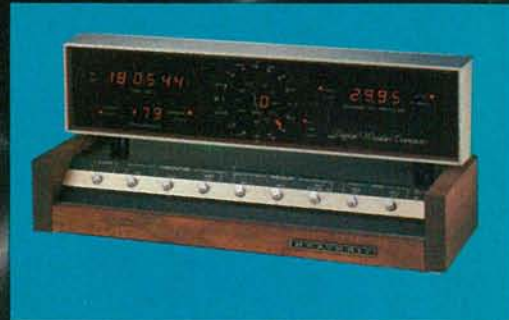
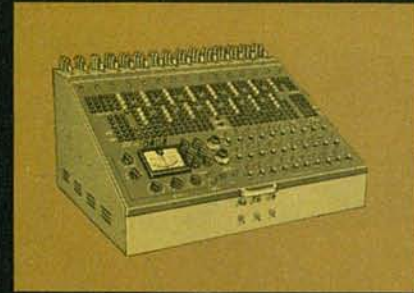
Today — Today's brainchildren include the popular Heathkit All-In-One Computer, a complete computer system with disk storage, smart terminal, two Z80 microprocessors — all in one compact unit.

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.

Heathkit 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.



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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.

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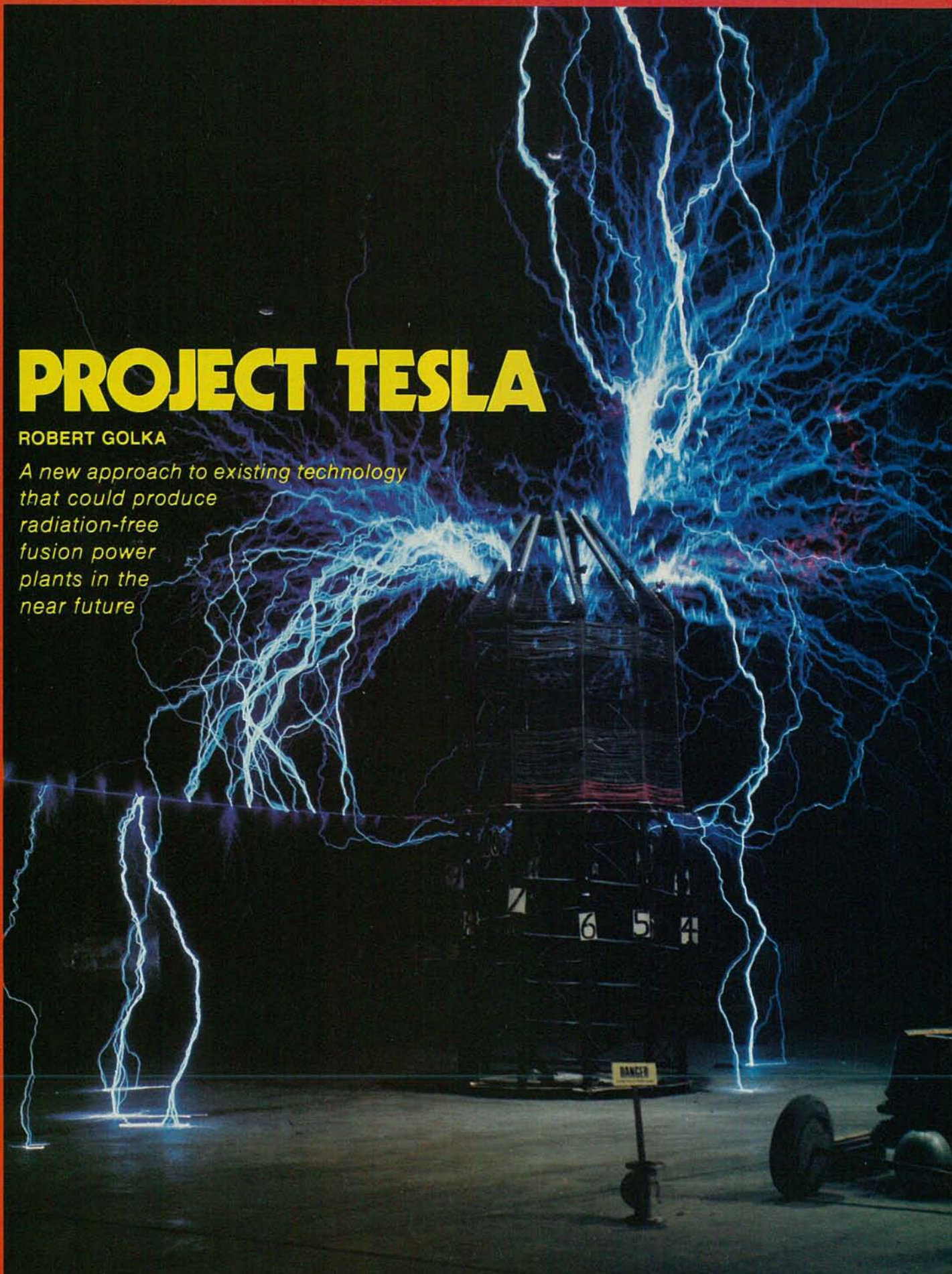
He also has the famous "Sylvania ECG Industrial MRO Replacement Guide and Catalog" which provides technical information, and cross-references more than 70,000 industrial part numbers.

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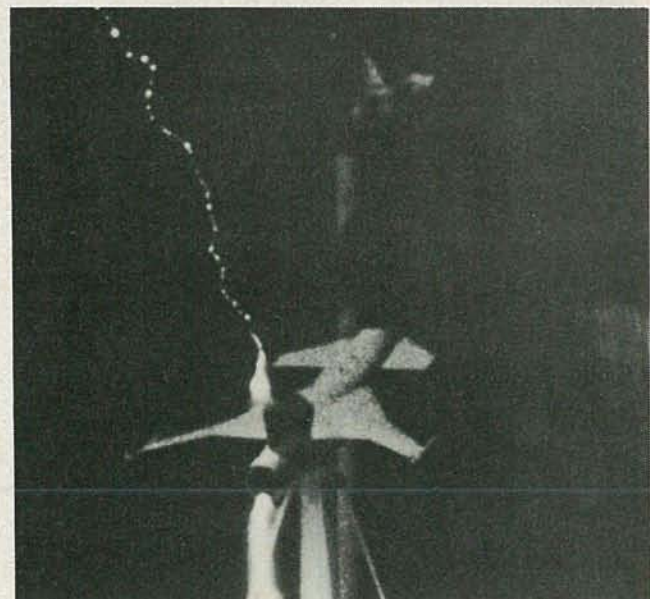
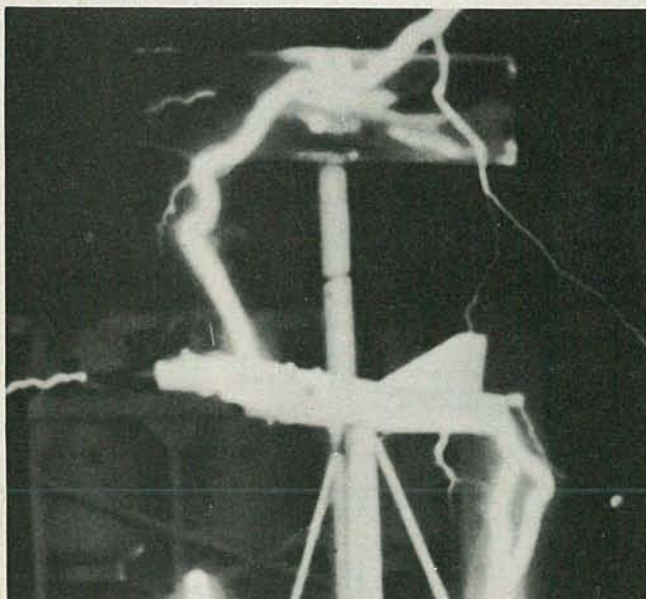
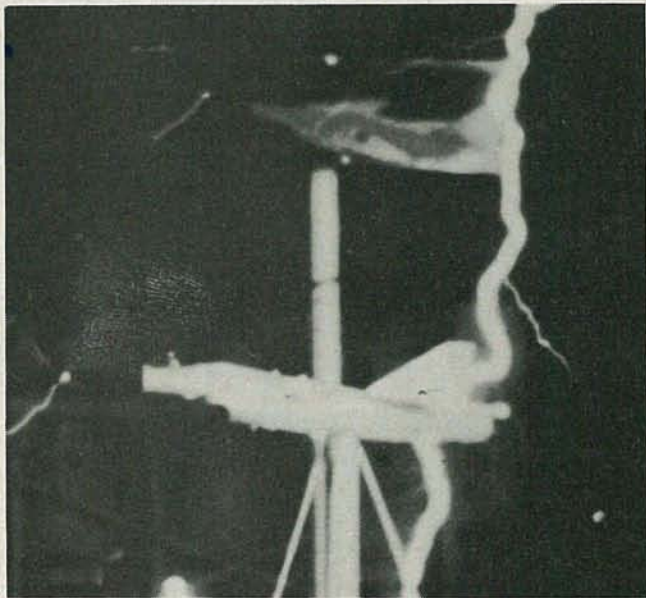


FOR MANY YEARS WE HAVE LOOKED FOR A WAY OF holding very hot gases without the use of magnetic fields. About 11 years ago (1968), we here at Project Tesla began looking into some of the research of Nikola Tesla, who in 1899 was experimenting with an international power and communicating system. During 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.

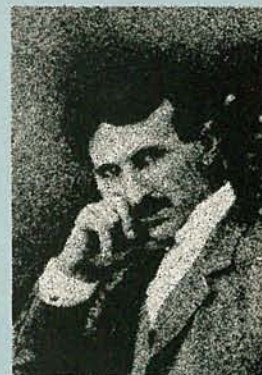
Once a billion and a half degrees have been reached, the fusion process starts and the laser can be extinguished. Each pair of hydrogen-deuterium atoms that fuse together make a helium atom and shoot off 2 neutron particles at high speeds. These neutron particles have no electrical charge at all, therefore, 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 led 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 CO₂ 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- μ F 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 com-

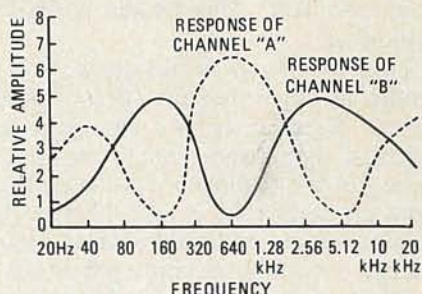


FIG. 2—FREQUENCY RESPONSE of synthesis sound circuit shows how the audio spectrum is split up to create a stereo effect.

ponents. 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.

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.

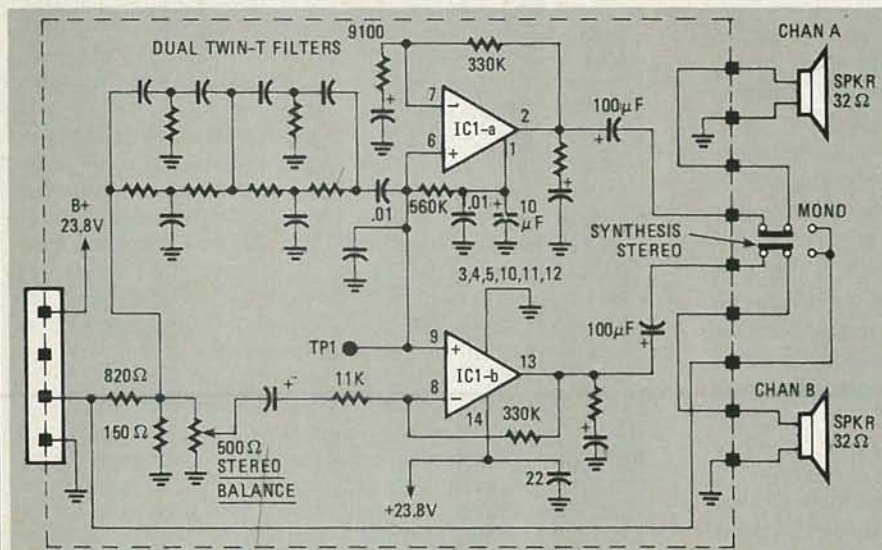


FIG. 1—SYNTHESIS SOUND CIRCUIT found in RCA's CTC-101 TV chassis produces a simulated stereo effect.

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

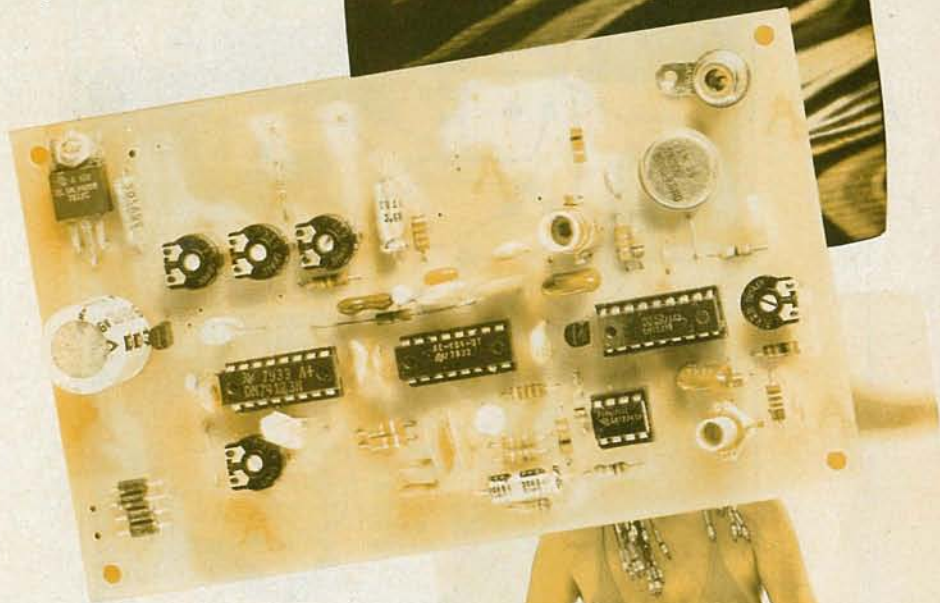
NOTE:

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.

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!



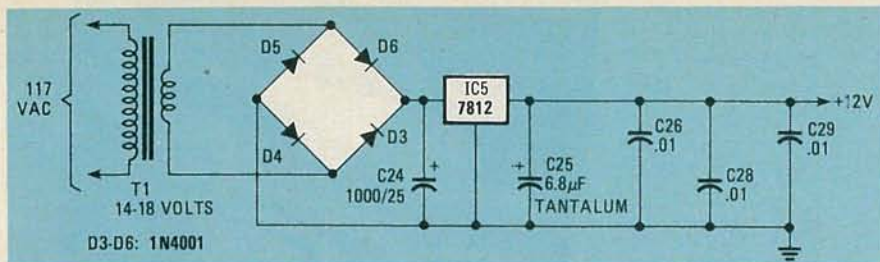


FIG. 4—THIS POWER SUPPLY (included on PC board) allows the decoder to operate from 117 VAC.

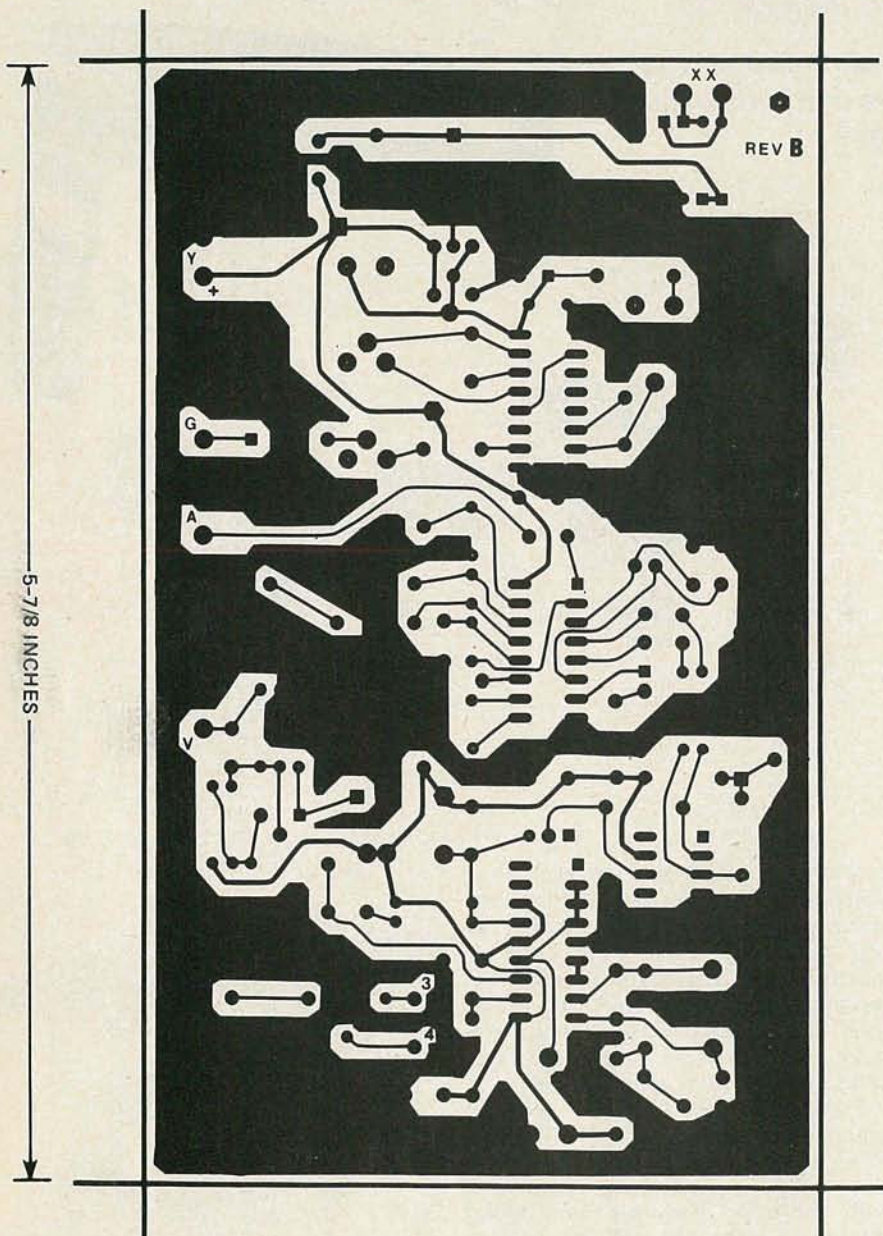


FIG. 5—HOLE MUST BE DRILLED at lower left of board for J1, if used.

(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.

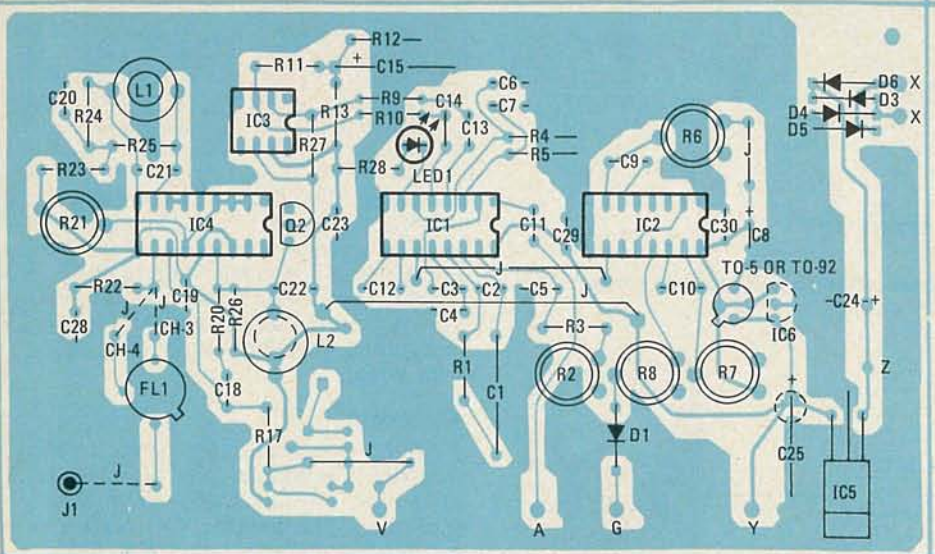


FIG. 6—PROVISION HAS BEEN MADE for use of different sized components (e.g., IC6, C22).

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"

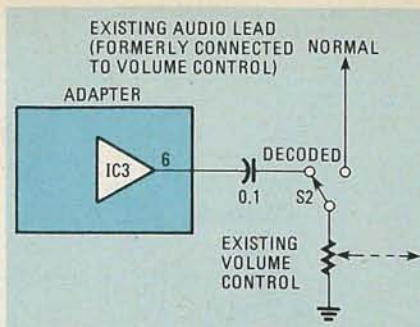


FIG. 7—SPDT SWITCH can be used to select "normal" or decoded audio signals.

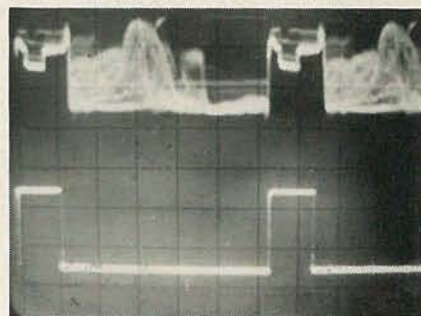


FIG. 8—UPPER TRACE shows scrambled signal; lower one shows gating pulse from decoder.

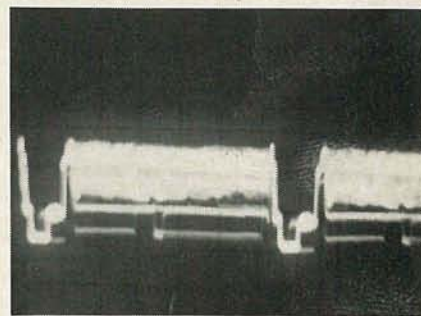


FIG. 9—A PROPERLY UNSCRAMBLED SIGNAL should look like this on your scope.

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.

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

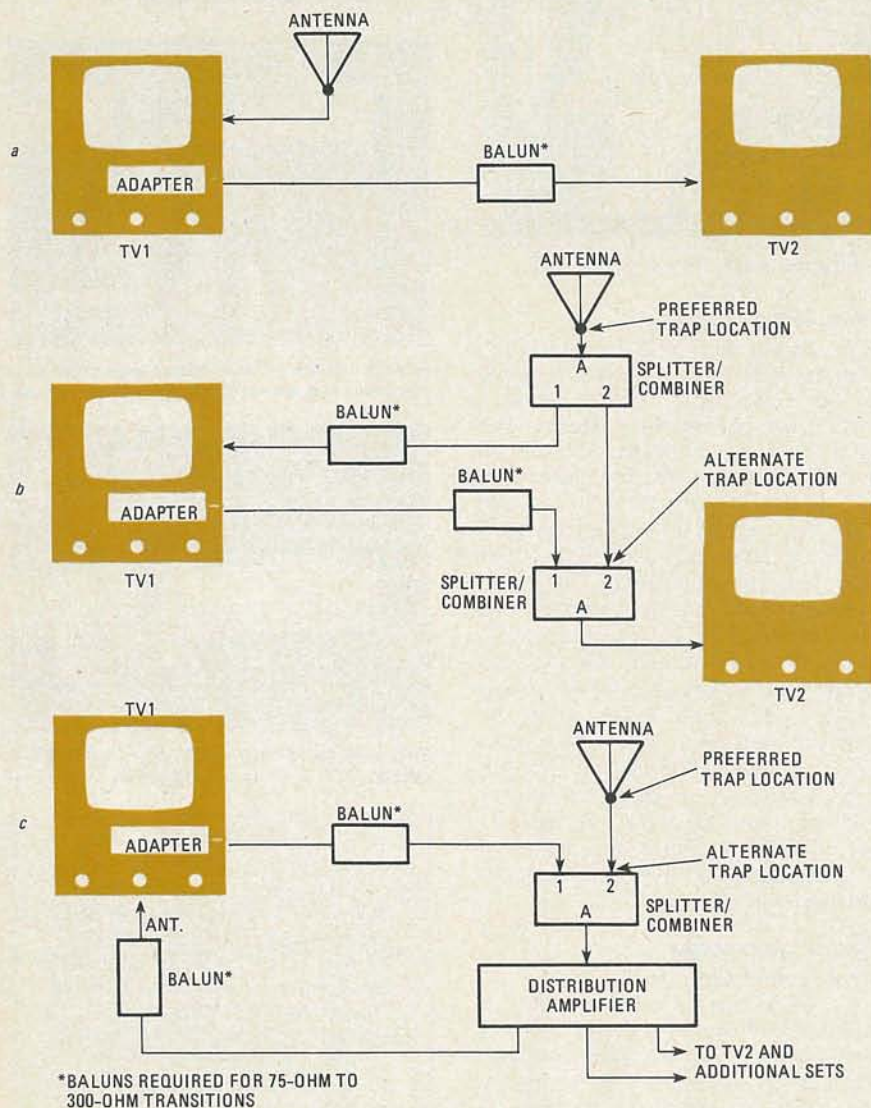


FIG. 11—SEVERAL METHODS for interconnecting a multi-set system. See text for details.

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 be-

tween 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

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

that cable should be connected via a .1- μ F 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.

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

ELECTRONICS IN YOUR NEXT CAR

PART 3

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 adjuster 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

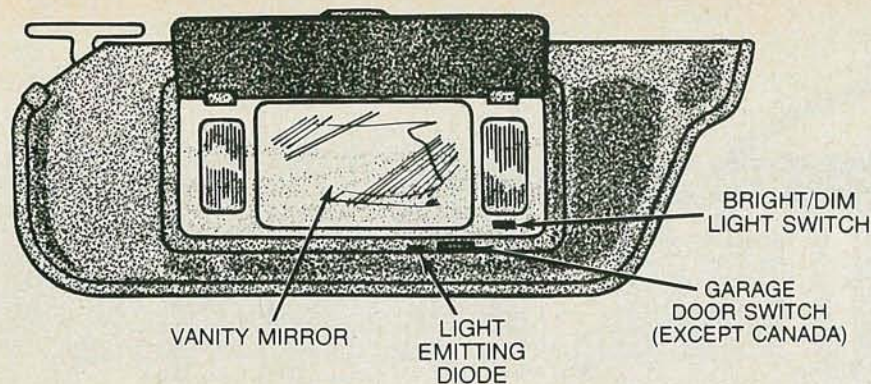


FIG. 1—GARAGE DOOR OPENER/visor mirror combination featured on the 1981 Imperial.

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

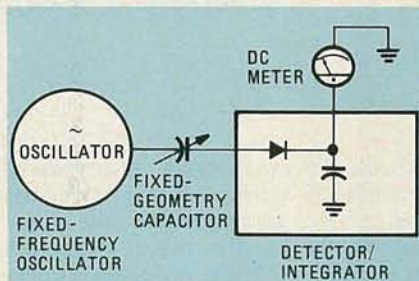


FIG. 3—DIESEL FUEL WATER monitor from GM uses a fixed geometry capacitive probe.

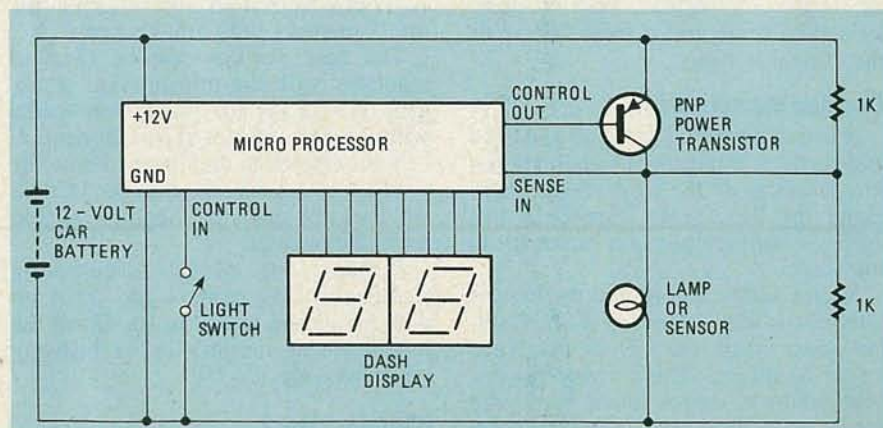


FIG. 2—A MICROPROCESSOR is at the heart of a unit that monitors all auto lamps.

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.

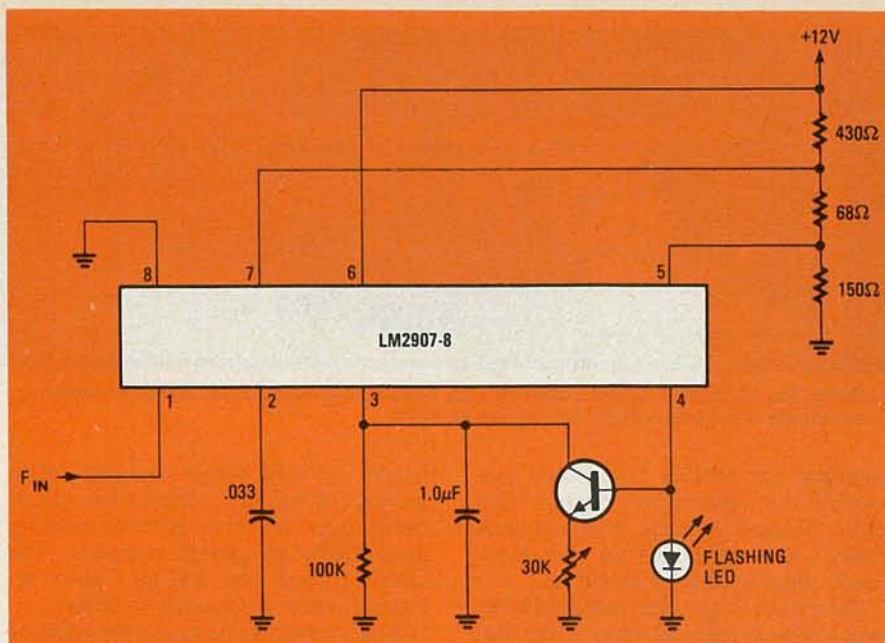


FIG. 5—SPEED ALERT circuits are easy to find. These devices can be put together for less than most cruise controls and are simple to install.

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

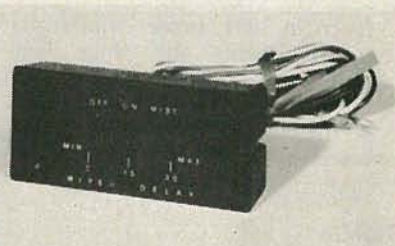


FIG. 6—WIPER CONTROL from Sears works only when the car's wiper switch is off.

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 car-makers and parts-makers 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 de-

froster 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 maxi-

mize 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.

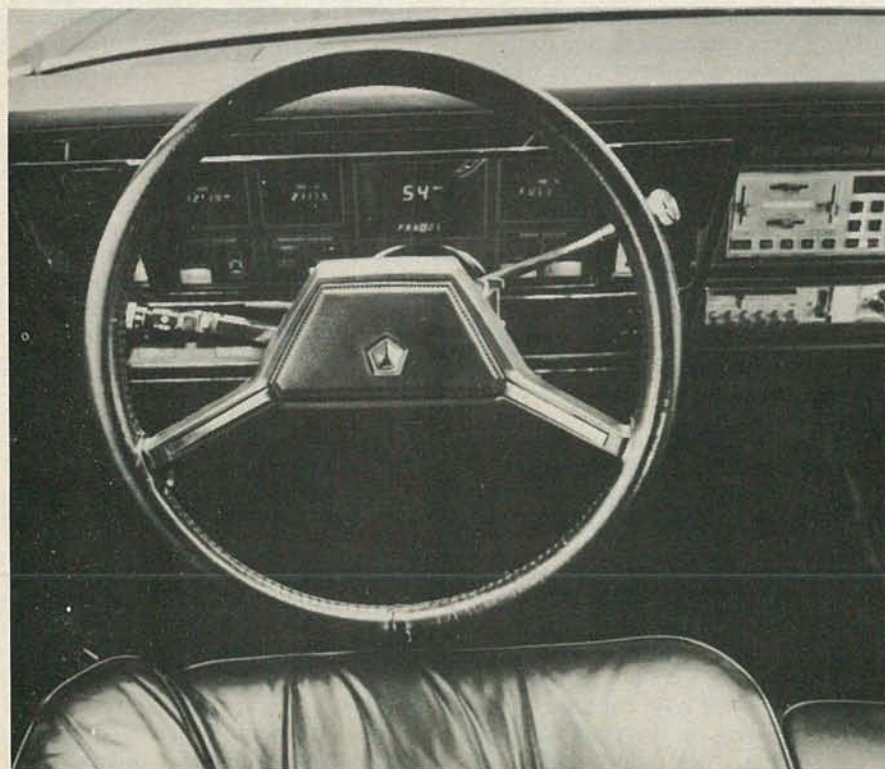
Police radar detectors are getting more sophisticated, both in terms of improved circuitry and human factors. The new trend is toward units mounted out of sight behind the grille with only a control and warning box on the dash, and toward better disguises. In the latter category, we've seen prototype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

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. car-makers, 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**



ELECTRONIC CONTROLS and readouts predominate on the 1981 Imperial.



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.

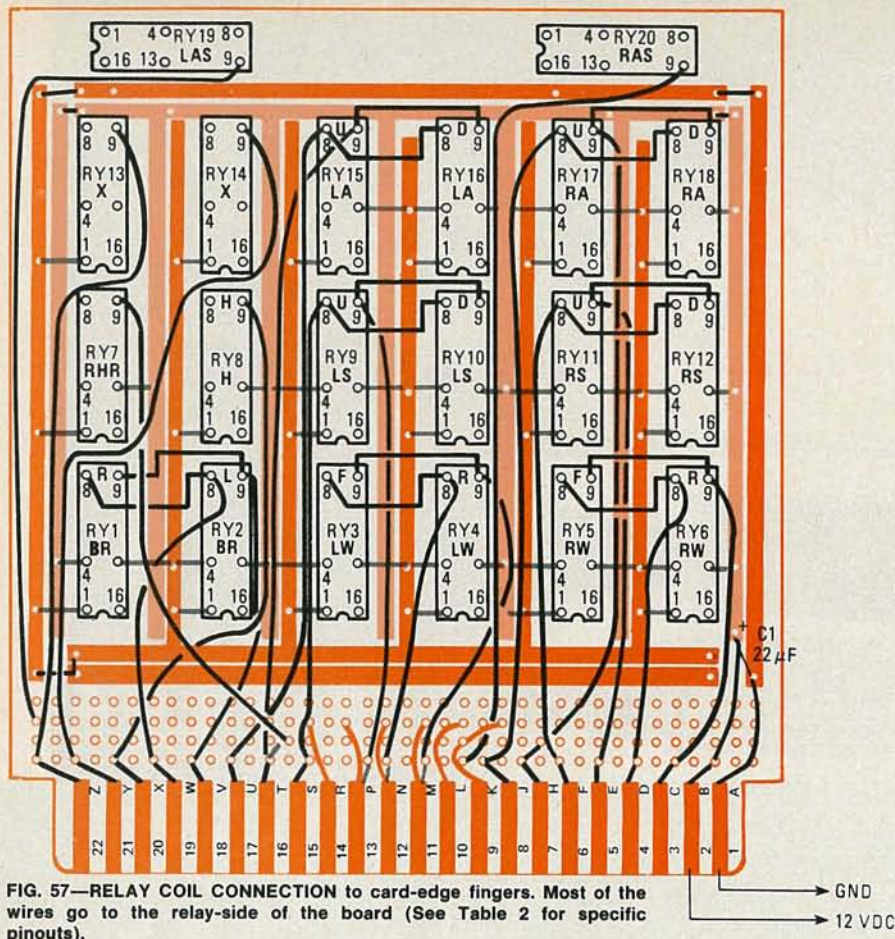


FIG. 57—RELAY COIL CONNECTION to card-edge fingers. Most of the wires go to the relay-side of the board (See Table 2 for specific pinouts).

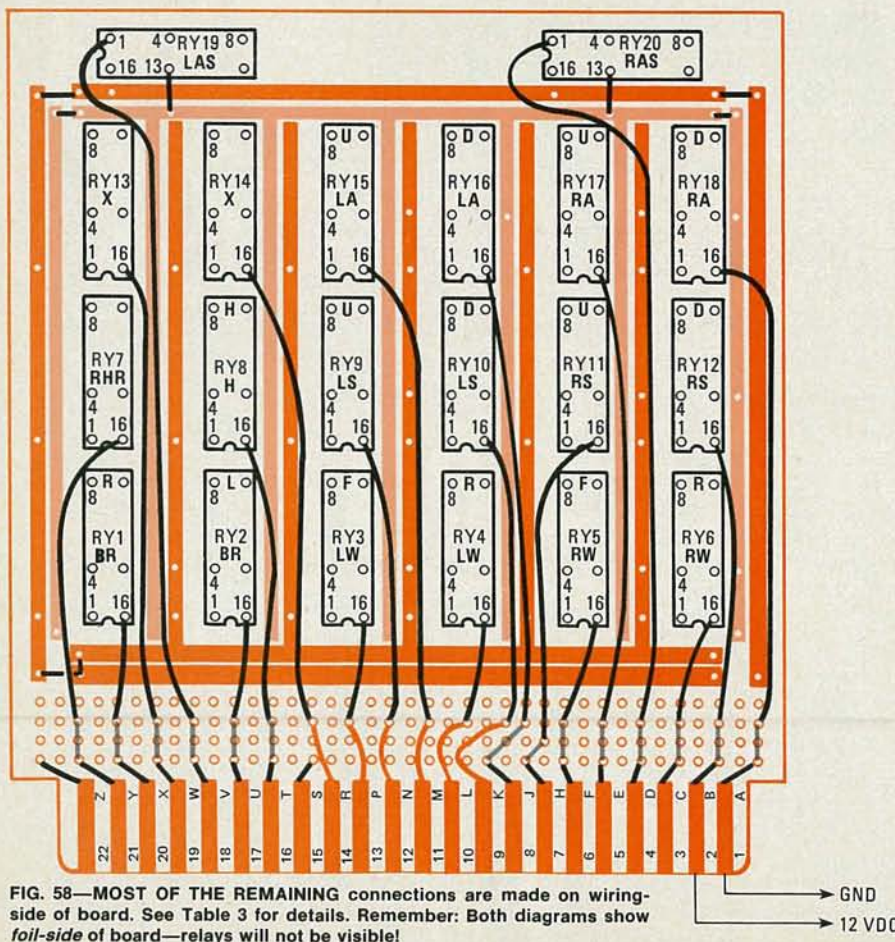


FIG. 58—MOST OF THE REMAINING connections are made on wiring-side of board. See Table 3 for details. Remember: Both diagrams show foil-side of board—relays will not be visible!

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!

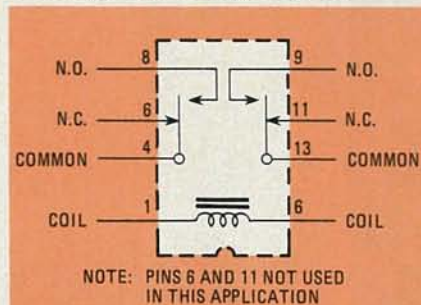


FIG. 59—PINOUT OF RELAYS used in this project by author. Relay contacts should be rated at one amp.

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

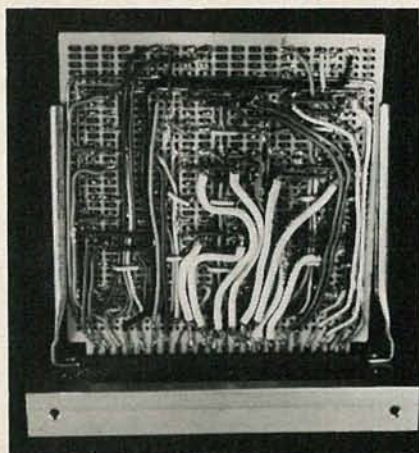


FIG. 60—BE VERY CAREFUL when wiring the relay board and check for shorts and solder bridges. Color coding wires helps.

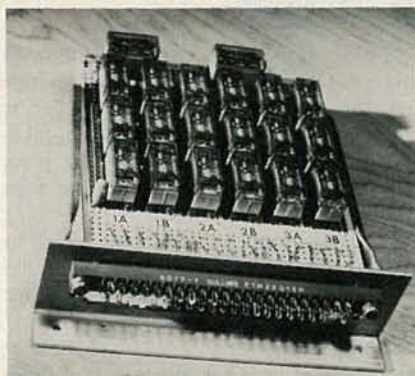


FIG. 61—RELAY BOARD plugs into 22/44 pin edge connector that will be wired to relay-driver board and to 12-volt systems.

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 μ F 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.

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 1/4-20 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 1/2-inch diameter aluminum rods six inches long, and to bore a 1/4-inch hole through the entire length of each. Those holes must be true, so work very carefully and slowly.

Next, the two 1/4-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 1/2-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 1/4-inch steel rod in and out of the hole while rotating it slow-

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 μ F tantalum capacitor	1
Miscellaneous: wire, solder, etc.	

TABLE 2 RELAY COIL WIRING		
Relay	From pin no.	To 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 $\frac{3}{4}$ -inch square extruded aluminum material with $\frac{1}{8}$ -inch walls) to attach the new arm to the shoulder motor cross-bar rod.

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

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

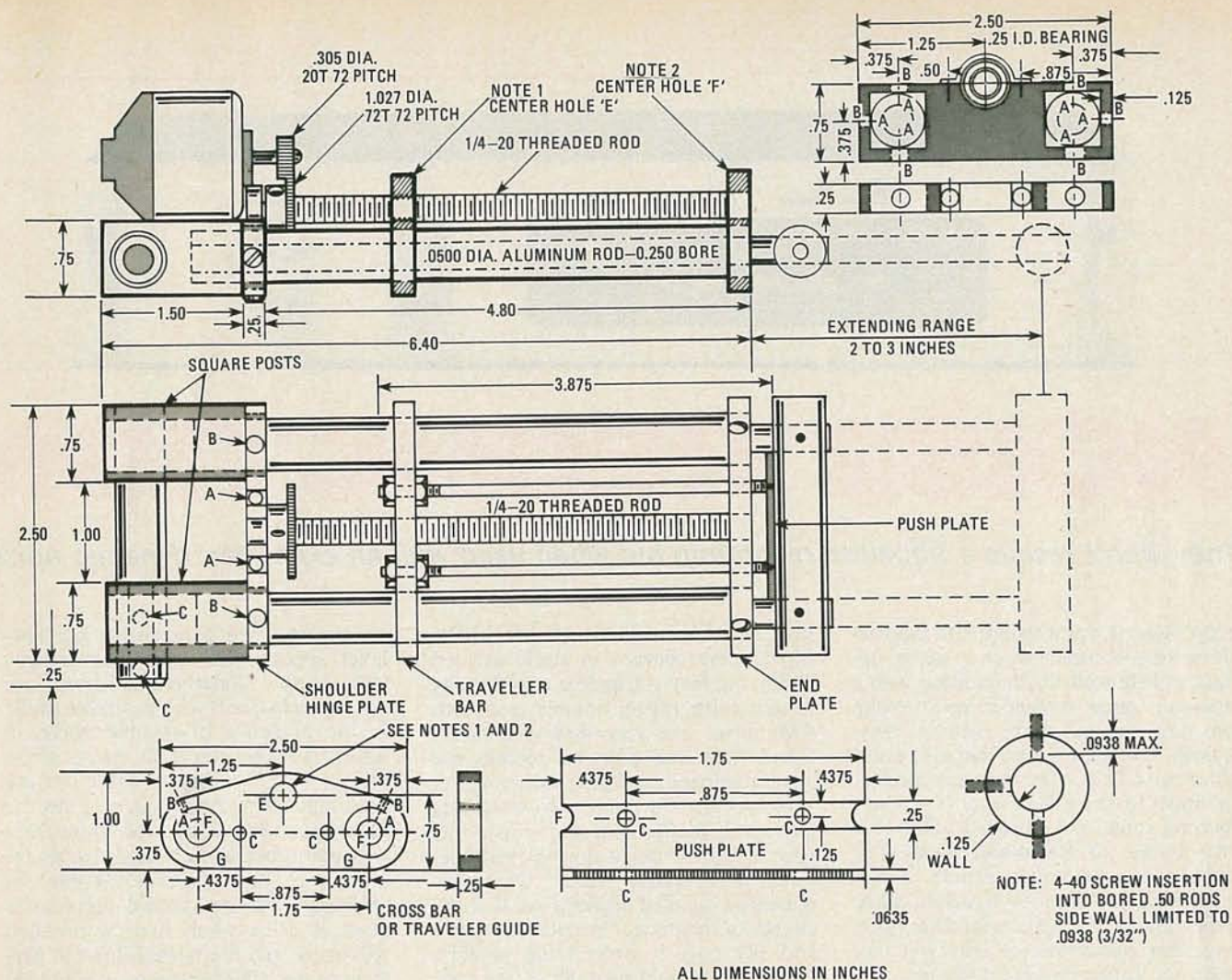
You can cut out those openings by drilling a series of small holes along the inside of the lines you marked and then cutting or drilling through the "webs" between the holes to remove the center piece. Then, using a warding file, finish the opening, from time to time checking the size of the opening 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 $\frac{1}{4}$ -20 threaded rod.

That bearing can be one of two kinds. It can either have an inside diameter of $\frac{1}{4}$ -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 $\frac{1}{4}$ -inch-wide strap of aluminum or

PARTS LIST—EXTENDER ARM				
Item	Size	Quantity	Supplier's part no.	Supplier
Aluminum side rod	$\frac{1}{2}$ -in. diam. \times 6-inch	2	AB-6	(A)
$\frac{1}{4}$ -inch aluminum plate	$1\frac{1}{4} \times 2\frac{1}{2}$ -inches	2	APS-1	(A)
Aluminum or brass plate	$\frac{1}{16} \times \frac{1}{4} \times 2\frac{1}{4}$ inches	1		(K)
	$\frac{3}{4} \times 2\frac{1}{2}$ -inches	1	APS-75	(A)
Bearing	$\frac{1}{4}$ -in. I.D.,	1	B2-10	(A, B)
$\frac{3}{4}$ -in. square aluminum post	$1\frac{1}{2}$ -long	2		(K)
Push rod	4 in. $\frac{1}{8}$ -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)



ALL DIMENSIONS IN INCHES

DRILL & TAP KEY			
A 43 DRILL-TAP 4-40	C 29 DRILL-TAP 8-32	E 7 DRILL-TAP 1/4-20	G .0500 DRILL OR DRILL 0.375, REAM TO 0.500
B 33 DRILL (BODY DIA. 4-40)	D 19 DRILL (BODY DIA. 8-32)	F 0.250 DRILL (BODY DIA. 1/4-20; 0.2497)	

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 1/2-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 1/4-inch aluminum plate, 2 1/2 x 1 1/4 inches, and filed to shape as shown in Fig. 62.

They are essentially the same, but have

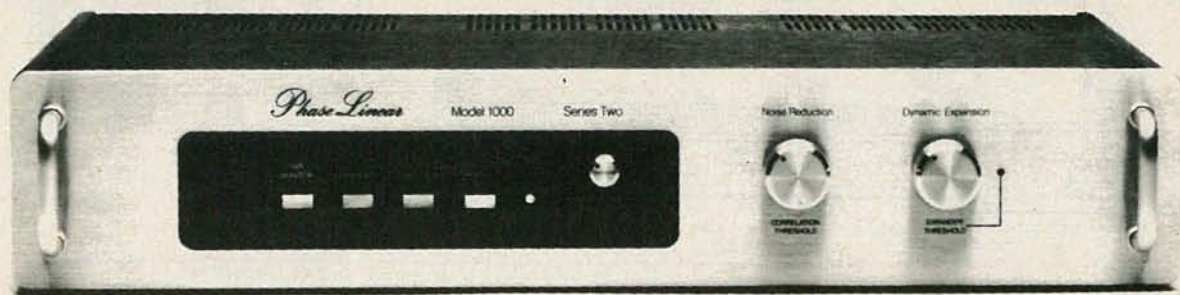
the following differences: The center hole in the end plate is simply made with a 1/4-inch bit. The center hole in the traveler-bar, however, must be tapped to 1/4-20 to accept the threaded steel rod. (Drill that one with a #7 bit before tapping.)

Another difference is that, while the 1/2-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, 2 1/4 x 1 1/4 inches in size. Mark a center line along the long dimension of the flat side of the plate. Then, measure 7/8-inch in from both ends along this center line, and drill 1/4-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 expand-

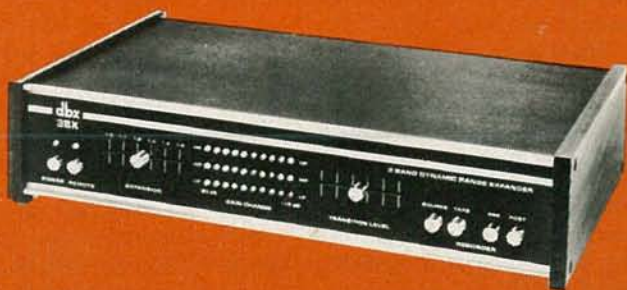
er, the reduced gain during the low-level section will make instruments less loud. Nonetheless, there are occasional signals with desirable treble in the presence of audible noise, in which case we find that we're in the dilemma of whether to filter out the noise and harm the signal, or allow the noise 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

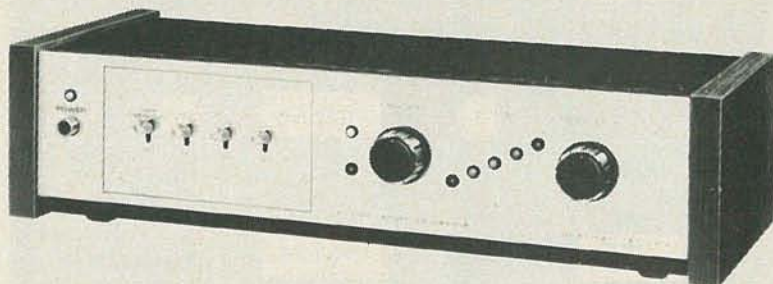


THE MODEL 1201A from KLH uses a sliding cut-off filter with a fixed control.



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 (Voltage Controlled Filter), rather than a VCA (Voltage Controlled Amplifier). 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

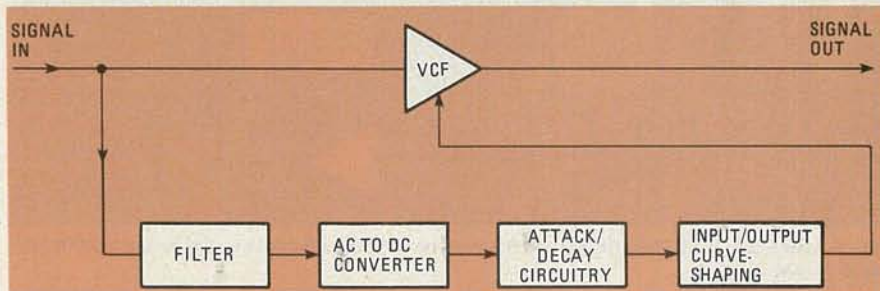


FIG. 1—TYPICAL BLOCK DIAGRAM of a dynamically variable filter. These devices can not perform miracles but they can be very effective on better recordings.

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

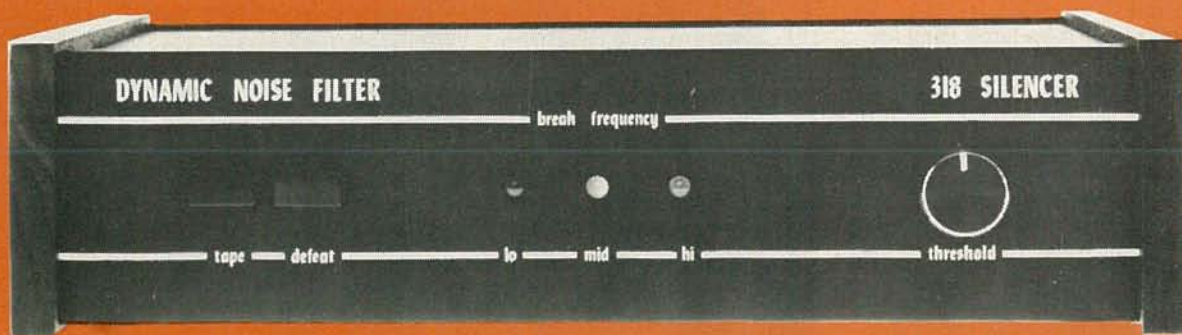
band. (The highest frequency band is fastest, of course.)

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.

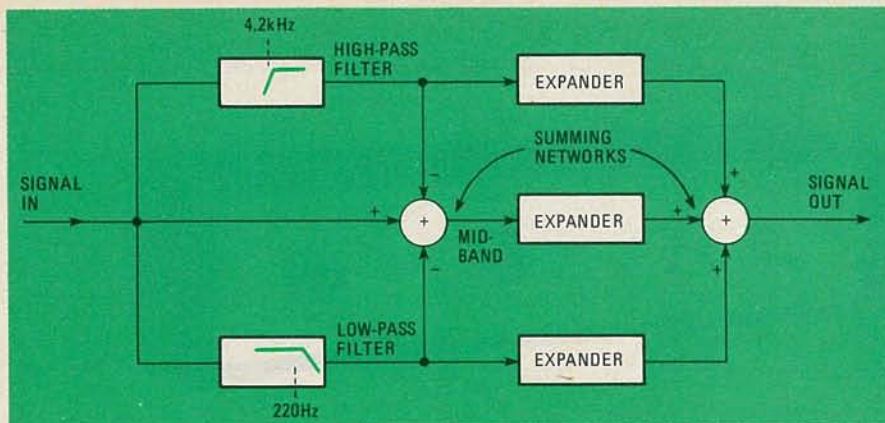


FIG. 2—A THREE BAND EXPANDER, such as the dbx model 3BX, divides the signal into three bands, expands them individually, and then sums the result.

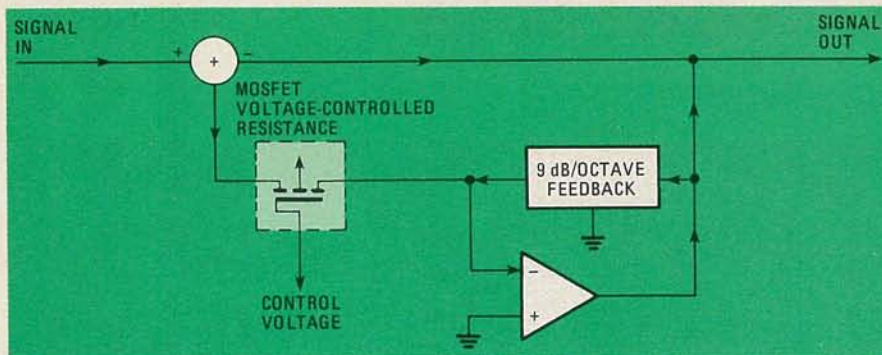


FIG. 3—AMOUNT OF FEEDBACK around the 9 dB-per-octave network is varied by the MOSFET in the KLH model 1201A.

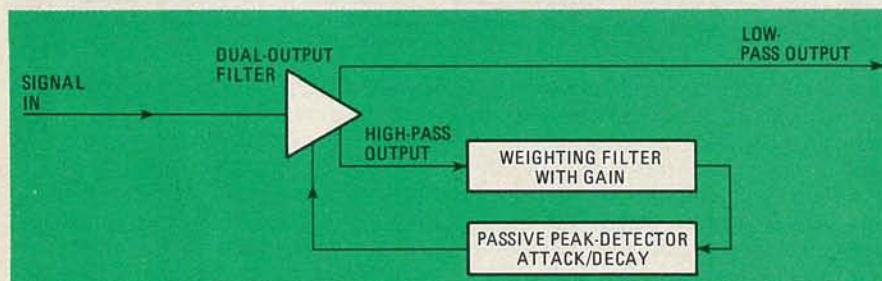


FIG. 4—THE AUTOMATIC GAIN CONTROL LOOP uses feedback to control the cut-off frequencies of both the high-pass and low-pass outputs in the Logical Systems model 318.

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.

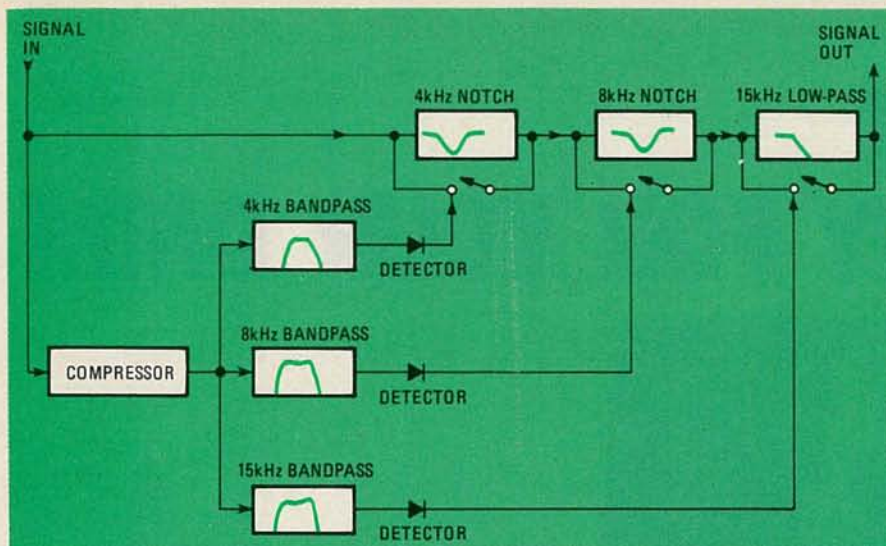


FIG. 5—THE THREE TO FIVE bands of attenuation in multiband notch filters are controlled by the energy in those bands.



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 further 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.

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

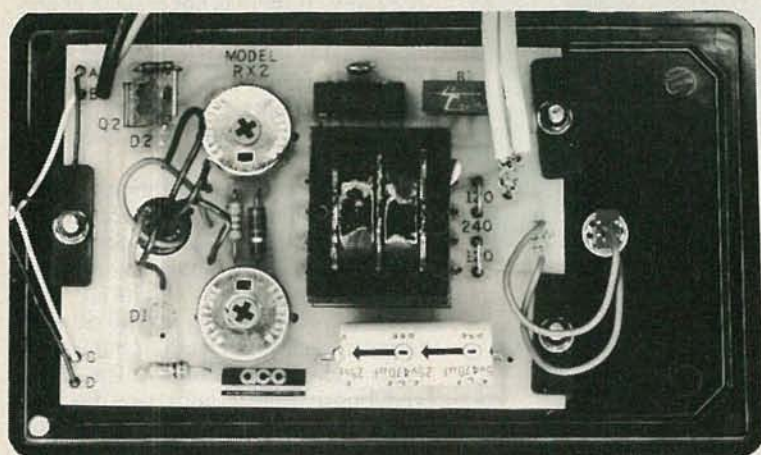
Phase Linear*
Model 1000 Series II
20121 48th Avenue West
Lynwood, WA 98036
Circle 98 on Free Information Card

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

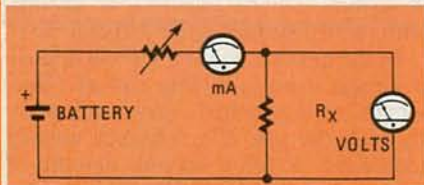


FIG. 1—THE VALUE OF R_x can be determined by passing a known current through it and measuring the voltage drop.

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.

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 ba-

nana-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 $\times 10$ range is for resistances of 0.01 to 10 ohms. On the $\times 100$ 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

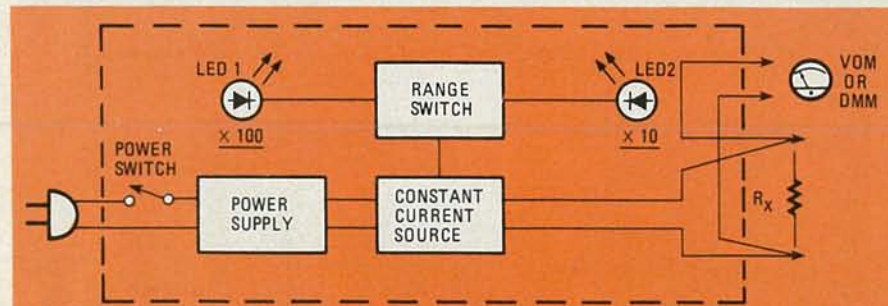
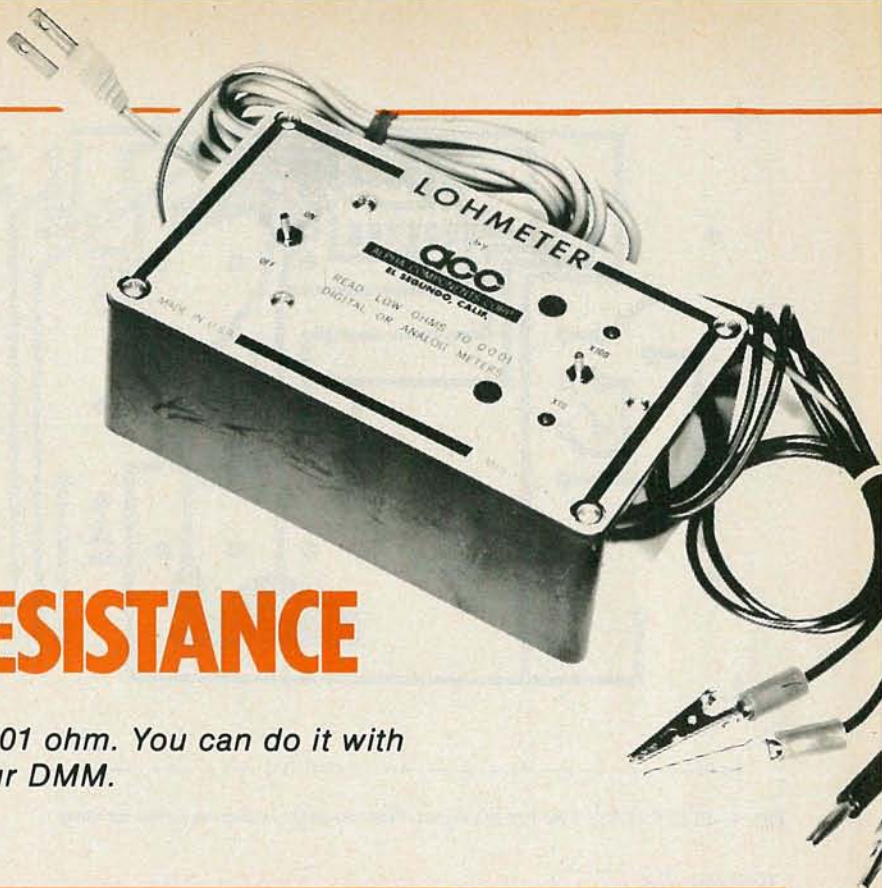


FIG. 2—BLOCK DIAGRAM of the Lohmeter. The current from the constant current source will not vary even if the line-voltage drops to 95 volts.

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 μ F, 15 volt electrolytic
C2—.001 μ F, 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.

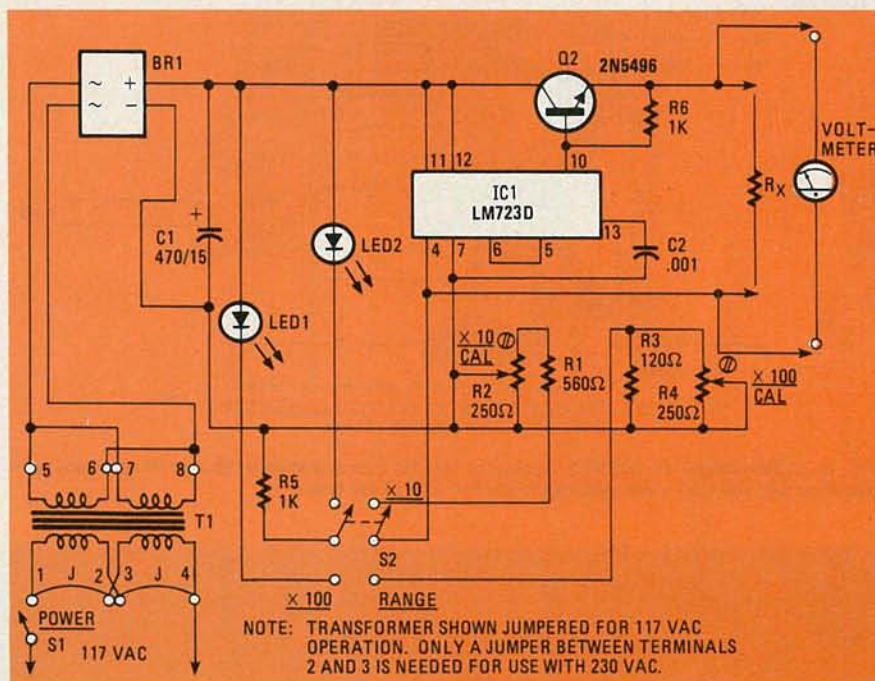


FIG. 3—A SCHEMATIC DIAGRAM of the Lohmeter. The test leads to R_x are two-conductor cables. The two resistance ranges are switch selectable and the LED's indicate which range is in use.

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

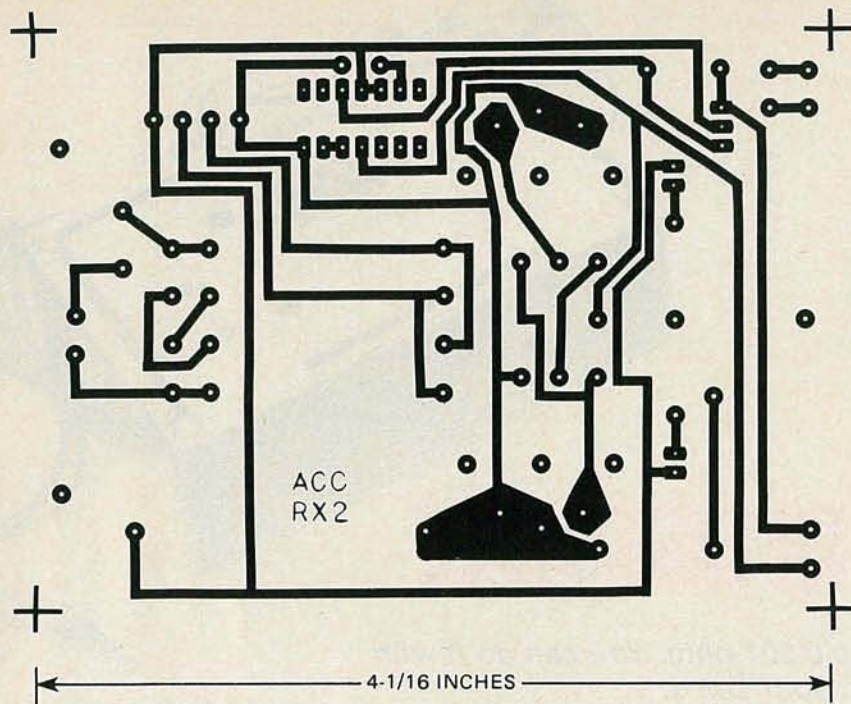


FIG. 4—FOIL PATTERN for the PC board. Point-to-point wiring may also be used.

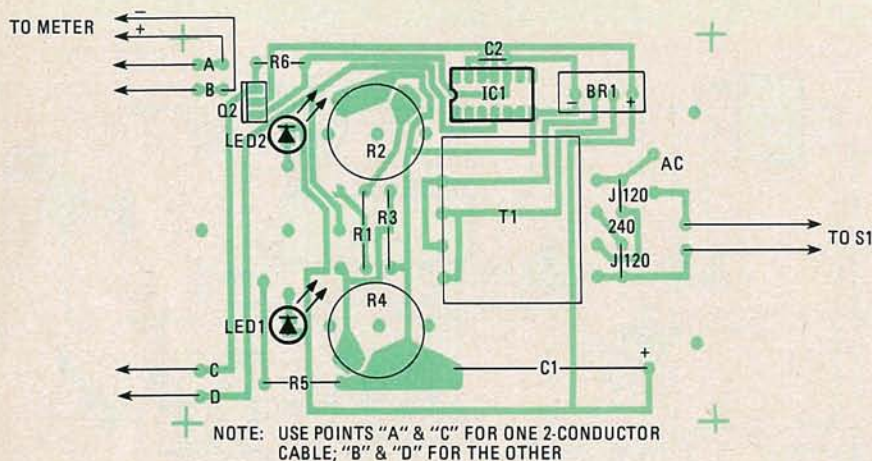


FIG. 5—COMPONENT PLACEMENT guide for the PC board. Switches S1 and S2 are front-panel mounted and the LED's are soldered to the foil side of the board.

TABLE 1

Unknown Resistance (ohms)	Range	Voltmeter Reading (volts)	Example
100 to 0.1	$\times 100$	1.0 to 0.001	1.0 volt $\times 100 = 100$ ohms 0.001 volt $\times 100 = 0.1$ ohm
10 to 0.01	$\times 10$	1.0 to 0.001	1.0 volt $\times 10 = 10$ ohms 0.001 volt $\times 10 = 0.01$ ohm
1 to 0.001	$\times 10$	0.1 to 0.0001	100 mV $\times 10 = 1.0$ ohm or 0.1 volt $\times 10 = 1.0$ ohm 0.1 mV $\times 10 = 0.001$ ohm or 0.0001 volt $\times 10 = 0.001$ 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 $\times 10$. Adjust R2 until you read 0.96 volts ($0.96 \times 10 = 9.6$ ohms). Change the range to $\times 100$ and adjust R4 to read 0.096 volts ($0.96 \times 100 = 9.6$ 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 $\times 10$ 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 $\times 100$. 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 $\times 10$ 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.

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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 1/2-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 Video Home System) which differs in several details from the Beta system. The two-hub VHS cassette is large enough to accommodate 800 feet of tape (also 1/2-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.

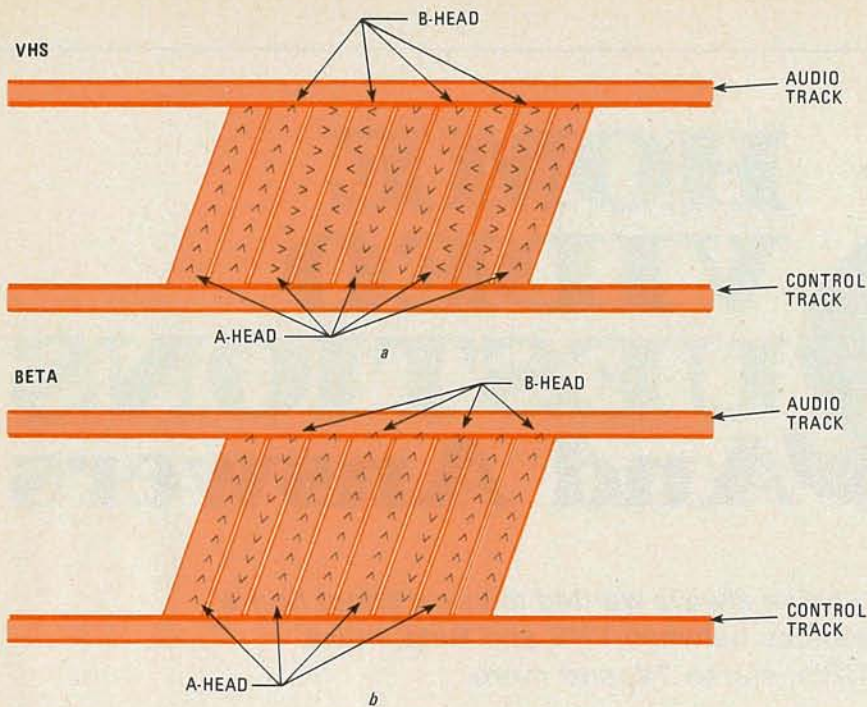


FIG. 1—A MAGNETIC PATTERN is laid down on a slowly moving tape by two rotating heads in both the VHS (shown in a) and Beta (shown in b) systems.

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 I 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

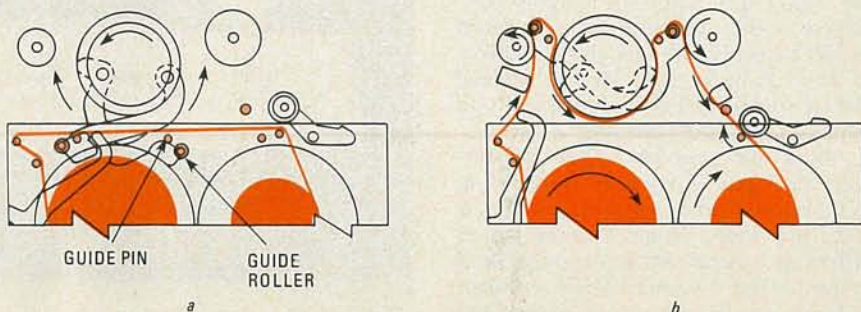


FIG. 2—M-LOADING, used in VHS systems, reduces head wear by not threading the tape (shown in a) except during playback and record operations (shown in b).

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

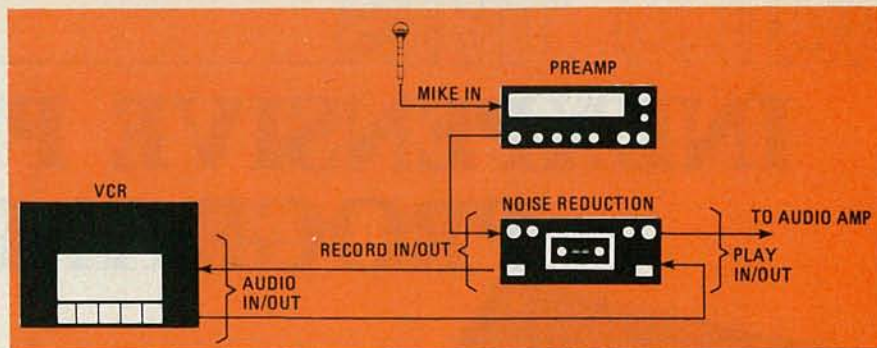


FIG. 3—NOISE REDUCTION in a VCR/camera combination is possible but a separate microphone and preamp must be used.

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.

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

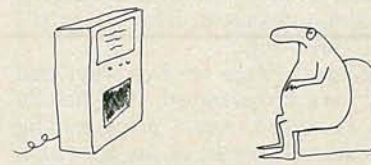
Indeed there are! Recently, Technicolor Audio Visual (a division of the company responsible for so many color movies) announced that, in cooperation with the Funai Company of Japan, it had developed a new type of video cassette recorder that weighs a mere seven pounds, complete with battery. It will 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 1/4-inch tape (instead of the 1/2-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**

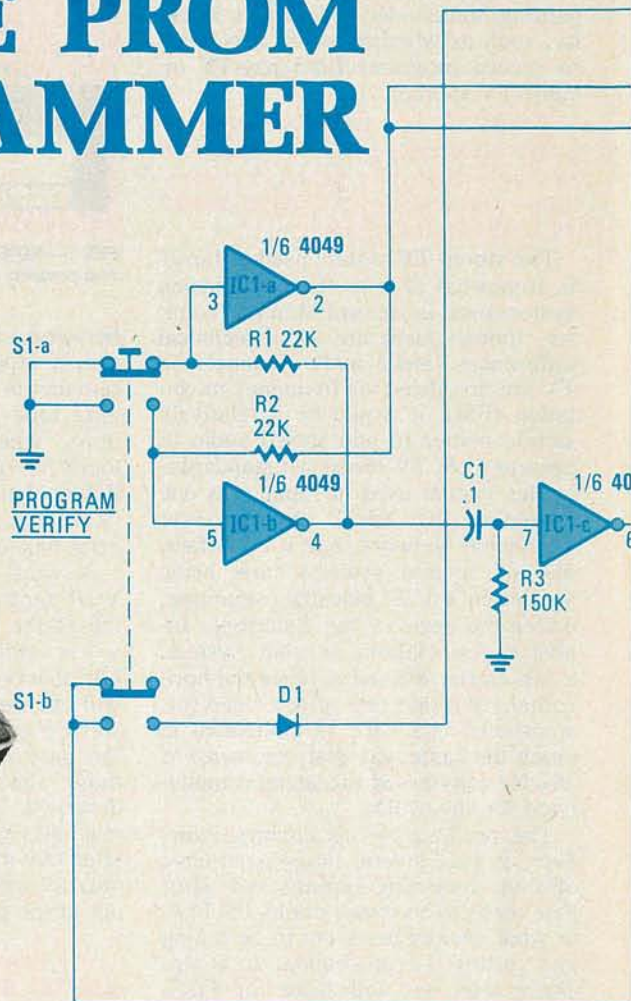


BUILD THIS

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 Read Only Memory).

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 (Programmable Read Only Memory). 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

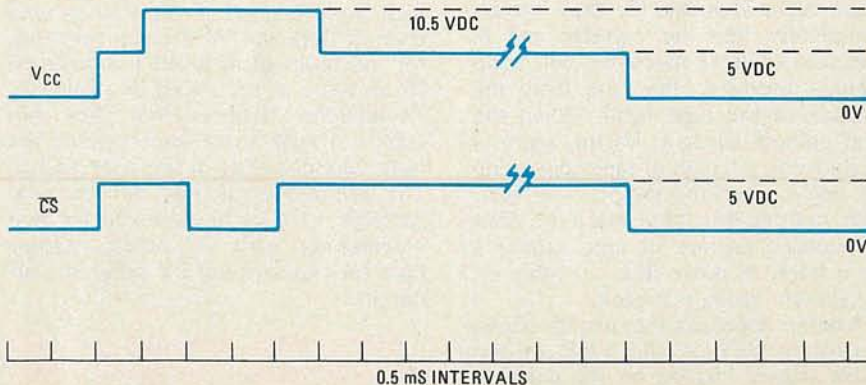


FIG. 1—TIMING SEQUENCE for programming a word of memory into the PROM.

Circuit description

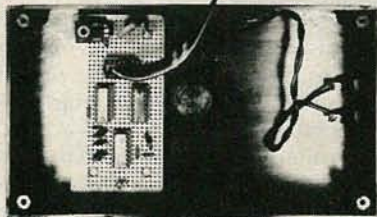
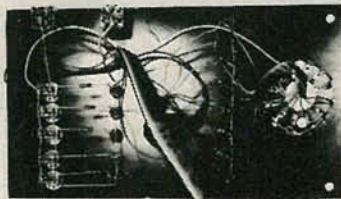
The main portion of the PROM programmer circuit is shown in Fig. 2. It uses two 4050 CMOS hex buffer/drivers, a 4049 CMOS hex inverter, one PNP power transistor and a five-volt regulator, such as an LM309 or LM340.

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, 1/2-watt, 10%

R22—1600 ohms

R23—220 ohms

Capacitors

C5—250 μ F, 25 volts, electrolytic

C6—.1 μ F, ceramic disc

C7—1 μ F, tantalum

Semiconductors

BR1—bridge rectifier, 50 PIV

IC5—LM317T, adjustable voltage regulator

T1—18 volts, one amp

Miscellaneous: construction board, wire, solder, etc.

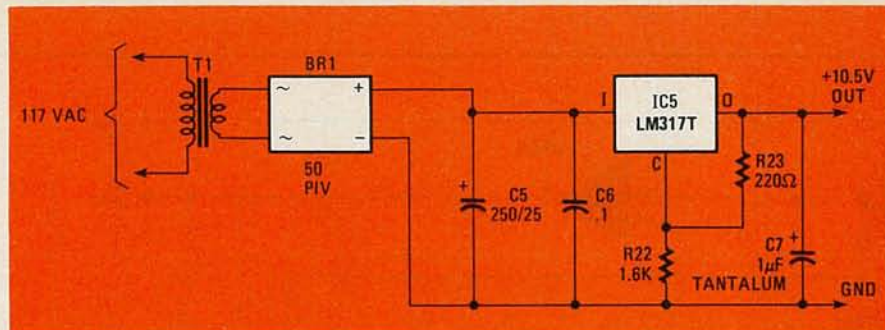


FIG. 3—SCHEMATIC DIAGRAM of the power supply for the PROM Programmer. It provides the 10.5 volts DC required to open the fusible links of the PROM.

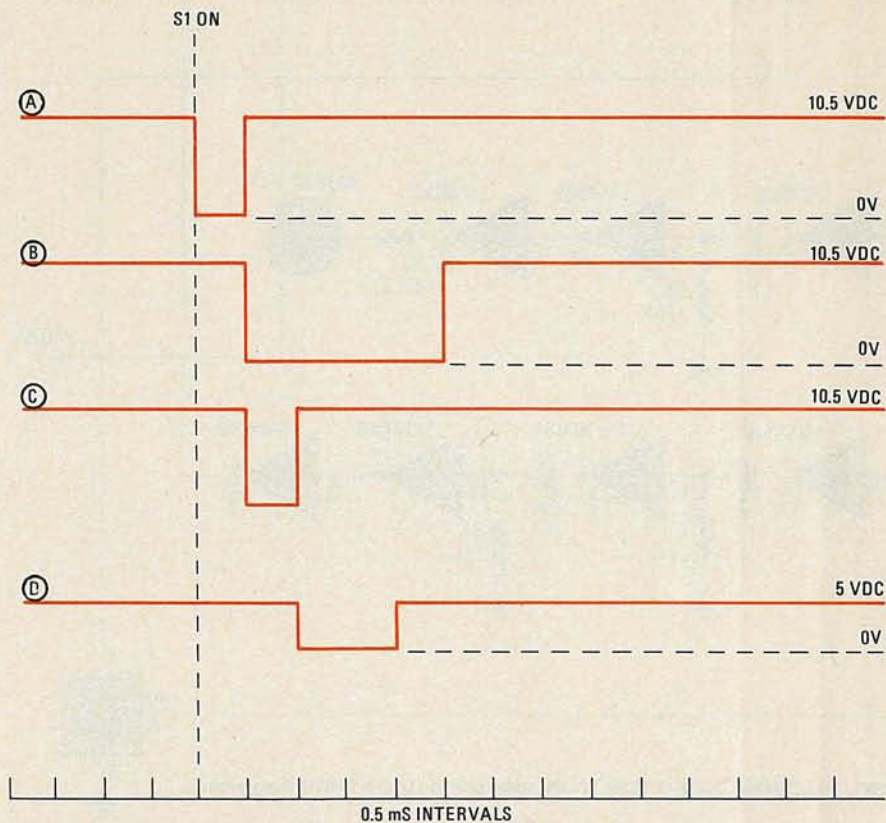


FIG. 4—TIMING DIAGRAM shows waveforms at specific points within the circuit. Circled letters correspond to circled letters in Fig. 2.

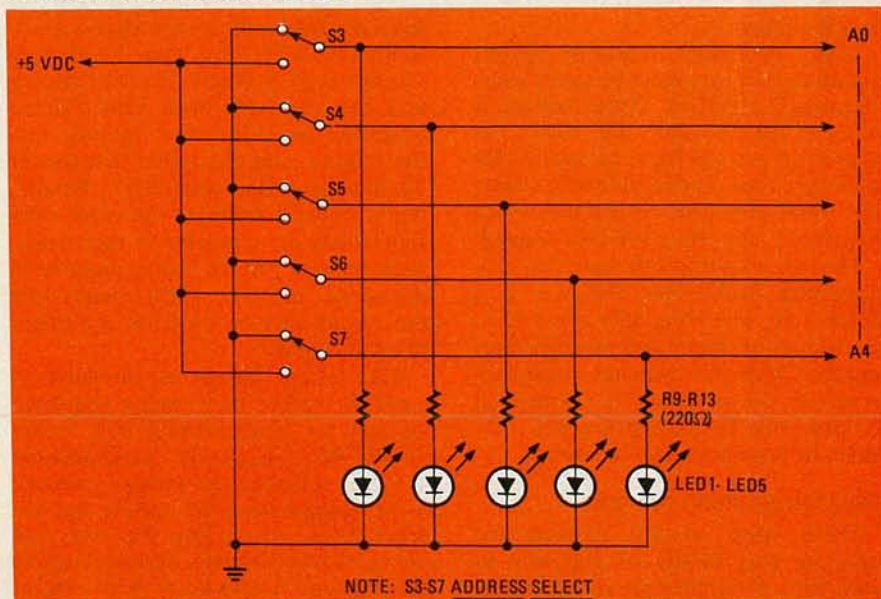


FIG. 5—PROM ADDRESSES are selected by five toggle switches and visual confirmation is provided by discrete LED's.

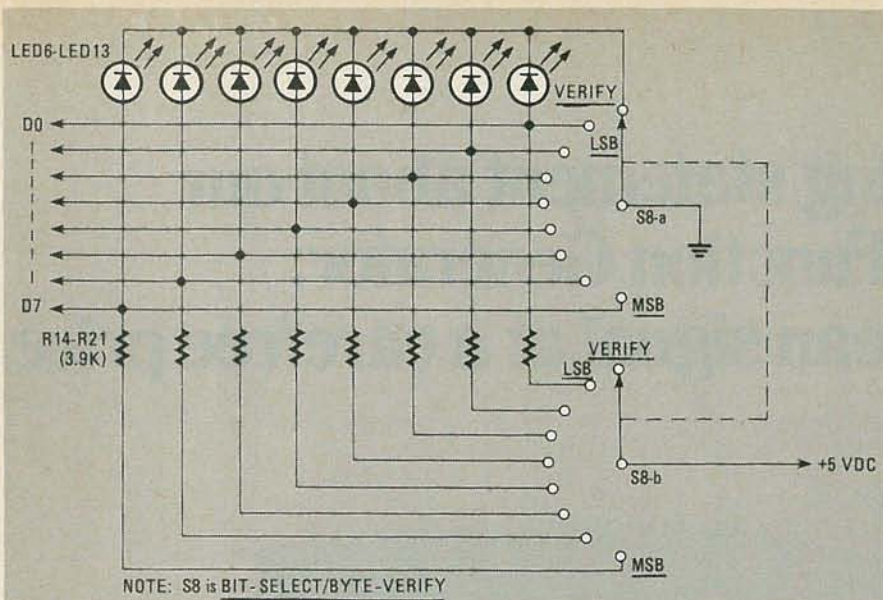


FIG. 6—A WORD IS PROGRAMMED sequentially one-bit at a time via a 9-position rotary switch.

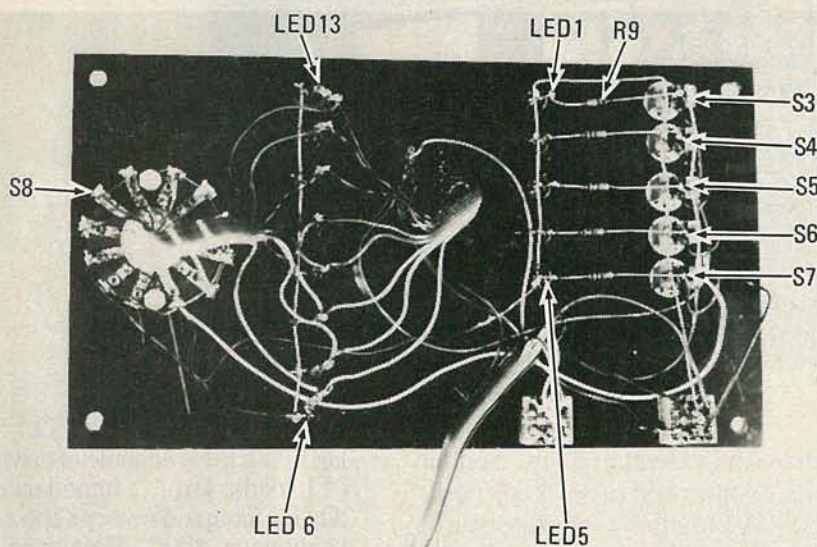


FIG. 7—PLACEMENT OF THE FRONT PANEL mounted components. Power switch S1 is located in the lower right corner and switch S2 is just to the left of S1. Connections to the PROM are made via a front-panel mounted DIP socket.

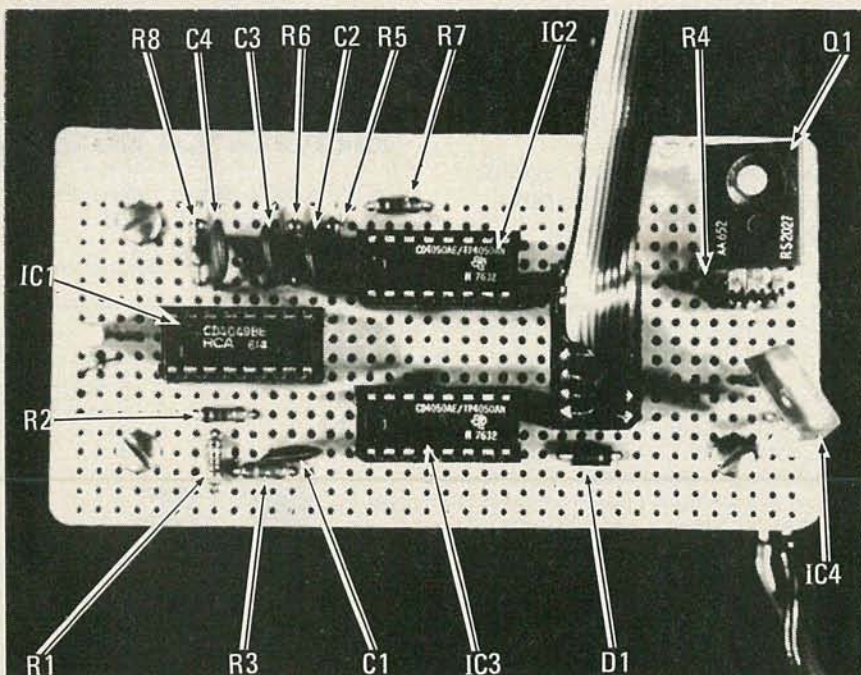


FIG. 8—THE PROTOTYPE used perfboard construction for the bulk of the circuitry.

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 verification 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.

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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 output 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).

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FEBRUARY 1981

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.

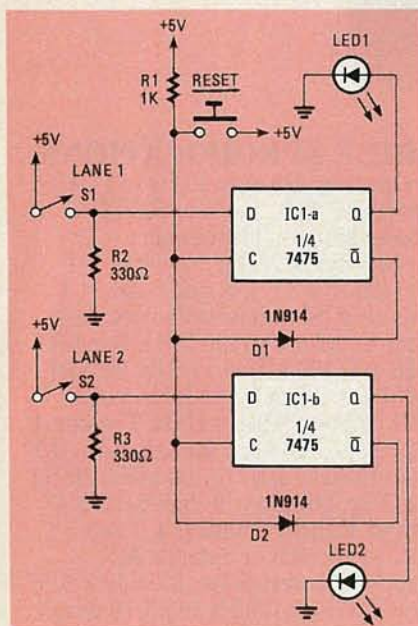


FIG. 1

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.
- \bar{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 LED₁ on.
- \bar{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, LED₁ is on and LED₂ 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 LED₁ stays on and LED₂ 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.

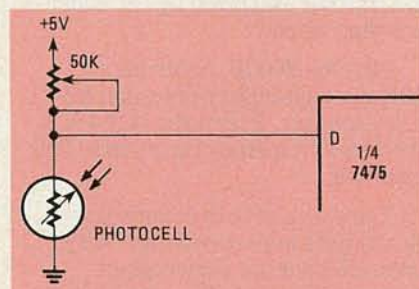


FIG. 2

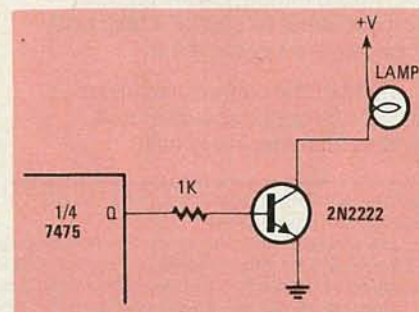


FIG. 3

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 mosquitoes 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

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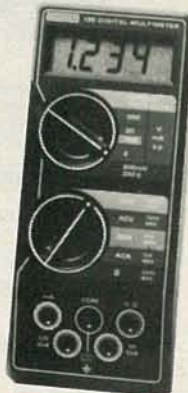
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	200mV, 2V, 20V, 200V, 750V	1%
DC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	2%
	AC CURRENT	
	2mA, 20mA, 200mA, 2000mA, 10A	3%
RESISTANCE	200 Ω , 2k Ω , 20k Ω , 200k Ω , 20M Ω	.5%

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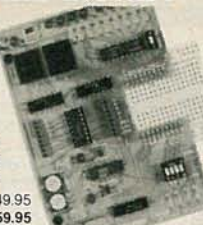
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CIRCLE 12 ON FREE INFORMATION CARD

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

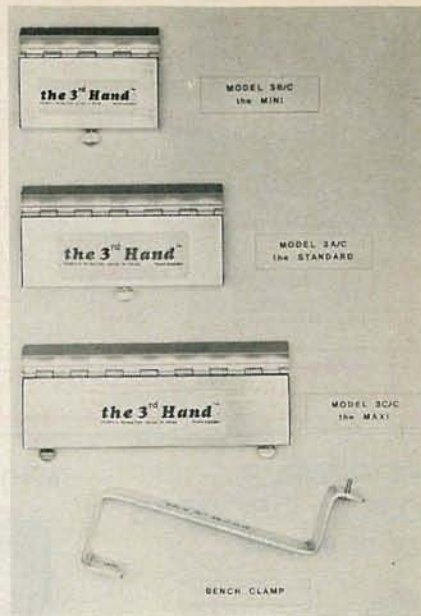


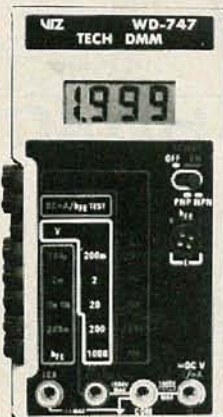
FIG. 5

fact that your boards slip in and out easily, they are held firmly.

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

VIZ LCD Digital Multimeter

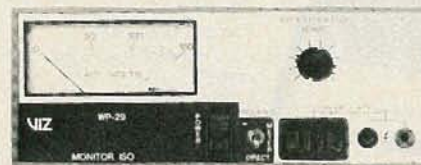


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new products

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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

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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.

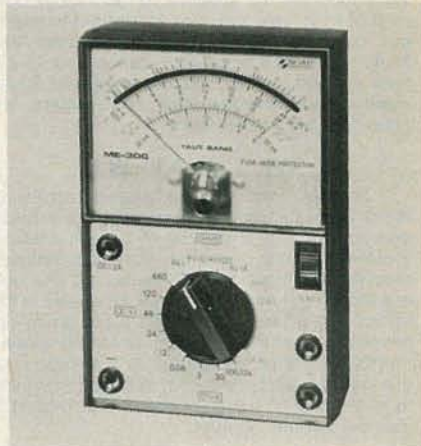
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Model 2401 Constant Speed Moto-Tool Kit with model 245 Moto-Tool, with constant-speed 25,000 RPM motor and shatter-proof housing, comes with built-in hanger and 14 accessories.

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-measure-



ment 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 $\pm 4\%$ AC and $\pm 3\%$ DC. The meter movement and PC board are protected against burnout by diodes, a fuse, and a fusible link. Price is \$38.00.—SOAR Electronics Corp., 200 13th Ave., Ronkonkoma, NY 11779.

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ing it easier to read when used in hard-to-reach places. This compact, lightweight unit features a jaw-width capacity of 1½ 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.

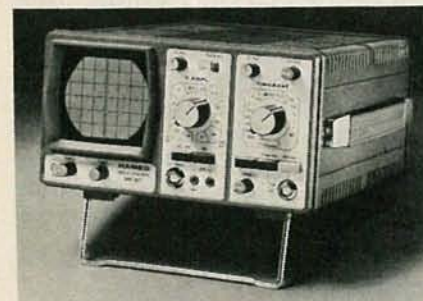


CIRCLE 154 ON FREE INFORMATION CARD

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 sensitivity 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**



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FEBRUARY 1981

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

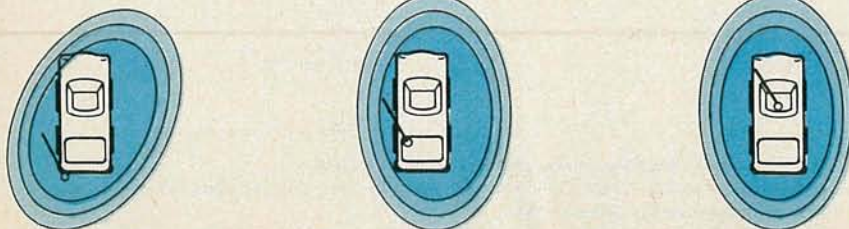
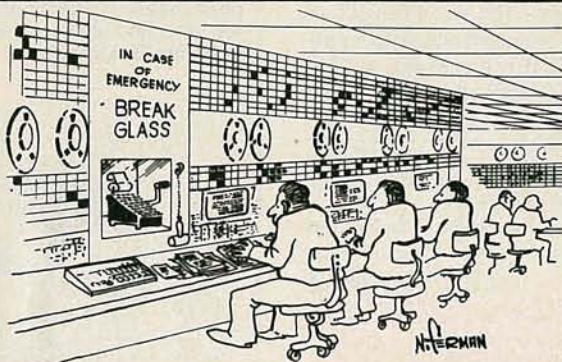


FIG. 1

(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



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CIRCLE 42 ON FREE INFORMATION CARD

FEBRUARY 1981 87

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 (Binary Coded Decimal) 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

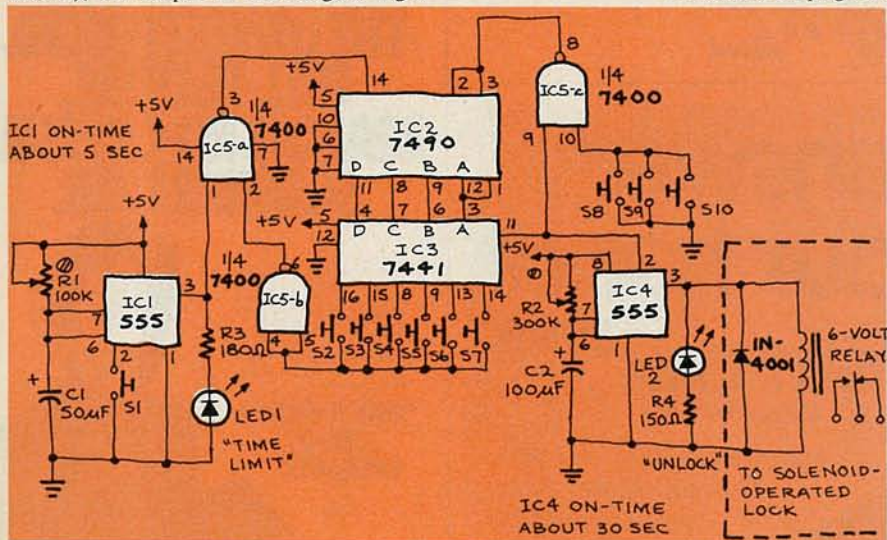


FIG. 1

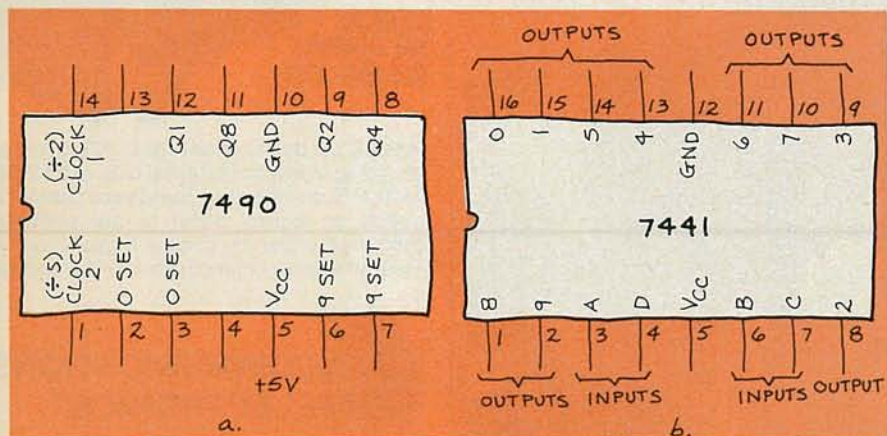


FIG. 2

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**.



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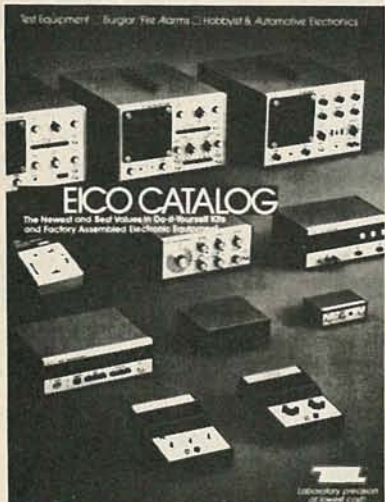
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CIRCLE 48 ON FREE INFORMATION CARD

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



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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

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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 F600, leaving 6000 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 (driver 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 origi-

nal 256 bytes located in the 8155A). The static RAM can be located anywhere from 6000 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).

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- 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

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- 177A LSI (SD) floppy disk controller.
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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 its 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- μ F capacitor rated at 400 volts. It promptly got very hot and burned up too. A 600-volt type did the same thing. A 4- μ F 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- μ F 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- μ F 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.)

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

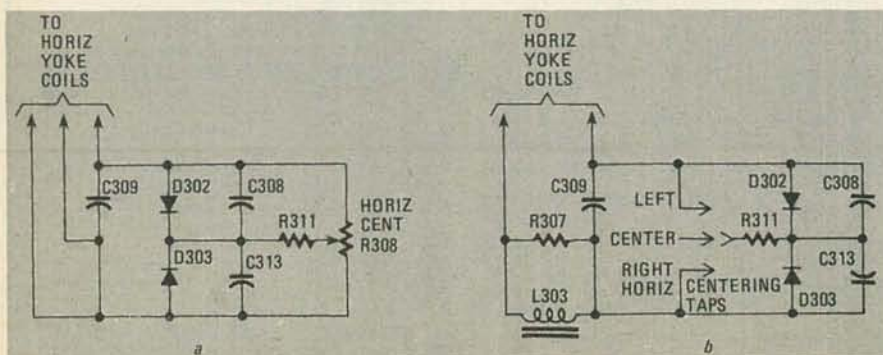


FIG. 1

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Linear Taper

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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 1/2 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

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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 x 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

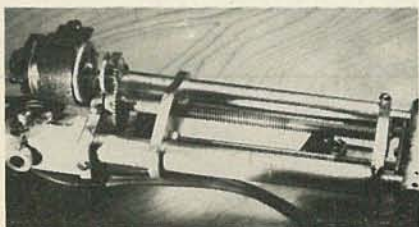


FIG. 63—COMPLETED EXTENDER ARM shows how new motor is attached and how it is connected to drive threaded rod.

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.

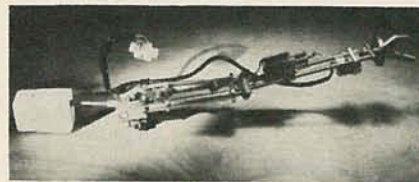


FIG. 64—LEAD COUNTERWEIGHT (left) is used if weight of entire arm assembly puts too much strain on shoulder motor.

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.

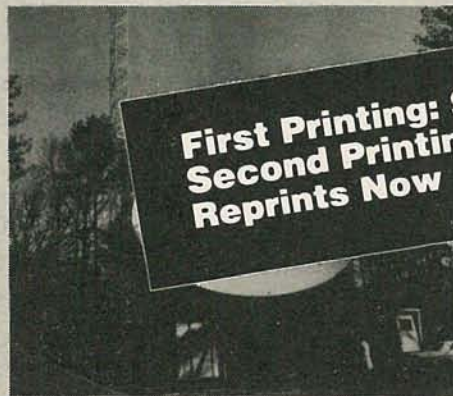
And, for everyone waiting to let his computer do the work, the relay-driver board will also accept instructions from the computer's parallel port.

Just wait till you see what's coming up!

R-E

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SERVICE QUESTIONS

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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.

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

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



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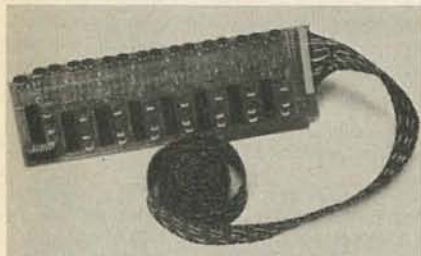
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APPLE COMPUTER ACCESSORIES, the *Applications Series*, is a line of devices designed for the *Apple II* computer. The *AI-02* Analog Input Card is a single-card data acquisition system with 16 analog channels. Each channel is monitored



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with 8-bit resolution. Channels are individually addressable and conversion time is 70 microseconds.

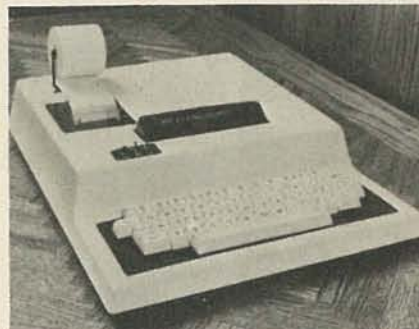
The Latched Analog Output Card, the *A003* (shown) is available in 2, 4, and 8-channel configurations. A program written in any language can

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



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two additional boards. Color is white with blue base. Price is \$49.94 plus \$2.50 for shipping and handling.—**Don-EI 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 modern interface it can be

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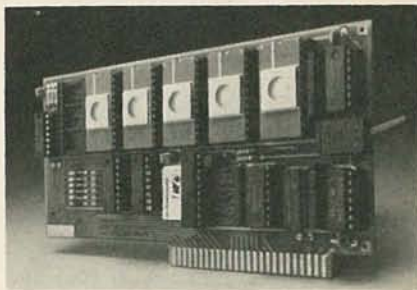
used as a remote terminal for timesharing services. With its floating-point math capability and "immediate-mode" operation, the computer can be used as a scientific calculator. The mini-floppy version, *C1P MF Series 2*, comes with a two-disk



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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.



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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

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7411	0.25		74LS42	0.82	74LS295	0.99	93S12	1.35	4001	1.35	4528	1.50	MC1711CP	0.39
7412	0.25		74LS46	0.64	74LS296	0.66	93S13	1.95	4002	0.35	4539	1.35	MC1741CG	0.35
7413	0.30		74LS48	1.05	74LS366	0.66	93S16	3.40	4006	1.19	4555	0.89	MC1748CP1	0.35
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7416	0.25		74LS51	0.34	74LS368	0.66	93S42	1.50	4008	1.05	4582	1.09	MC17805CT	1.20
7417	0.25		74LS54	0.34	74LS373	2.25	93S43	5.95	4009	0.49	4702	7.10	MC17806CT	1.20
7420	0.20		74LS55	0.34	74LS374	2.25	93S46	1.55	4010	0.49	4703	8.25	MC17808CT	1.20
7423	0.25		74LS73	0.45	74LS386	0.53	93S67	2.65	4011	0.35	4704	7.30	MC17812CT	1.20
7425	0.29		74LS74	0.45	74LS390	1.80			4012	0.25	4705	9.25	MC17815CT	1.20
7426	0.29		74LS76	0.52	74LS490	1.89			4013	0.48	4706	9.75	MC17824CT	1.20
7427	0.25		74LS78	0.48	74LS670	2.45			4014	1.05	4720	6.95	MC17812CT	0.77
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7442	0.59		74LS107	0.44	74S04	0.46	74C30	0.34	4022	1.05	40160	1.17	MS733A	0.66
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7451	0.20		74LS132	0.91	74S21	0.48	74C85	1.45	4031	3.25	40194	1.17	NE568A	1.20
7453	0.20		74LS136	0.48	74S22	0.46	74C86	0.49	4034	2.75	40195	1.17	NE568V	1.50
7454	0.20		74LS139	0.45	74S23	0.46	74C89	3.99	4035	0.99			NE569	0.98
7459	0.20		74LS139	0.82	74S32	0.70	74C90	1.10	4040	1.20			SE540L	6.00
7460	0.20		74LS151	0.75	74S40	0.45	74C93	1.10	4041	1.06			SN75451P	0.50
7470	0.29		74LS152	0.75	74S50	0.45	74C95	1.30	4042	0.99	75451BCT	50.50	SN75492N	0.52
7472	0.25		74LS158	0.84	74S51	0.46	74C107	0.69	4043	0.89	75492CP	0.52	UAK2111A	1.55
7473	0.35		74LS154	1.40	74S60	0.45	74C151	2.35	4044	0.89	DS7452N	0.52	WA311TC	0.85
7474	0.35		74LS155	0.89	74S64	0.48	74C154	3.00	4046	1.79	LM311N	0.85	WA324PC	0.35
7475	0.49		74LS156	0.89	74S65	0.48	74C157	2.06	4047	1.99	LM311V	0.85	WA555TC	0.35
7476	0.35		74LS157	0.75	74S74	0.78	74C160	1.17	4048	0.95	LM334N	0.75	WA556CT	0.90
7480	0.40		74LS158	0.75	74S76	0.78	74C161	1.17	4049	0.49	LM340T-5	1.20	WA709CV	0.28
7482	0.63		74LS160	1.05	74S78	0.78	74C162	1.17	4050	0.55	LM340T-6	1.20	WA709CT	0.28
7483	0.69		74LS161	1.05	74S86	0.78	74C163	1.17	4051	1.19	LM340T-8	1.20	WA710CA	0.29
7485	0.89		74LS162	0.98	74S112	0.78	74C164	1.17	4052	1.19	LM340T-12	1.20	WA710PC	0.29
7486	0.40		74LS163	1.05	74S113	0.78	74C165	1.17	4053	1.19	LM340T-15	1.20	WA711CA	0.39
7489	1.75		74LS164	1.15	74S114	0.78	74C173	1.29	4060	1.49	LM340T-24	1.20	WA711PC	0.39
7490	0.43		74LS168	1.45	74S132	0.95	74C174	1.15	4066	0.78	LM342P-12	0.77	WA733PC	0.66
7491	0.59		74LS169	1.45	74S133	0.95	74C175	1.15	4068	0.29	LM348N	1.25	WA741CT	0.35
7492	0.43		74LS170	1.80	74S134	0.98	74C192	1.37	4069	0.35	LM380N	0.95	WA741HC	0.35
7493	0.43		74LS173	1.33	74S135	0.99	74C193	1.37	4070	0.49	LM382N	1.00	WA748CV	0.35
7494	0.65		74LS174	1.20	74S138	0.97	74C196	1.17	4071	0.35	LM556CN	0.35	WA748CT	0.35
7495	0.65		74LS175	0.89	74S139	1.00	74C202	7.50	4073	0.35	LM566CN	0.35	WA7800LC	1.20
7496	0.65		74LS180	0.57	74S140	0.57	74C221	1.89	4075	0.35	LM566CN	1.20	WA1213PC	1.35
7497	2.00		74LS190	1.25	74S151	1.55	74C901	0.48	4076	1.29	LM566CN	1.50	WA7805UC	1.20
74100	0.45		74LS191	1.25	74S153	2.60	74C902	0.48	4077	0.69	LM567CN	0.98	WA7806UC	1.20
74101	0.45		74LS192	1.15	74S157	0.95	74C903	0.79	4078	0.45	LM7000N-8	0.28	WA7806UC	1.20
74121	0.34		74LS193	1.15	74S158	1.55	74C904	0.79	4081	0.35	LM710CN	0.29	WA7812UC	1.20
74122	0.39		74LS194	1.35	74S174	1.90	74C905	6.00	4085	0.79	LM711CN	0.39	WA7815UC	1.20
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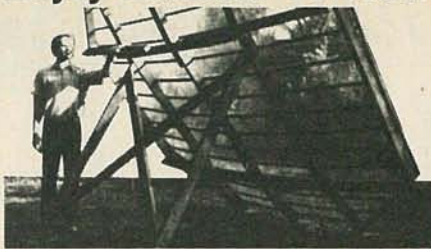
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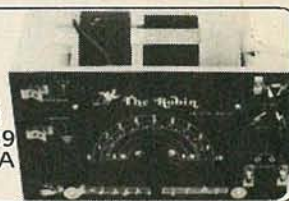
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The CT-90 is the most versatile, feature packed counter available for less than \$300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count 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 \$99⁹⁵ 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
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7 DIGITS 500 MHz \$79⁹⁵ WIRED



PRICES:

MINI-100 wired, 1 year warranty	\$79.95
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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 \$159⁹⁵ WIRED



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
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DIGITAL MULTIMETER \$99⁹⁵ WIRED



PRICES:

DM-700 wired, 1 year warranty	\$99.95
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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:	100uV to 1 KV, 5 ranges
DC/AC current:	0.1 uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
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79⁹⁵

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**
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Miniature SPST DIP Switches

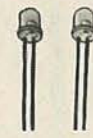


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Perfect for digital or low current applications. .100 x .300" DIP centers. Socket or PCB mounting.

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One red, one green. Mount quickly in 1/2" dia. hole. Long 4" leads. Long-life bulbs included. **272-332** **Pkg. 2/1.89**

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Stereo Reverb Project-Board™



NEW!
9⁹⁵

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**

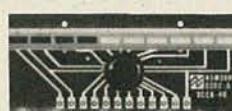
Submini 5-Volt DIP Relays



A **2⁹⁹**
B **4⁴⁹**

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LED VU Meter Module



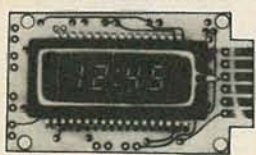
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- Ultra-Fast
- Pre-Wired!

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Great audio system "upgrader"! 10-element red display has moving point or bar graph option. Requires 12VDC. With applications data. 2x7/6x7/32". **277-1009** **9.95**

12-Hour Auto Clock Module



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± 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**

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3⁵⁹

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Semiconductor Guide

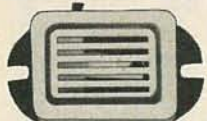


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Adjustable over 0-37V range.

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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: 1V max.
- Power supply: $\pm 40V @ 5 \text{ amp}$



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
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- Minimizes speaker/room non-linearities
- Frequency response from 30Hz to 16KHz
- 10 tone controls plus defeat, monitor and tape selector.
- Control range $\pm 12\text{dB}$ 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: $-65\text{dB} \pm 3\text{dB}$
FREQ. 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 $+5\text{dB}$. 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 3 1/2", 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 to $+3\text{dB}$. 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



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 illumination 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 Supply 6 18V DC

ONLY \$6.00 EACH

PROFESSIONAL PANEL METERS



- A. 0-50UA 8.50 ea.
- B. 0-30VDC 8.50 ea.
- C. 0-50VDC 8.50 ea.
- D. 0-3ADC 9.00 ea.
- E. 0-100VDC 9.00 ea.

All meters white face with black scales. Plastic cover.

SPECIAL 0.5" LED ALARM CLOCK MODULE

ASSEMBLED! NOT A KIT!

- 4 digits 0.5" LED Displays
- 12 hours real time format
- 24 hours alarm audio output
- 59 min. countdown timer
- 10 min. snooze control.



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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 $P_o = 0.1W$ 30K Ω
Power band width 20HZ~20KHZ
Freq. response 10HZ~100KHZ
Output resistance = 8 Ω

With built in protection circuit.
All units come with data sheet.

PART	OUTPUT (W)	SUPPLY VOLTAGE	PRICE
STK040	10W+10W Stereo	$\pm 16V$ D.C.	\$14.50
STK041	15W+15W Stereo	$\pm 20V$ D.C.	\$18.50
STK043	20W+20W Stereo	$\pm 22V$ D.C.	\$22.50
STK054	23 WATTS	$\pm 23V$ D.C.	\$13.50
STK056	30 WATTS	$\pm 22V$ D.C.	\$18.50
STK050	50 WATTS	$\pm 35V$ D.C.	\$26.50
STK070	70 WATTS	$\pm 42V$ D.C.	\$32.50
STK1050	100 WATTS	$\pm 50V$ 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 6 1/4" long. With a standard FM radio, can be heard anywhere on a one-acre lot; sound quality was judged very good.

\$16.50

FLASHER LED

Unique design combines a jumbo red LED with an IC flasher chip in one package. Operates directly from 5V-7V DC. No dropping resistor needed. Pulse rate 3Hz @ 5V 20mA.

2 for \$2.20

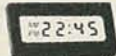
BIPOLAR LED RED/GREEN

2 colors in one LED, green and red, changes color when reverse voltage supply. Amazing!
2 FOR \$1.60

LCD CLOCK MODULE!

- 0.5" LCD 4 digits display
- X'tal controlled circuits
- D.C. powered (1.5V battery)
- 12 hr. or 24 hr. display
- 24 hr. alarm set
- 60 min. countdown timer
- On board dual back-up lights
- Dual time zone display
- Stop watch function.

NIC1200 (12 hr) \$24.50 EA.
NIC2400 (24 hr) \$26.50 EA.



SANYO UHF VARIATOR 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 2 1/4" x 1 1/4" x 3/4". 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

FLUORESCENT LIGHT DRIVER KIT



With Case Only
\$6.50 Per Kit

12V DC POWERED
Lights up 8 ~ 15 Watt Fluorescent Light Tubes. Ideal for camper, outdoor, auto or boat. Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board, light tube not included!

SUPER FM WIRELESS MIC KIT — MARK III



FMC-105
\$11.50 PER KIT

This new designed circuit uses high 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.

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT



EXCLUSIVE!! \$3.95 ea
Model F-179

Never worry about battery, because it has none! Easy to carry in pocket and handy to use. Ideal for emergency light. It generates its own electricity by squeezing grip lever. Put one in your car, boat, camper or home. You may need it some time!

ELECTRONIC DUAL SPEAKER PROTECTOR



Cut off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.

KIT FORM
\$8.75 EA.

"FISHER" 30 WATT STEREO AMP



Super Buy
Only \$18.50

MAIN AMP (15W x 2)
Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not included). Power band with (KF.1% ± 3dB). Voltage gain 33dB. 20Hz - 20KHz.

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 7/8" 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.
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2 BIT COUNTER, WARBLE PULSE ALARM BOARD



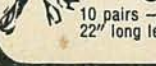
This new assembly easily converts to a counter, stop watch, warble and pulse alarm generator by adding a few components. We supply the data and typical applications. Requires 9V battery to operate.
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ILLUSTRATED
LESS COVER



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: 1 1/4" dia. x 7" long. New. Shpg. Wt. each pack, 1 lb.

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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

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SOUND ACTIVATED SWITCH



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±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.

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DPDT	\$1.80	
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ELECTRONIC SWITCH KIT

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SOCKETS FOR RELAY 50¢ each

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BRAND NEW
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SOCKETS FOR RELAY 50¢ each

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pulse rate 3hz @ 2v 20 ma

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24 VOLTS C.T. @ 200 mA \$1.65

PAY TV DECODER

continued from page 54

desired output frequency according to Table 1.

- Adjust the slug of L2 for a frequency of $4.50 \pm .05$ MHz.
- 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

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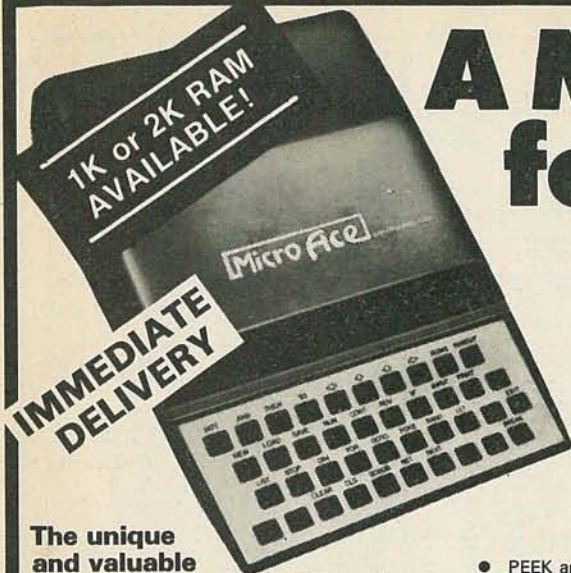
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No other personal computer offers this unique combination of high capability and low price.

The MicroAce teach-yourself BASIC manual.

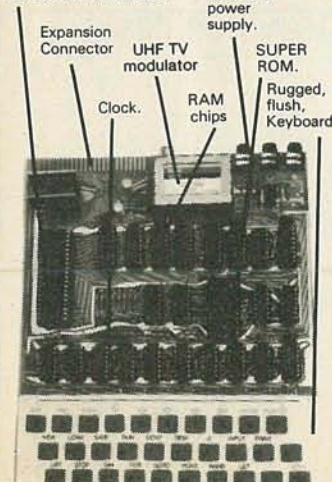
If the features of the BASIC interpreter mean little to you—don't worry. They're all explained in the specially-written book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming—from first principles to complex programs. (Available separately—purchase price refunded if you buy a MicroAce later.) A hardware manual is also included with every kit.

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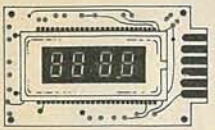
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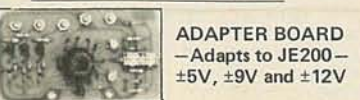
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MC6800A	Quad 3-State Bus Trans. (MC873P)	2.25

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Z80A (780-1)	CPU (MK3800N-4) (4MHz)	19.95
CDP1802	CPU	19.95
2650	MPU	19.95
IDM260LDC	CPU-4 Bit Slice (Com. Temp. Grade)	19.95
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FM805	CPU	19.95
IN5290	CPU-16 Bit	29.95
MM5900JL	MPU-16 Bit	19.95

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MM500H	Octal 80-Bit	9.95
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LM335Z	Temperature Transducer	1.40
LF736N	JFET Input Op. Amp	1.10
LF736N	Sample & Hold Amplifier	1.30
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CD4051	8-Channel Multiplexer	1.19
AY-6-833	2-Ch. D/A Conv.	5.95

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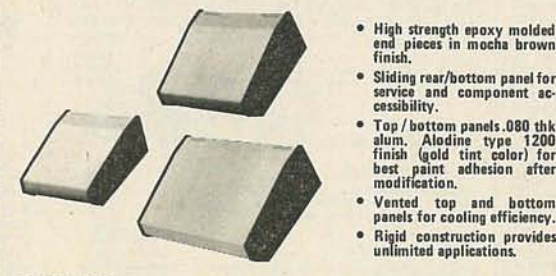
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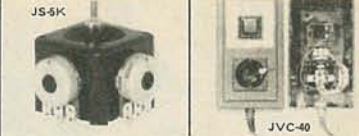
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74LS20	26	74LS165	65
74LS21	28	74LS170	175
74LS22	26	74LS174	75
74LS26	49	74LS175	75
74LS27	26	74LS190	75
74LS30	28	74LS193	95
74LS32	32	74LS195	95
74LS38	32	74LS196	85
74LS42	65	74LS221	140
74LS48	78	74LS240	165
74LS51	25	74LS241	165
74LS54	35	74LS243	145
74LS74	38	74LS244	145
74LS75	60	74LS245	225
74LS83	44	74LS253	95
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74LS86	95	74LS258	95
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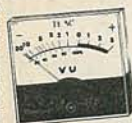
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7pf	33pf	82pf	180pf	470pf	.0015uf	.015uf
10pf	47pf	100pf	220pf	600pf	.003uf	.022uf
1pf - .050uf	.1uf					
Total	EA.	PK-10	PK-100	EA.	PK-10	PK-100
1-1000	\$.20	\$.95	6.50	.25	1.25	9.00
1000-	.20	.85	6.00	.25	1.10	8.00

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CK-c2 5ea. of the above values \$11.50
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.0033uf	.15	.95	7.50	.068uf	.25	1.30
.0047uf	.15	.95	7.50	.1uf	.30	1.75
.0068uf	.15	.95	7.50	.15uf	.40	2.25
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solid dipped ± 20%

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.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. 5 ea. of above - \$37.50					

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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
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7406	.20	7576	.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
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7417	.20	7490	.59	74175	.85
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7425	.39	7492	.59	74177	.70
7426	.35	7493	.35	74180	.35
7427	.25	7494	.59	74181	1.85
7430	.20	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
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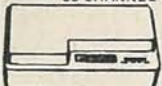
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5. ACCURACY: A choice of precision to ultra precision time base oscillators. Our ± 1 PPM TCXO (temperature compensated xtal oscillator) and ± 0.1 PPM TCXO are sealed units tested over 20-40°C. They contain voltage regulation circuitry for immunity 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 $\pm .05$ 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.

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10. CERTIFIED CALIBRATION: All models meet FCC specs for frequency measurement and provided with each model is a certificate of NBS traceable calibration.

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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 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 PACK
		STABILITY	AGING	DESIGN	10 Hz to 500 MHz	500 MHz to 1.1 GHz		12 MHz	60 MHz	Max. Freq.			
7010A	600 MHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	N/A	(3) 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (600 MHz)	YES OPTIONAL	NO	YES OPTIONAL
8010A	1.1 GHz	± 1 PPM	<1 PPM/YR	TCXO*	15 mV	30 mV	(4) 0.1, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.1 GHz)	YES STANDARD	YES	YES OPTIONAL
8010A	1.1 GHz	± 0.1 PPM	<1 PPM/YR	OCXO**	15 mV	30 mV	(4) 0.1, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.1 GHz)	YES STANDARD	YES	YES OPTIONAL
8013	1.3 GHz	± 0.1 PPM	<1 PPM/YR	TCXO*	15 mV	30 mV	(4) 0.1, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.3 GHz)	YES STANDARD	YES	YES OPTIONAL
8013	1.3 GHz	± 0.05 PPM	<1 PPM/YR	OCXO**	15 mV	30 mV	(4) 0.1, 1, 1, 10 sec	1 Hz	1 Hz	10 Hz (1.3 GHz)	YES STANDARD	YES	YES OPTIONAL

TCXO = Temperature Compensated Xtal Oscillator

**OCXO = Proportional Oven Controlled Xtal Oscillator

S 7010A		
A	600 MHz Counter - 1 PPM TCXO	\$199.95
1A	600 MHz Counter - 0.1 PPM TCXO	\$249.95
ACCESSORIES:		
	Handle/Tilt Bar (not shown)	\$2.95
	7010 Ni-Cad Battery Pack & Charging Circuitry Installed Inside Unit	\$19.95
	External Clock Input/Output	\$35.00
	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 - 0.05 PPM Oven	\$499.00
#8013 1	1.3 GHz Counter - 0.1 PPM TCXO	\$550.00
#8013 05	1.3 GHz Counter - 0.05 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	
#P-102	Audio Usage Probe, Hi-Z	\$16.95
#LFM 1110	General Purpose Low Frequency Multiplier X 10, X 100, X 1000	\$16.95
	For High Resolution of Audio Freq	\$119.95



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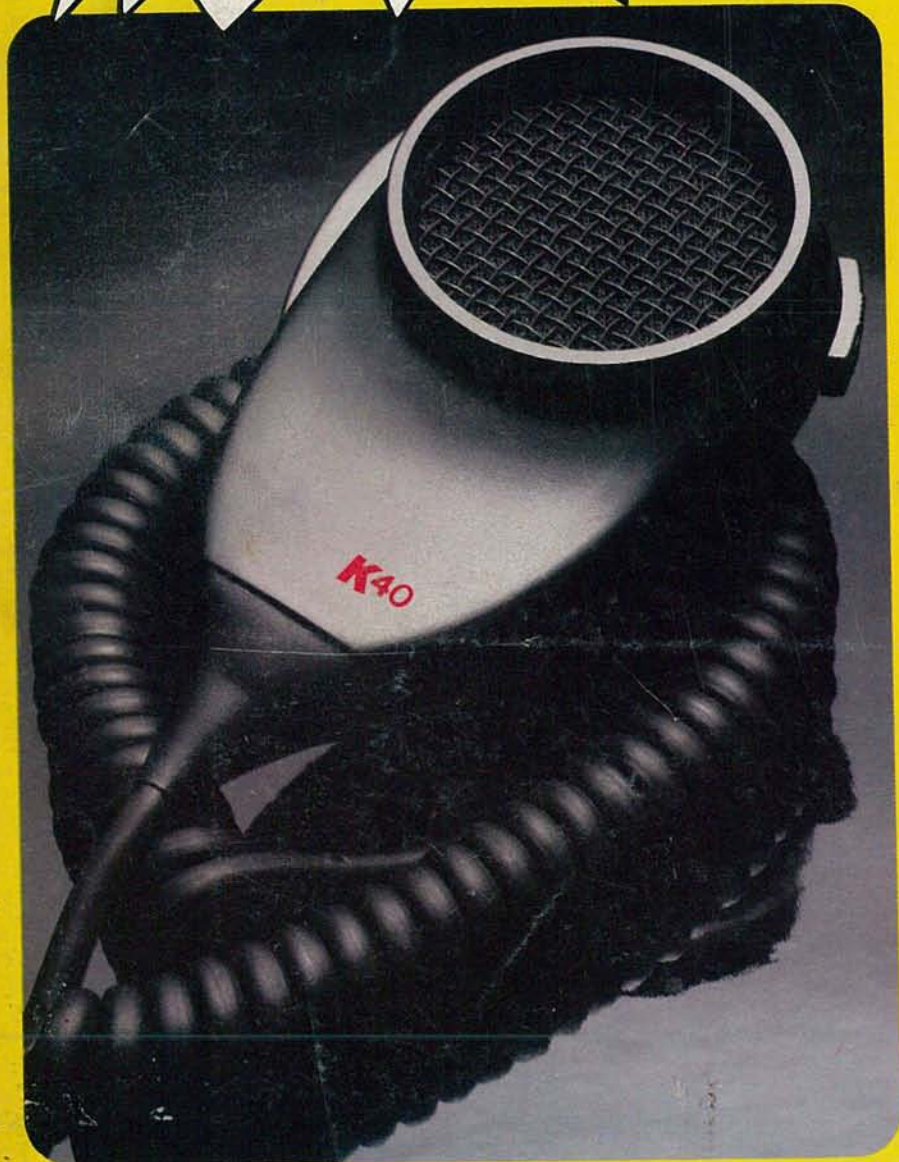
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- FRESH CHARGE WITH NO BATTERIES

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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.

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