GREAT GAMES YOU PLAY ON YOUR TV

75¢ ■ JUNE 1976

Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

LEARN SOMETHING NEW
★ Ball Lightning Experiments
★ Komputer Korner
★ About Function Generators

BUILD ONE OF THESE
★ Pong & Bumper
★ 8080 Computer

HI-FI STEREO
★ Hi-Fi Test Gear
★ R-E Lab Test Reports
Phase-Linear Preamp
Sansui Cassette Deck

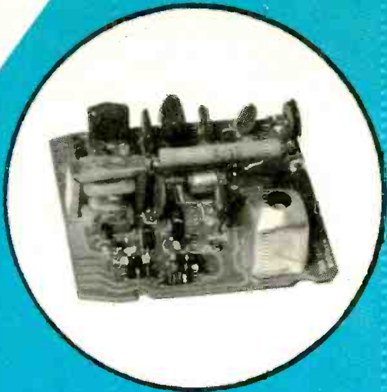
TELEVISION
★ Video Discs & Tape
★ Jack Darr's Service Clinic
★ Reader Problems Solved
★ Step-By-Step Troubleshooting
★ Equipment Reports

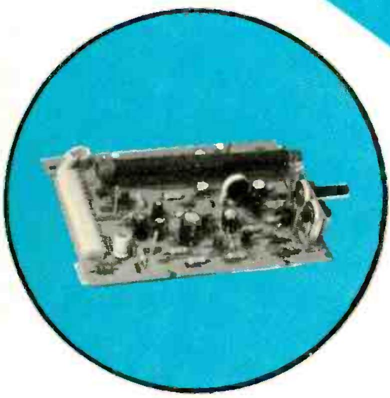
GERNSBACK PUBLICATION

CLIFTON
21
[redacted]

GIVE YOUR OLD MODULES

ANOTHER CHANCE





At PTS getting another chance means module rebuilding or exchanging at the lowest possible cost. Compare our prices to anyone else's. Another chance also means quality work in the least amount of time and our one year warranty. In addition to rebuilding, buying and exchanging modules we maintain an extensive inventory of replacement modules.

Module Rebuilding
$5.95 Up

PTS—FIRST IN TUNER SERVICE IS NOW FIRST IN MODULE REBUILDING

PTS HAS COMPANY-OWNED SERVICE CENTERS THROUGHOUT THE U.S. AND CANADA.

PTS

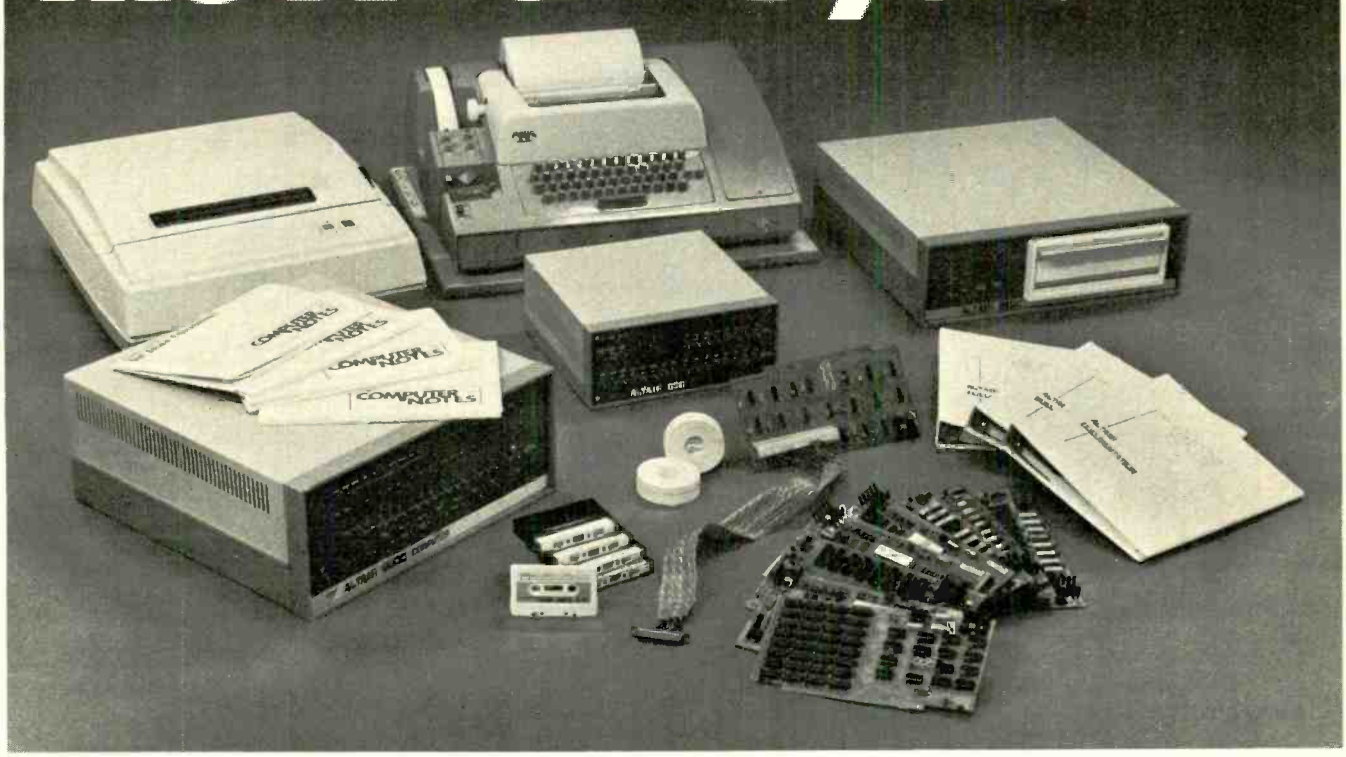
ELECTRONICS, INC.

PRECISION TUNER SERVICE

Consult the white pages of your telephone directory for the address and number of your nearest PTS Service Center. General Headquarters: Bloomington, IN - Birmingham - Phoenix - Los Angeles - San Diego - San Jose (CA) - Sacramento - Arvada (CO) - Jacksonville - Tampa - Indianapolis - Kansas City (KS) - Metairie (LA) - Silver Spring (MD) - Boston - Springfield (MA) - Detroit - Grand Rapids (MI) - Minneapolis - St. Louis - E. Paterson (NJ) - Buffalo (NY) - Long Island - Charlotte (NC) - Cincinnati - Columbus (OH) - Cleveland - Oklahoma City - Portland (OR) - Pittsburgh - Philadelphia - Montreal - Memphis - Houston - Longview (TX) - Salt Lake City - Norfolk - Seattle - Milwaukee.

Circle 1 on reader service card

Can anyone beat the Altair System?



We doubt it.

When it comes to microcomputers, Altair from MITS is the leader in the field.

The Altair 8800 is now backed by a complete selection of plug-in compatible boards. Included are a variety of the most advanced memory and interface boards, PROM board, vector interrupt, real time clock, and prototype board.

Altair 8800 peripherals include a revolutionary, low-cost floppy disk system, Teletype,™ line printer, and soon-to-be-announced CRT terminal.

Software for the Altair 8800 includes an assembler, text editor, monitor, debug, BASIC, Extended BASIC, and a Disk Operating System. And this software is **not just icing on the cake**—it has received industry wide acclaim for its efficiency and revolutionary features.

But MITS hasn't stopped with the Altair 8800. There is also the Altair 680—complete with memory and selectable interface—built around the new 6800 microprocessor chip. And soon-to-be-announced are the Altair 8800a and the Altair 8800b.

MITS doesn't stop with just supplying hardware and software, either. Every Altair owner is automatically a member of the Altair Users Group through which he has access to the substantial Altair software library. Every Altair owner is informed of up-to-date developments via a free subscription to **Computer Notes.** Every Altair owner is assured that he is dealing with a company that stands firmly behind its products.

After all, we didn't become the leader by messing around. Shouldn't you send for more information or visit one of our Altair dealers?

Altair Coupon

Please send me the following information:

☐ Your latest catalog and price list
☐ Software information package
☐ Please include a list of your dealers

NAME________________________

ADDRESS________________________

CITY________________ STATE & ZIP________

mits
2450 Alamo S.E. Albuquerque, N.M. 87106

To SBE

war·ran·ty

is not just another word

We at SBE have built our reputation on the quality and reliability of every single product we sell. To maintain the high standards we have set for ourselves, every SBE product is thoroughly tested to insure meeting our stringent quality control before shipment.

Our insistence upon "out-of-the-box performance" is best evidenced by the fact that every CB radio, every scanner, and all land/mobile and marine transceivers are checked and re-tested before they leave our factory.

Skilled technicians with intricate test equipment insure that every product manufactured receives this double check-out before the SBE "Quality-Assurance Personalized Seal" is affixed to each box. With that seal goes our guarantee, for a full year, that the SBE product will perform up to its specifications —from the sophisticated circuitry to the smooth-functioning controls.

It is just such quality control, coupled with our advanced technology and innovative engineering, that has made SBE a leader in the CB field. The Brute is just one more achievement in this development—a small but precision-built 23-channel transceiver incorporating all the features and performance of a full-size CB.

You can count on every SBE product and accessory for dependable performance and reliability. We have built our reputation on that!

SBE® **Better Communications through Creative Technology**

For information write: SBE, Inc., 220 Airport Blvd., Watsonville, CA 95076

INTERNATIONAL OFFICES: E. S. Gould Marketing Co. Ltd., Quebec, Canada/Linear Systems, S. A., Geneva 1, Switzerland

Circle 2 on reader service card

Radio-Electronics®

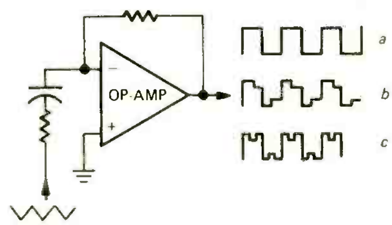
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

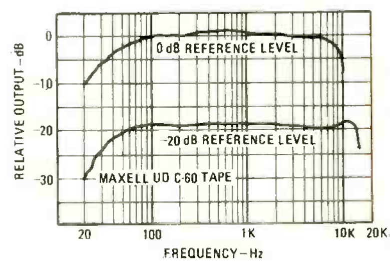
JUNE 1976 Vol. 47 No. 6

ON THE COVER

If you've been wondering how TV games work and how you might build your own, this is the answer. We're starting this 3-part story on page 35 of this issue. We think you'll like it.



USING A FUNCTION GENERATOR to check a differentiator is a snap. Learn how in the story starting on page 56.



PERFORMANCE OF SANSUI SC-3000 with high-output ferric tape. Get all the performance specs starting on page 50.

Radio-Electronics, Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Phone: 212-777-6400. Second-class postage paid at New York, NY and additional mailing offices. One-year subscription rate: U.S.A., U.S. possessions and Canada, $8.75. Pan-American countries, $10.25. Other countries, $10.75. Single copies 75c.

Subscription Service: Mail all subscription orders, changes, correspondence and Postmaster Notices of undelivered copies (Form 3579) to Radio-Electronics Subscription Service, Boulder, CO 80302.

looking ahead

CB bombshell

Just as the entire CB equipment industry was looking to the FCC for relief from overcrowding of the current 27-MHz band through addition of more channels — which had been an almost foregone conclusion—the Commission put the kibosh on the whole idea and decided to take a new look at interference problems caused by increasing CB use. Expansion of the current band from 23 to 40 or 50 channels thus is clearly out the window at least for the time being, and the odds may even favor the eventual movement of the band out of harm's way, far upstairs to 900 MHz.

The Commission has been increasingly disturbed by geometrically mounting complaints of interference by CB equipment with television and radio receivers, including CB receivers themselves. Under the FCC's original plan to expand from 23 to 50 channels, one of the immediate problems posed was that the difference between any two channels came out to a magic number—455 kHz, which, of course, is the second IF frequency used in all AM radios, including CB. This, combined with other interference problems, added up to such a headache that the Commission decided to take another look at the whole thing.

Now this doesn't mean the end of communicating on the existing band. The Commission presumably will allow plenty of time for current equipment to wear out before moving everything upstairs—or whatever it does. But it does mean CB'ers will have to live within the current 23 channels for some time.

The FCC also approved a new CB licensing program which could eliminate those endless waits for that vital document that is necessary before you can legally push the talk button. Under the new plan, the CB dealer would give purchasers an application form incorporating a temporary license that is valid as soon as the application form is mailed to the FCC. That's the good news, such as it is. The bad news is that FCC Chairman Richard Wiley told a Congressional subcommittee he favors restoring the CB license fee from the current $4 to the former $20. At that rate, CB users would pay the FCC about $100 million a year, nearly twice the entire budget of this communications regulatory body. Hardly seems fair when you consider that the FCC also regulates the telephone company and all TV and radio broadcasters.

Weighty question

The National Bureau of Standards is looking for the answer to an age-old question: What's a portable? The television industry's answer—"anything with a handle"—apparently won't do, as NBS studiously attacks the problem of the maximum weight and bulk to qualify for the appelation. Just another boondoggle? Well, it may have some practical applications since the study is being conducted for the Federal Trade Commission that will use the results in its guidelines under the Warranty Act. Because many set manufacturers state that portables must be carried into the shop for warranty service, the Bureau's findings could affect future servicing policies. Wonder if they'll make a special classification for "hernia model?"

Betamax

Although Sony's Betamax home videocassette recorder has been on the market in color TV console form since late last year, it's now becoming available as a deck attachment—the first such deck designed exclusively for the consumer market. The deck is priced at $1,300, including an accessory digital timer. It is designed to record television programs while the viewer is away from home, or to record one program while another is viewed (since it has its own tuner). A one-hour cassette sells for $15.95, a new low for videotape. The secret of Betamax's tape conservation is the elimination of the guard-band between helical tracks.

Betamax will be phased into the United States gradually, market by market. It is being promoted as a "time-shift machine," to rearrange TV schedules according to the wishes of the viewer. No accessory camera is yet available. Some pre-recorded cassette educational courses are already available from Time-Life and are being offered to Betamax users.

Unlike Sony's highly successful educational-institutional U-Matic videocassette recorder that uses ¾-inch tape, Betamax employs ½-inch cassette tape. In answer to questions about the limitation of 60 minutes per cassette, Sony officials said they are developing a cassette-changer attachment as well as a longer-playing cassette.

Brainy turntable

The latest thing in turntables is the ADC Accutrac. It uses a wireless remote control to permit the user to select up to 24 programs on 13 separate tracks of an LP disc in any sequence. An infra-red generator in the pick-up arm scans the record surface. The beam scatters when it hits the closely spaced grooves within a selection, but is reflected back to a detector in the arm when it hits the smooth surface between selections. The remote transmitter has select, play, cue and reject controls. The price of the direct-drive turntable with automatic programming is $500.

A changer version, to be available next year, will let the user program selections and the order in which they're to be played from up to six different records. The concept could lead to a new type of jukebox that uses a few LP's instead of individual-selection records and which will search and locate any specific track selected by the coin-dropper.

New picture tube

That new Zenith color picture tube, reported here last month, will be introduced in a brand new 19-inch set series in August. It's a departure from standard tubes in that it's designed for automated production from glass to gun. The faceplate is a single piece of curved glass, as opposed to the traditional glass with a "skirt" or flange. This permits lower-cost glass production, automatic deposition of phosphors and more manufacturing precision. The deflection angle is 100 degrees, a compromise between the current 90 degrees and the power-consuming 110-degrees.

The tube has a new tri-potential gun with a second focusing grid that permits a spot size 60% smaller than the standard gun. This means, according to Zenith, that it can now produce high-resolution slot-mask color tubes in 19- and 25-inch sizes. The 19-inch version is about 2½ inches shorter than a conventional dot-mask 90-degree (delta-gun) 19-inch picture tube, but only about 0.6-inch shorter than the slot-mask 90-degree tube being used by most manufacturers (not including Zenith).

The net result may not be so obvious to the TV set buyer, but on first inspection the new tube provided a good clear and bright picture, comparable to other Zenith Chromacolor tubes. The prospect of complete automation of the picture-tube manufacturing operation, if realized, could eventually provide consumer benefits in terms of price and performance.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

new & timely

Diplomatic bugs and antibugs pose embassy health problems?

Radiation in some diplomatic headquarters may be great enough to create potential health hazards, according to recent newspaper reports. These state that the Ambassador to the Soviet Union, Walter J. Stoessel Jr., personally warned the Embassy staff in Moscow that Soviet microwave transmitters were beaming high levels of energy into the Embassy. Apparently there was no evidence that the levels were so high as to cause biological damage, but obviously the possibilities were significant enough to make a warning seem advisable.

It was believed at first that the Soviet transmissions were intended to activate listening devices planted in the Embassy. A later report, in *The New York Times*, states that "the electromagnetic waves are coming—both sides privately concede—not from Soviet equipment designed to eavesdrop on the Embassy, but from Russian machinery trying to jam American listening devices in the big embassy building. . . ."

The type of bugging that requires microwave transmission is usually carried on by planting passive devices tuned to a given frequency. They will then reradiate signals beamed to them on that frequency. In the famous bugging of the Great Seal hung over the desk of the U.S. Ambassador in Moscow, the device was a cylindrical chamber coupled to a 9-inch whip antenna, the system being resonant to 330 MHz. The front wall of the resonant chamber (approx. 3 inches in diameter) was a flexible metal diaphragm. Sound waves pressing against it changed the chamber dimensions slightly, causing the resonant frequency to vary from 330 MHz. Thus when a Soviet 330-MHz wave was directed at it, modulation by speech in the room would cause the resonant frequency to vary, reradiating more or less strongly as it approached and departed from the steady-state 330 MHz. Of course another strong signal at or near 330 MHz would have jammed the Soviet listening frequency, and it is that kind of jamming that is suspected in the present case.

Other kinds of bugging call for high microwave power. Theoretically, a high-power beam directed on a window pane and reflected to a receiver might carry intelligible information, much the same as the resonant chamber does. So far, no one has reported any successful experiments in this direction, but it is unlikely that successful experiments in such a field would be widely publicized.

Microwave emissions, though less dangerous than X-rays, can produce harmful biological effects, though enormous amounts of power would be necessary to build up dangerous levels more than a few yards away from the transmitting antenna.

New multi-media technique for prison health care

The University of Miami, in cooperation with the Department of Hospitals of Dade Co., FL, and the health systems department of Westinghouse Electric Corp., is engaged in a two-and-a-half year evaluation of a new health-care technique. The new technique combines two-way audio, television and medical data links for observation of symptoms and consultation with nurse practitioners to make medical aid available to medically isolated people.

Two-way audio-visual communication links are installed between Miami's Jackson Memorial Hospital and three institutions in Dade County—the main jail, the stockade and the women's detention center. Specially trained nurse practitioners staff the three jail clinics.

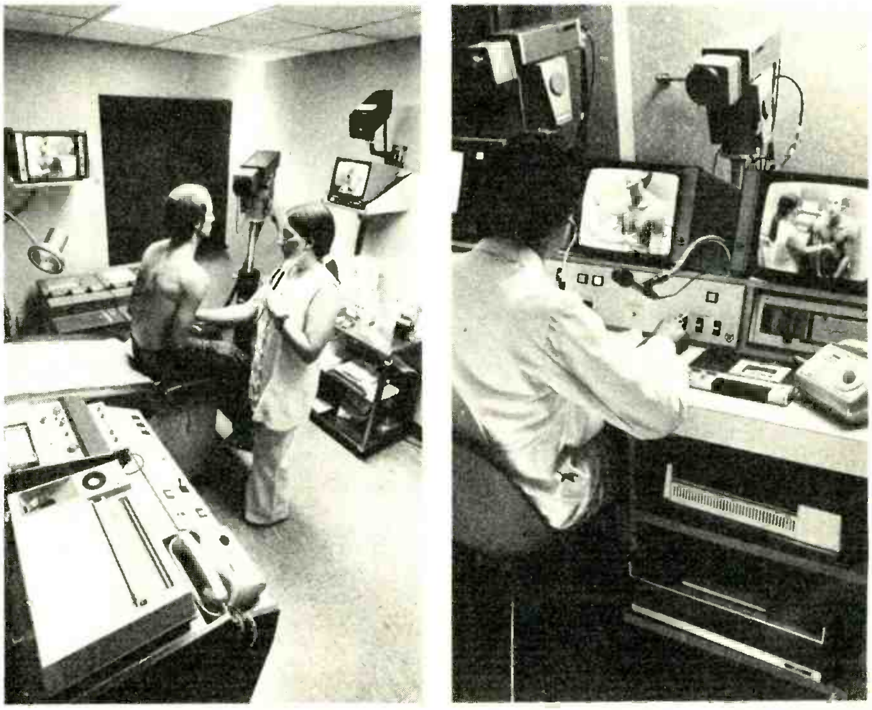
Three approaches are being evaluated, a black-and-white live TV system at the main jail, a slow-scan system with video stills transmitted over the ordinary phone line every 90 seconds at the stockade, and both live and slow-scan color TV at the women's center. Voice channels, electronic stethoscopes, electrocardiography (EKG) channels and facsimile transmitters assist in patient care.

All communication is two-way—the patient and doctor see and hear each other. The nurse also has a monitor with which she can see the picture received by the doctor.

This combination of facilities—none of them new in themselves—offers opportunities greater than have been possible with remote-care systems in the past. An example was a patient with chest pains, possibly due to a heart attack. An EKG was transmitted to the doctor who simultaneously listened to sounds from an electronic stethoscope that the nurse applied to the patient's chest and back as directed by the doctor. He was also able to watch the patient's facial expression and his neck veins as he stood up and lay down as directed while watching the EKG printout (that could have been transmitted by ordinary telephone). The result was a verdict of indigestion.

Probably most useful in isolated institutions, such as prisons, geriatric care facilities and remote military installations, this technique could also find wide use in the rural areas of developing nations.

(continued on page 12)



MULTI-MEDIA PATIENT CARE. (right) The doctor controls camera position and zoom, focus and brightness from his console, and can give instructions while receiving verbal, visual, stethoscopic, EKG and hard-copy medical information. (left) The patient can see, hear, and speak to the doctor—communication becomes face-to-face. The nurse can also see on her monitor the picture that the doctor is viewing.

now 3-strong

Xcelite® family of attaché tool cases

TC-150/ST

And here's the newest addition...Model TC-150/ST...containing an intermediate assortment of tools for the technician, serviceman, or field engineer. It contains 52 items in all, including 24 famous Xcelite "Series 99" interchangeable-blade tools, a broad variety of other Xcelite Professional screwdrivers, nutdrivers, pliers, cutters, strippers, measuring tapes, and specialized electronic tools, plus the Weller® Cordless Soldering Iron and recharger, an added convenience where outlets aren't accessible. Tools are mounted in see-thru pockets on removable pallets in a durable, attractive case with Whiskey-tan Marvelon exterior and sun-tan vinyl lining. Plenty of extra space for additional tools, prints and manuals! Solid brass hardware and padded handle are additional quality touches.

TC-100/ST

It joins the other fast-selling members of the family... Model TC-100/ST, the "big daddy" of Xcelite's cased tool sets, with the greatest variety—a total of 86 types and sizes of drivers, wrenches, pliers, cutters, strippers...and Model TC-200/ST, the 37-piece set that's unequaled in economy and value.

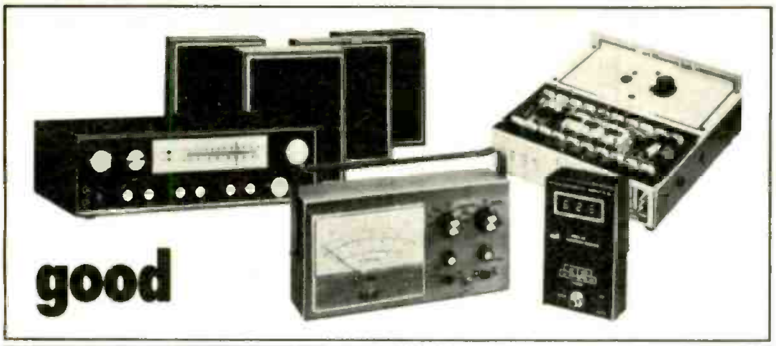
Request literature and prices right away...and stock up. Your customers will soon be asking about TC-150/ST and the other Xcelite Attaché Tool Cases.

TC-200/ST

COOPER INDUSTRIES

Weller-Xcelite Electronics Division
The Cooper Group
Apex, N. C. 27502

Circle 4 on reader service card



7 kits: Quadraphonic Stereo...

$445 or low monthly terms

A basic TV/Audio Servicing Course including 7 training kits for your experiments. You build your own 4-speaker Quadraphonic System, solid-state volt-ohmmeter, CMOS digital frequency counter, and electronics Discovery Lab. Includes 48 bite-size lessons (18 on color TV), 10 special reference texts with hundreds of servicing shortcuts, tips on setting up your own business, etc. This completely up-to-date course covers black & white and color TV, FM multiplex receivers, public address systems, antennas, radios, tube, transistor and solid-state circuits.

11 kits: Quadraphonic Stereo and B/W TV...$550

or low monthly terms

A complete course in B&W and Color TV Servicing, including 48 lessons (18 on color TV) 10 special reference texts and 11 training kits. Kits you build include 4-speaker Quadraphonic System, solid-state volt-ohmmeter, CMOS digital frequency counter, electronics Discovery Lab, plus a 12" diagonal solid-state black & white portable TV to build and use. At each assembly stage, you learn theory and "Power-On" application of that theory in typical solid-state TV sets.

11 kits: 19" diagonal Color TV...

$880 or low monthly terms

The course includes 42 lessons and 4 reference texts plus kits and experiments to build a superb solid-state 19" diagonal color TV receiver . . . complete with cabinet, and engineered specifically for training by NRI's own engineers and instructors. This handsome set was designed from the chassis up to give you a thorough understanding of circuitry and professional trouble-shooting techniques. You build your own solid state volt-ohmmeter, CMOS digital frequency counter, and experimental electronics Discovery Lab.

14 kits: 25" diagonal color TV and Quadraphonic Stereo...$1195.00

or low monthly terms

The ultimate home training in Color TV/Audio servicing with 48 bite-sized lessons, 10 reference texts, and 14 training kits . . . including kits to build a 25" diagonal color TV, complete with console cabinet; a 4-speaker Quadraphonic Center; a wide band, solid-state, triggered sweep, service type 5" oscilloscope; digital integrated circuit color TV pattern generator; a CMOS digital frequency counter, and an electronics Discovery Lab. This gives you thorough TV and Audio training for hundreds of dollars less than the separate courses you'd have to take elsewhere.

This Master Course combines theory with practice, using the "Power-On" stages for experimentation and learning. Building NRI's equipment will give you the confidence and ability to service any color TV or Audio unit on the market. And you'll have a magnificent TV and quad unit for years of trouble-free performance.

Pro Color: 19" diagonal color TV...

$665 or low monthly terms

An advanced Color TV Servicing Course for experienced technicians, 18 lessons, 5 new "Shop Manuals", and NRI 19" diagonal Color TV receiver with cabinet.

new & timely

(Continued from page 6)

Microcomputer interfacing workshop

A three-day workshop based on the popular 8080 microprocessor will be held September 23, 24 and 25, 1976. Sponsored by the Virginia Polytechnic Institute and State University, Extension Division of the Continuing Education Center in Blacksburg, Virginia, the course will include many hours of experience in programming and interface construction with over 12 operating microcomputers for participant use. For more information, contact Dr. Norris Bell, Virginia Polytechnic Institute and State University, Continuing Education Center, Blacksburg, VA 24061, or call 703-951-6328.

Buffalo TV stations plan to jam signals to Canada

A Canadian government decision to ban all foreign commercials on Canadian cable-TV systems has led to plans to prevent U.S. signals from entering Canada in usable form. Thus Canadian cable-TV receiving stations would not be able to pick up U.S. programs for transmission to their subscribers.

More than 40 percent of Canadian households subscribe to Canadian cable-TV, which is described as the fastest growing enterprise of its kind in the world. The reason is that the cable supplies U.S. network programs to thousands of people who are too far away from the border to receive U.S. television direct. Up to the present, the American stations have been quite happy with the situation since they could allow their large Canadian audience to be reflected in their advertising rates.

Deletion of the U.S. commercials from Canadian cable programs—presumably with the object of encouraging advertisers to use Canadian broadcast stations—would cut sharply into the revenues of the Buffalo stations. Therefore, WBEN-TV, WGR-TV and WKBW-TV have applied to the FCC for experimental license to erect a relatively low-power station that will transmit signals at frequencies sufficiently different from the frequencies of the Buffalo stations to superimpose a herringbone or "hash" pattern on them that would completely destroy their entertainment value.

The geography of the area is such that a station can be erected with a directional pattern that would jam practically all the signals going into Canada, while having practically no effect on New York areas.

The Canadians are—understandably—somewhat upset by the prospect, and at last accounts were studying international radio law to discover if etheric pollution of this type is illegal. But both Canadian TV viewers and American TV broadcasters were—at the time this was written—hoping for an amicable solution, possibly an arrangement by which the U.S. stations can share in the profits they feel they have created for the Canadian cable companies.

Marconi Fellowship goes to Japanese electronic engineer

Professor Hiroshi Inose of the University of Tokyo has been selected to receive the 1975 Marconi International Fellowship, an award of $25,000. The award, for his "contributions to mankind through research and development in the applications of electronic computers to practical problems," will be presented to him by Prince Philip, the Duke of Edinburgh, at the Royal Society of Arts in London in early May.

PROFESSOR HIROSHI INOSE

Professor Inose was nominated for the award by Dr. John R. Pierce, California Institute of Technology, and by the Communications Society of the IEEE.

Lab for laser energetics at University of Rochester

A $46.5 million Laboratory for Laser Energetics is being established at the University of Rochester (NY). It will be the first university-government-industry teaching and research center in laser and energy studies that will also be available to scientists all across the country.

The laboratory's principal instrument will be a 10,000-joule (a joule is a unit of energy equal to one watt applied for one second) neodymium glass laser system, which will be among the world's most powerful systems for fusion and energy research. The principal propect of the lab will be to explore the feasibility of controlled nuclear fusion as a clean, abundant future energy source.

Radio-Electronics®

Hugo Gernsback (1884-1967) founder
M. Harvey Gernsback editor-in-chief and publisher
Larry Steckler, CET, editor
Robert F. Scott, W2PWG, CET, technical editor
Arthur Kleiman, associate editor
Jack Darr, CET service editor
Leonard Feldman contributing high-fidelity editor
David Lachenbruch, contributing editor
Karl Savon, semiconductor editor
Vincent P. Cicenia, production manager
Donna L. Glass, production assistant
Harriet I. Matysko, circulation director
Sheila Wertling, circulation assistant
Arline R. Bailey, advertising coordinator

Cover photo by Walter Herstatt
Cover design by Louis G. Rubsamen

Radio Electronics is a member of the *Institute of High Fidelity* and is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature.*

Radio-Electronics magazine is published by Gernsback Publications, Inc.
200 Park Ave. S. New York, NY 10003
(212) 777-6400

President: M. Harvey Gernsback
Vice President: Larry Steckler
Treasurer: Carol A. Gernsback
Secretary: Bertina Baer

letters

MORE ON SOUND GUARD

After reading my story about Sound Guard, the new Ball Corporation record preservative (**R-E**, March, 1976), several readers have written to me regarding one point which was not specifically discussed in that article. Many disc enthusiasts wondered what would happen if they used one of the liquid record cleaning products on their discs after they had been treated with the new Sound Guard coating.

I have asked the people at Ball Corporation about this and, according to their experts, it is perfectly safe to use such liquid cleaners on records that have been Sound Guard coated. They point out, however, that such treatment is apt to be required less often since Sound Guard, in addition to its preservative function, also contains a small amount of anti-static material which should reduce dust attraction significantly. They also point out that Sound Guard is soluble in some of the commercially available record cleaning solutions and therefore may be partially or entirely removed from the surface of a disc when such additional cleaning solutions are used.

The makers of Sound Guard therefore suggest that after liquid cleaning of recordings, an additional protective coating of Sound Guard be applied for continued protection and preservation of the record surface.

LEONARD FELDMAN
Contributing Hi-Fi Editor

DIGITAL STOPWATCH

Several readers have written to us stating that they have had difficulty locating the Motorola MC14571 specified for IC5 of the Electronic Stopwatch in the November 1975 and February 1976 issues. This IC was a developmental type that has since been replaced by the MC14081.

Several errors have also popped up. Mr. Tyler tells us that the battery polarity is wrong in the calculator schematic (Fig. 1 of the article.) It should have been drawn with the negative side to ground.

The stopwatch schematic (Fig. 5 in the February 1976 issue) shows two pin-5's associated with IC2. The right-hand pin-5 connected to D3 of the 6-digit display should be pin-6. There are also two D1's shown in Fig. 5. Since all the diodes are the same type-number, this shouldn't cause too much of a problem.—*Editor*

WIFE TO BARDOT

Upon seeing the cover of the March, 1976, issue of R-E, specifically "Build One of These," ASCII To BARDOT Converter, I am anxiously awaiting my next issue that, I hope, will contain a WIFE To BARDOT project.

JOHN P. SCHOENHARL
Dayton, OH

Talk about novel ideas! If any of our more ambitious readers come up with a prototype for this, please submit it. We certainly would be interested. Maybe if all our readers pool their efforts. . . . —Editor

MINI VS. MICRO

I wish to express disagreement with J. Titus et. al., "Komputer Korner 2," Feb. 1976. They state that "microcomputers are not as sophisticated as some of the popular minicomputers and cannot easily perform certain types of data processing problems." They also imply that surrounding microcomputers with large amounts of input-output equipment is a waste of money. I disagree violently with them and feel that they should have mentioned that with $5000 worth of equipment, a microcomputer can usually perform the tasks that $10,000 systems by big-name manufacturers perform. This is not due to the quality of the microprocessor but is a result of the pricing structure of the big manufacturers. While flipping through the Digital Equipment Corporation's price list for PDP8A400 equipment, I find a real time clock for $320 whereas IMS has an 8080 clock for $138. A disk system costs either $11,000 or $1,500 depending on whether you want a mini or a micro.

ROBERT M. LOSEE
Chicago, IL

We still must say that it is not very wise to add a large amount of I/O equipment such as cassettes, floppy disks, etc. to a microcomputer. You may if you wish, but right now you'll spend most of your time waiting for delivery, assembling kits and debugging your system. Time is money. I think you'll find the final cost almost equal for mini and microcomputers.

I feel that the availability of software is what swings things finally to the side of the minicomputers for most data processing tasks. The PDP-8, PDP-11 and NOVA families have thousands of applications programs that just aren't available for the microcomputers. BASIC for the 8080 is a start but I have seen very few programs that really do anything.

Disks are available in the price range you mention, but I think that you'll find that floppy disks for both minis and micros are in about the same range.—Jonathan A. Titus

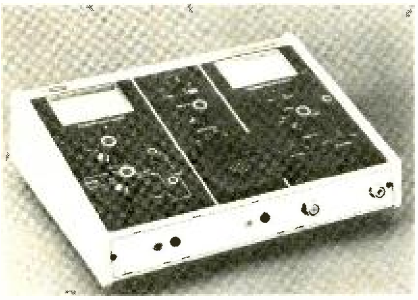
SERVICE MATERIAL

I am glad to have a chance to write to

(continued on page 88)

equipment reports

B & K MODEL 1040 CB SERVICEMASTER



Circle 88 on reader service card

CB RADIO IS GROWING. THE FCC WILL CONfirm that this is the understatement of the century. The sheer mass of the little radios has brought on a massive demand for service facilities. Two-way radio shops are already overloaded. So, this leaves the TV shop. They have the trained men and most of the test equipment. FCC Rules state that no one but licensed technicians can make adjustments to the transmitters that will "result in unlawful operation." Translated, this means excessive RF power output or off-frequency operation. However, in most of these sets the frequency adjustments are crystal-controlled and *sealed*. The finals are designed so that they cannot radiate more than the legal power limit. It is *not* illegal to *test* the transmitters for legal power output and modulation.

So, this leaves a lot of room for legal servicing of the receivers, power supplies, antenna installation, and similar troubles. Only a small number of specialized test equipment is needed to do this type of work. The B & K Division of Dynascan, 1801 West Belle Plaine Ave., Chicago, IL 60613, has come up with a new unit—the 1040 CB Servicemaster. With this instrument plus normal TV service equipment, the TV technician can make readings of RF power output, check for standing wave ratios (SWR), read receiver power output, test for modulation and distortion, and check practically everything about them. The model 1040 is an all-in-one compact package and very simple to use. It can be used for bench testing with its built-in AC power supply, or in a vehicle with battery power from the cigarette lighter socket.

As a matter of fact, this is a real "package deal." All you need is a few test cables to hook up the CB set to the 1040 and from then on it's all pushbutton testing. A very comprehensive manual comes with the instrument. This covers not only the uses of the 1040, but what they modestly call a "short course" in CB radio servicing. All necessary tests for both receivers and transmitters are included; even single sideband (SSB) transmitters may be checked.

Using the model 1040

The 1040 is divided into two main sections. One section is for transmitter tests. It has an RF wattmeter with ranges of 10, 50 and 100 watts. So, it can be used for testing radios in the Business band and others with higher power-output.

An internal 50-ohm load is provided. The CB set's own antenna may be used also by flipping a switch from INT to EXT RF load. All that you need is a short piece of coaxial cable with a plug on each end. This connects to the TRANSMITTER input jack of the 1040. The vehicle or fixed station antenna may be connected to the EXT. RF LOAD jack.

Now, by pressing the mike button you can read the average RF power output directly on the meter. Set the FUNCTION-SELECTOR switch to REV position and you read the reverse RF power; this is what is being reflected back from the antenna when it is mismatched. By setting the switch to SET REF position, you adjust the meter for full-scale. Turning to READ SWR gives you a direct readout of the SWR. The lower this ratio, the more efficient the antenna and the greater the output power. A ratio of 1:1 is considered ideal and most of the good commercial vehicle or fixed antennas will come very close to this.

With the external battery power (two screw terminals on the back panel, polarity-marked) the model 1040 can be used to check for SWR on antennas in vehicles. With some of the unusual configurations seen today, this is always a good idea. The transmitter can also be checked for legal RF power output. This is now 4 watts RF into the antenna.

Modulation of the transmitter may be checked in one of two ways. Switching the RF POWER switch to the PEAK position and then modulating the transmitter should show an increase in the RF power. With full modulation, the increase should be about 22%. You can look at either the unmodulated RF envelope or the modulated RF carrier by connecting an oscilloscope to the BNC jack labelled SCOPE on the back panel. You do *not* need a 35-MHz scope to do this. They thought of that—the model 1040 includes a mixer circuit that beats the 27-MHz RF carrier down to about 1.5-2.0 MHz. Practically all scopes will show the modulated carrier envelope at this frequency. Actual modulation percentage can be calculated by measuring the pattern on the scope.

The receiver section of the 1040 has two audio outputs—one is a 1,000 Hz tone and the other a 2-tone mixed signal consisting of 500 Hz and 2400 Hz. The output of either of these can be fed to a small speaker mounted on the front panel. Volume of this is controlled by the AUDIO GAIN control just above. To get a fixed frequency AF modulation, set the switch to 1 kHz, hold the mike face-down on the speaker and press the mike-button. The modulation percentage can be varied by adjusting the AUDIO GAIN control.

Both of the audio signal outputs are available at the AUDIO OUTPUT jacks on the panel. So; they can be used for testing the mikes as well. If the transmitter has good modulation when the signal is fed directly into the audio input, but it is weak when the mike is held over the speaker, this indicates that a new mike is needed!

The 2-tone test is used for checking modulation of SSB transmitters. Many CB sets can be switched from AM to SSB. FCC Standards require a very low level of intermodulation distortion. (This is also essential for clear communications, of course!) The prescribed test is feeding in two audio-tones simultaneously. The tones must not be harmonically related in any way. The 500-Hz and 2400-Hz tones meet these specifications. The IM product of these must be a minimum of 25 dB down at the output. To make a precise test of this, a spectrum analyzer is needed. However, you can display the modulation envelope of a SSB transmitter, just as with an AM transmitter, and get a good visual check. If you can see that the modulation peaks look like the 2-tone signal looks on a scope, the chances are that the modulation is all right. The 2-tone signal can also be fed through the speaker into the mike to check it for possible distortion. I might add here for the benefit of those who are as ignorant of actual SSB test procedures as I was, watch it! On SSB you will *not* see an *unmodulated* RF carrier on the scope! In SSB, both the carrier and one sideband are suppressed. There is actually *no* RF output until it is modulated! You'll see no reading on the meter or scope until modulation is applied.

The receivers can also be checked for audio power output, distortion, sensitivity, etc. For audio tests, the 1.0 kHz tone is fed into the audio input of the receiver. The external speaker or phone jack of the CB set is connected to the RECEIVER AUDIO jacks on the panel. A LOAD SELECTOR switch lets you select the correct load impedance—4, 8 or 16 ohms. The audio power output can be read on three ranges, 0.1, 1.0 and 10 watts. For reading this, the AUDIO GAIN and VOLUME control on the set are adjusted to check for the power output on the meter. To read distortion, turn the switch to SET FULL SCALE position and adjust the control for a full-scale reading. Then turn the switch to the ADJ FOR MIN position, and adjust the % DIST control for the lowest reading. This gives

(continued on page 18)

The Black Watch Kit $29.95

Dimensions: 1½" x 1" x 3/10"
Weight: ½ oz.
Strap: 3/4" wide
Case: Specially designed unbreakable black matte plastic. Water resistant.
Batteries: Mallory RM41H. One year life with normal use.

THE KIT CONTAINS

1. printed circuit board
2. unique Sinclair-designed IC
3. encapsulated quartz crystal
4. trimmer
5. capacitor
6. LED display
7. 2-part case with window in position
8. batteries battery-clip
10. black strap
11. full instructions for building and use.

All you provide is a fine soldering iron and a pair of cutters.

The Black Watch by Sinclair is unique. Controlled by a quartz crystal...powered by two hearing aid batteries...it's also styled in the cool prestige Sinclair fashion: no knobs, no buttons, no flash... just touch the front of the case to show hours and minutes and minutes and seconds in bright red LEDs. There's a re-set control on the back.

*Guaranteed. A correctly-assembled watch is guaranteed for a year. It works as soon as you put the batteries in. On a built watch we guarantee an accuracy within a second day. In building it yourself you may be able to adjust the trimmer to achieve an accuracy within a second a week.

Take advantage of this no-risks, money-back offer today!

The Sinclair Black Watch is fully guaranteed. Return your kit undamaged within 10 days and we'll refund the cost of your kit without question.

sinclair™

NOW ALSO AVAILABLE WITH DATE!

Sinclair Radionics Inc.
375 Park Avenue
New York, New York 10022

Please send me:
Black Watch kit(s) at $29.95 $_____
Black Watch kit(s) with date at $39.95 $_____
Black Watch(es) assembled at $49.95 $_____
Sales Tax (N.Y. residents) $_____
Shipping & Handling $2.50 per unit $_____
Enclosed is my check/M.O. for total $_____
☐ Please send me the Sinclair calculator catalog

Name _____
Address _____
City _____
State _____ Zip _____

EQUIPMENT REPORTS

(continued from page 16)

you a direct readout of the percentage of 3rd harmonic distortion in the receiver audio stage.

This is important in two ways. Practically all of these transceivers use the receiver audio stages for the *modulators*. This test can be very helpful in finding the cause of distortion in the transmitted signal. For example, if you read the normal 4 watts of RF power, unmodulated, but the audio stages show a maximum output of only 2 watts audio, you will not have enough audio power to produce full modulation. This will cause a clear but weak signal. The reverse is also true. If you read only 2 watts RF and 4 watts audio, the transmitter is being overmodulated and will garble.

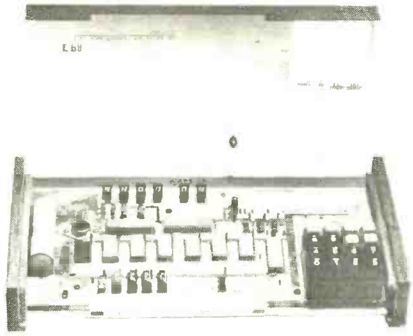
To check for sensitivity, an RF signal generator can be connected to the BNC RF GENERATOR jack on the back panel. It will feed directly into the receiver antenna. You can check for calibration and RF sensitivity if the signal generator has a calibrated RF attenuator.

The third BNC jack on the back panel can be connected to a frequency counter. Just push the mike button and read the channel frequency directly.

This is a very complete "package" for servicing of CB radios, either on the bench, car, boat, mobile home or what have you. With only a few other test instruments, usually already on the bench, you can get into the CB radio service business in a big way for not too much money. While checking the prototype out, we had a chance to make direct comparisons with some far more expensive types of equipment, and found that the accuracy of the 1040 compared very well with these! **R-E**

Circle 7 on reader service card

EPA Micro-68 Computer



Circle 120 on reader service card

ELECTRONIC PRODUCT ASSOCIATES' ANSWER to microcomputer fever is a self-contained system complete with power supply and a wood and smoked plastic 9 × 12 × 2 inch (229 × 305 × 51 mm) case. Plug it in and you're ready to start programming.

The Micro 68 is built around the Motorola M6800 microprocessor. It has a six-digit seven-segment display and a 16-key hexadecimal-input keyboard. The display is seven-segment, not a true hexadecimal format, so B and D are indicated by lower case representations using the seven segments. The decimal point is lit when "b" is displayed to help distinguish it from a "6."

The system is controlled by the John-Bug PROM monitor, one of the most sophisticated of the keyboard-display kind. In its basic form, the kit is intended as a learning tool or prototyping system for engineers, scientists, and laymen.

The monitor system is contained on four 1K bit PROM's for a total of 4K bits or 512 8-bit words of firmware. The lettered keys on the input keyboard double as control keys for the system. Keys A through F have been assigned the functions AUTO, BACK, CHANGE, DO, EXAMINE, and FORWARD.

To get started, press the one remaining button, the RESET button, and the display lights up with EPA uP . . . very cute. Pressing EXAMINE lights up dashes in the four leftmost places. Punching in an address puts the address in the first four digits and the two remaining digits, which are slightly separated from the rest, light up with the contents of that memory location in hexadecimal. The FORWARD key increments the address one location each time the button is depressed. BACK is an unusual feature not found in most similar systems. It decrements the address and displays memory contents. It is particularly convenient to have the address displayed simultaneously so you don't have to worry about losing your place or getting confused when sequential memory locations are loaded with the same instruction or data.

(continued on page 20)

Circle 8 on reader service card

(continued from page 18)

To load a program or alter something at a particular address, first get to that address using the E, F, and B keys and then press CHANGE. The rightmost display digits are extinguished and become loaded with the new data that is keyed in. Another unusual feature is the A key that automatically enters the data, increments the address and awaits the next entry. By using the AUTO function, you can quickly enter a program by continuously keying in the instructions in hexadecimal without the nuisance of hitting any additional keys. If you hit a wrong key or make a mistake, you can immediately correct it by pressing RESET and using the other functions to backtrack, or you can continue on and go back later. It is probably wise to examine the program when you are finished entering it and make the corrections then.

TABLE 1—COUNT SIX PROGRAM

```
        0000 DE LDX THREE
        0001 45
        0002 4F CLRA
ZRONBR  0003 A7 STAA NBR,x
        0004 48
        0005 09 DEX
        0006 26 BNE ZRONBR
        0007 FB
NXTCNT  0008 BD JSR CLRDSPY
        0009 F1
        000A BA
        000B DE LDX ONE
        000C 4D
LDTWO   000D A6 LDAA, NBR,x
        000E 48
        000F 44 LSRA
        0010 44 LSRA
        0011 44 LSRA
        0012 44 LSRA
        0013 DF STX STORE
        0014 47
        0015 BD JSR LDDSPY
        0016 F1
        0017 A5
        0018 DE LDX STORE
        0019 47
        001A A6 LDAA NBR,x
        001B 48
        001C 84 ANDA OF
        001D OF
        001E BD JSR LDDSPY
        001F F1
        0020 A5
        0021 DE LDX STORE
        0022 47
        0023 08 INX
        0024 9C CPX FOUR
        0025 4F
        0026 26 BNE LDTWO
        0027 E5
        0028 CE LDX 15
        0029 00
        002A 15
LOOP    002B DF STX STORE
        002C 47
        002D BD JSR DSPLY
        002E F1
        002F C7
        0030 DE LDX STORE
        0031 47
        0032 09 DEX
        0033 26 BNE LOOP
        0034 F6
        0035 0C CLC
        0036 DE LDX THREE
        0037 45
ADD     0038 A6 LDAA NBR,x
        0039 48
        003A A9 ADCA INCR,x
        003B 4B
        003C 19 DAA
        003D A7 STAA NBR,x
        003E 48
        003F 09 DEX
        0040 26 BNE ADD
        0041 F6
        0042 7E JMP NXTCNT
        0043 00
        0044 08
THREE   0045 00
        0046 03
STORE   0047 00
        0048 00
NBR+1   0049 00
        004A 00
        004B 00
INCR+1  004C 00
ONE     004D 00
        004E 01
FOUR    004F 00
        0050 04
```


Circle 9 on reader service card

When the program is entered and ready to go, press D and "do" lights up in the rightmost two digits. Entering the starting address starts the program as soon as the last key is released.

One more feature is the shared function of the "8" key. Next to it is printed RTI (Return To Interrupt). It is very useful for debugging programs by inserting SWI—software interrupt instruction—in your program. Each time the program encounters the instruction, the system is interrupted. The monitor dumps the MPU registers into assigned memory locations that can then be examined as well as any other memory locations. Depressing the RTI key will resume the program from where it left off or from a new condition set up by the programmer. If there is a loop in the program, it is possible to circle the loop each time the button is pressed and recheck the system status each time around.

As with most ROM or PROM monitor systems, the subroutines in the monitor can be used by the programmer. This is particularly helpful in using the display. The Micro 68 display is multiplexed (the segment lines to the six digits are all in parallel.) The software and the monitor program is used to scan the display. One assigned memory location is used as a digit mask. Setting one of the bits to a logic 1 enables a corresponding display digit. Another memory slot is loaded with the character pattern to be displayed.

I have some suggestions for the programmer, particularly the beginner, when approaching this system. Make a numeri-

(continued on page 30)

What are your opportunities in the electronics field? Here are some eye opening facts from ETI.

Q. What about the job market in electronics?

A. It's good. In fact, it seems to be one of the few fields that stays relatively steady in bad times. Today, for example, estimates indicate that several thousand jobs will be opening up for electronics technicians each year, for years to come. One reason for this is the fact that electronics are the basis of almost all communications, and this is a communications-oriented nation.

Q. What kind of jobs are you talking about?

A. For example, there are jobs available in electronic/industrial automation, electronic equipment repair and servicing, in the broadcast and radio telephone communications field, at airports, and even in medicine and in hospitals, where electronics are rapidly increasing in importance. And there are hundreds of other jobs opening up as electronics continues to make great strides, in new ideas and developments.

Q. Can such a complicated subject as electronics be successfully taught by the home-study method?

A. Of course it can. Electronics Technical Institute has proven that beyond a shadow of a doubt. Our graduates are working in practically every phase of electronics. This is largely due to the kind of instruction provided by ETI. For example, its course in the Fundamentals of Electronics features an exclusive teaching system called Autotext. And throughout all the courses the student is thoroughly monitored and carefully guided by a licensed instructor, whose professional and personal interest is to see that he masters every bit of information presented to him. Of course, we must give a lot of credit to our students themselves. They know that no matter how good the instructor and instruction may be, *they* have to make it work. So most of them apply themselves diligently, and they find the more they learn, the more they *want* to learn.

Q. But I have a job, and as much as I would like to get into electronics, I can't afford to take time off. How do I get around that?

A. You don't have to take time off from your job. You study at home, in your free time. We do advise, however, that you set aside a certain time for your study schedule and stick to it, even if it's only a couple of hours a day. The beauty of the ETI way of learning is that you work at your own pace, making sure you've completed your assignment thoroughly and completely. We think you'll find, as you go along, that learning the ETI way can be fun.

Q. But I was never very big on books and study. I like to work with my hands.

A. With your ETI course, you'll get plenty of work with your hands. In fact, the

ETI system of teaching combines hands-on work with study, so that you actually learn by doing. As you move along developing your technical knowledge, you will use, in many phases, specially developed Project Kits. So you apply your knowledge in logical, hands-on sequences, from the first step through completion of basic units. It all adds up to knowledge and self-confidence gained by actually *doing* the job.

Q. It all sounds very interesting and inviting. But I wouldn't want to commit myself before knowing more.

A. We wouldn't want you to. In fact, we insist that you check it out first. All you do is fill out the coupon and mail it to us. We'll send you a colorful new 48-page ETI Career Book that will give you the facts and the many opportunities ETI can open up for you. If you like electronics, you'll enjoy reading this book.

Q. Do I obligate myself in any way by sending for your book?

A. Absolutely not. The ETI Career Book is free, and it involves no responsibility on your part, nor will a salesman call on you. All we want to do is to be sure you have all the facts about ETI and what it can mean to your future. And you can get these facts and complete information about ETI's 18 different courses and programs in electronics by filling out and mailing the coupon to us today. We'll send you ETI's Career Book by return mail. We think it will be a real eye opener for you. Mail the coupon today.

Electronics Technical Institute

Division of Technical Home Study Schools

Electronics Technical Institute • Dept. 2-479-066
Little Falls, New Jersey 07424

☐ **Send my free Career Book!**
Tell me how I can get ahead in Electronics through ETI.
I've checked the fields of special interest to me.

☐ **TV/Audio Servicing**
Black & White
Color
Solid State
CATV
Closed Circuit
Video Recorders
Radio
Hi-Fi Stereo

☐ **Computers**
Digital Electronics
Computer Technology
Computer Programming

☐ **Communications**
FCC License
Aircraft
Marine
Mobile Two-Way
Microwave

☐ **Business and Engineering**
Electronics Fundamentals
Electronics Drafting
Industrial Electronics
Advanced Electronics
Industrial Instrumentation
Electronics Technology
Medical Electronics

☐ Check here for Veteran information.

Name________________________________
(please print)

Address______________________________

City____________State____________Zip________

Circle 10 on reader service card

KOMPUTER KORNER

How the microcomputer controls input/output devices with software

DAVID LARSEN, PETER RONY, and JOHN TITUS*

THIS MONTH WE WOULD LIKE TO EXPLAIN how computer instructions cause an I/O device to operate. The I/O device that we shall choose for our discussion is the optically isolated solid-state AC relay. These relays can control any AC power device within the output current ratings of the relay. Shown in Fig. 1 are typical solid-state relays that are available for prices ranging from $5 to $20 in quantities of one. Such relays permit a single TTL output signal (logic 0 or logic 1) to control up to 10 amperes of 220 VAC power, as is possible with the Hamlin model 7522 relay (top center of Fig. 1). Internally, each relay contains a light-emitting diode, a light-sensitive transistor, a power triac and a transparent dielectric optical path that isolates the digital and power circuitry. It can withstand a voltage difference of at least 1000 volts.

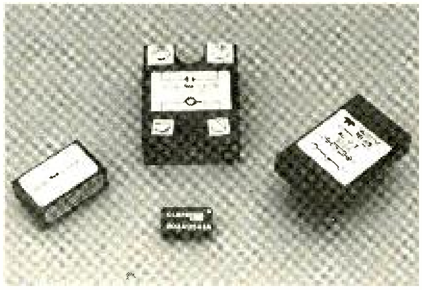


FIG. 1—TYPICAL SOLID-STATE RELAYS that are optically isolated.

A typical microcomputer I/O circuit that employs the solid-state relay is shown in Fig. 2. Recall that the microcomputer sends synchronization pulses, called *device select pulses*, to the I/O device. In Fig. 2, these are the negative-going pulses from the SN74154 decoder circuit that, for an 8080 microcomputer, have a time duration of only 500 ns. It should be clear that a single 500 ns pulse cannot sustain the continuous operation of an AC power device. What is required is a simple "interface" between the microcomputer and the solid-state relay that would permit the AC power device to operate continuously, if it is so desired. A suitable interface is a single SN7474 positive-edge triggered flip-flop and a single buffer from a SN7407 hex buffer/driver IC. The buffer is needed since it is not good engineering practice to drive a solid-state AC relay directly from the output of a flip-flop.

With suitable software, the microcomputer and SN74154 decoder can generate individual device select pulses that either clear or set the SN7474 flip-flop. To clear the flip-flop and turn on the AC power device, only a single 500 ns pulse is needed. The flip-flop output, Q, will remain at logic 0 until a single 500 ns pulse is applied to the preset input at which time the AC device will turn off.

Any simple open-collector gate or inverter can be used as the buffer between the output of the flip-flop and the input of the solid-state relay. Suitable choices would be the SN7401 or SN7403 2-input NAND gates, the SN7405 inverter, or the SN7409 2-input AND gate.

*This article is reprinted courtesy American Laboratories

Output instructions

We will discuss microcomputer instructions in considerable detail in subsequent columns. To summarize, their exist 78 different instructions for the 8080 microprocessor IC, and a total of 256 variations of such instructions. Each instruction contains a single 8-bit *instruction code* that indicates which type of operation or group of operations the microcomputer will execute. Some instructions contain two or three 8-bit words that are present in successive memory locations. A *byte* is defined as a group of eight bits occupying a single memory location. Thus, the 8080 microprocessor instructions are either 8-, 16-, or 24-bits long, with the first eight bits always being the instruction code.

The output instruction is a 16-bit instruction that consists of two successive bytes located in successive memory locations. The first byte, in binary code, is always 11010011. The second byte can be any 8-bit binary number from 00000000 to 11111111; this is the device code of the specific output device that will receive eight bits of data from the accumulator. The contents of the accumulator remains unchanged after the instruction is executed.

A simple program

The simplest program that incorporates the output instruction is probably the one given below:

Memory address	Instruction byte	Description
0	11010011	Send device select pulse to device given by following 8-bit device code
1	00000000	Device code for clear input to SN-7474 flip-flop
2	01110110	Halt the microcomputer

An 8080 microcomputer operating at a clock rate of 2 MHz will execute the previous program in 8.5 μs. The AC-power device will remain on once the program has been executed. To turn off the device, a slightly different program is required:

(continued on page 24)

Sylvania solves the problems of old age.

If you still have sentimental attachments for your old color test jig, Sylvania has attachments for it, too.

Our attachments put your old test jig back to work on the latest high voltage, hybrid and all solid-state sets.

For example, our CK2000 and CK2001 regulators will adapt your present jig to safely handle up to 35 kV. The CK2000 comes with an anode voltage meter and three range programmers covering 19-26 kV, 25-31 kV and 27-35 kV. The CK2001 has all the same features as the CK2000 without the anode meter.

If your present jig handles only tube sets, attaching the Rig-A-Jig™ CK1900X will improve its versatility to handle solid-state and hybrid sets as well.

But most important of all, we don't let any of our test equipment grow old. Our complete line of cables and adapters comes out almost as soon as the new sets do. A continually revised set-up manual shows you which adapters to use with which set.

By updating your present jig, Sylvania is giving it a longer lease on life. See your Sylvania distributor today.

We're helping you make it.

GTE SYLVANIA

KOMPUTER KORNER
(continued from page 22)

Memory address	Instruction byte	Description
0	11010011	Send device select pulse to device given by following 8-bit device code
1	00000001	Device code for preset input to SN-7474 flip-flop
2	01110110	Halt the microcomputer

The AC-power device will turn off when the second instruction byte in the program is executed and remain off after the microcomputer halts. A more practical program requires additional instructions.

Keep in mind that a memory address contains 16 bits. When we write, "memory address 0," we really mean the memory address corresponding to the following 16-bit binary word: 00000000 00000000. Note that we have split the 16 bits into two parts, the most significant 8-bits and the least significant 8-bits. The most significant 8-bits are called the HI (or H) memory address and the least significant 8-bits are called the LO (or L) memory address. Both the LO and HI address must be present for a memory location to be accessed.

With an actual program, the solid-state relay shown in Fig. 2 will turn on and off according to various decisions made by the program. A typical microcomputer-controlled system could easily have several such relays.

In a more orderly and systematic treatment of the 8080 microprocessor, one would probably introduce the 8080 instruction set prior to the discussion of any particular instruction, such as the output instruction described this month. Since we do not believe that you are willing to wait several months until we get to the output instruction, we have decided to treat it first. In a future column, we will explain how the 8-line-to-256-line decoder circuit shown in Fig. 2 generates individual device select pulses. **R-E**

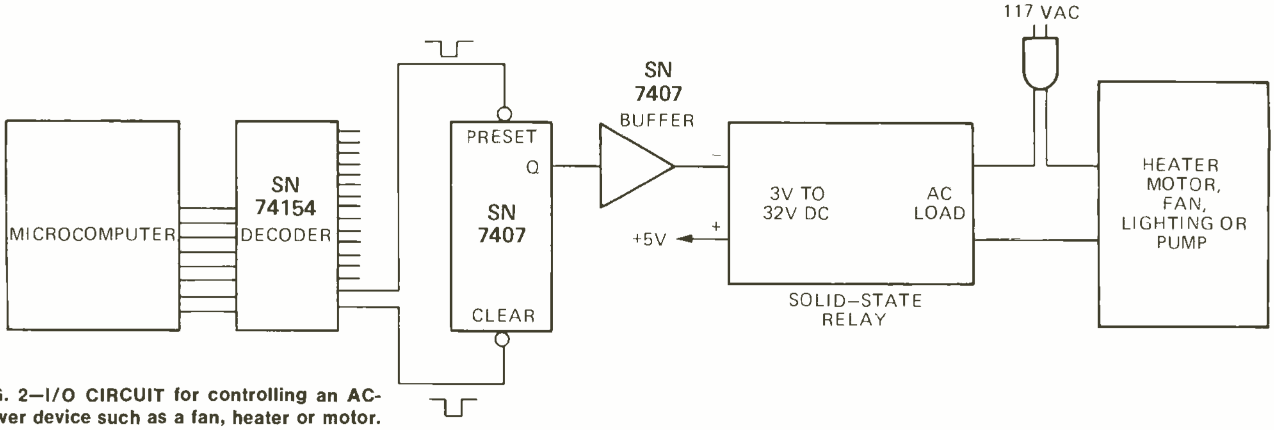


FIG. 2—I/O CIRCUIT for controlling an AC-power device such as a fan, heater or motor.

IF YOU'RE NOT DESIGNING WITH A CSC PROTO-BOARD®, LOOK AT ALL YOU'RE MISSING.

Accessibility—All parts are instantly and easily accessible, for quick signal tracing, circuit modifications, etc.

Utility—Models are available with or without built-in regulated power supplies (fixed or adjustable).

Variety—A wide variety of models are available with capacities ranging from 630 to 3060 solderless tie-points (6 to 32 14-pin DIP's), to fit every technical and budget requirement.

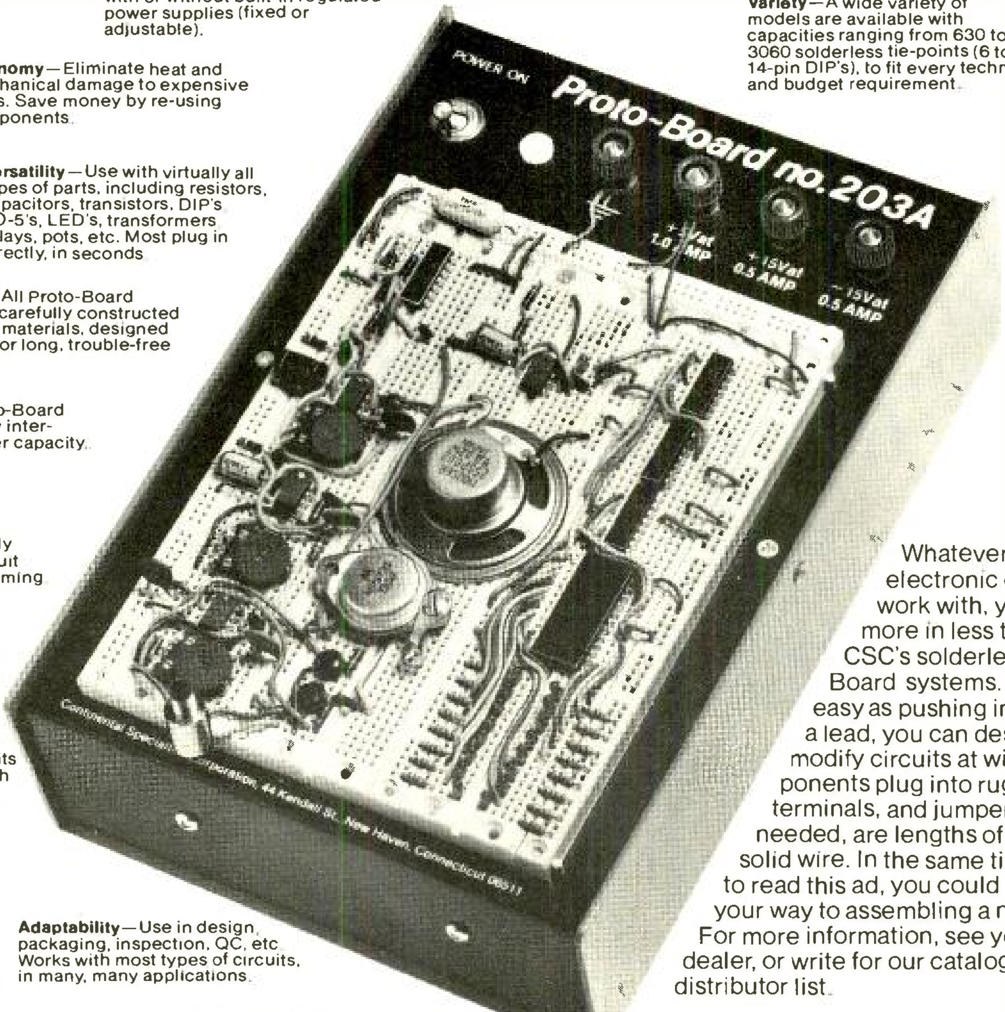
Economy—Eliminate heat and mechanical damage to expensive parts. Save money by re-using components.

Versatility—Use with virtually all types of parts, including resistors, capacitors, transistors, DIP's TO-5's, LED's, transformers relays, pots, etc. Most plug in directly, in seconds.

Durability—All Proto-Board models are carefully constructed of premium materials, designed and tested for long, trouble-free service.

Expandability—Proto-Board units can be instantly interconnected for greater capacity.

Visibility—All parts are instantly and easily visible, for quick circuit analysis and diagramming.



Speed—Assemble, test and modify circuits as fast as you can push in or pull out a lead. Save hours on every project.

Adaptability—Use in design, packaging, inspection, QC, etc. Works with most types of circuits, in many, many applications.

Flexibility—Use independently, or in conjunction with other accessories, such as scopes, counters, CSC Proto-Clip™ connectors, Design Mate™ test equipment, etc. One Proto-Board unit can serve a thousand applications.

Whatever type of electronic circuits you work with, you can do more in less time with CSC's solderless Proto-Board systems. As fast and easy as pushing in or pulling out a lead, you can design, test and modify circuits at will. Components plug into rugged 5-point terminals, and jumpers, where needed, are lengths of #22 AWG solid wire. In the same time you took to read this ad, you could be well on your way to assembling a new circuit. For more information, see your CSC dealer, or write for our catalog and distributor list.

CSC PROTO-BOARD SOLDERLESS BREADBOARDS

MODEL NUMBER	NO. OF SOLDERLESS TIE-POINTS	IC CAPACITY (14-PIN DIP'S)	MANUFACTURER'S SUGG LIST	OTHER FEATURES
PB-6	630	6	$15.95	Kit—10-minute assembly
PB-100	760	10	19.95	Kit—with larger capacity
PB-101	940	10	29.95	8 distribution buses, higher capacity
PB-102	1240	12	39.95	Large capacity, moderate price
PB-103	2250	24	59.95	Even larger capacity; only 2.7¢ per tie-point
PB-104	3060	32	79.95	Largest capacity; lowest price per tie-point
PB-203	2250	24	75.00	Built-in 1%-regulated 5V, 1A low-ripple power supply
PB-203A	2250	24	120.00	As above plus separate ½-amp +15V and −15V internally adjustable regulated power supplies

CONTINENTAL SPECIALTIES CORPORATION

CSC

EASY DOES IT

44 Kendall Street, Box 1942
New Haven, CT 06509 • 203-624-3103 TWX: 710-465-1227
West Coast office: Box 7809, San Francisco, CA 94119 • 415-421-8872 TWX: 910-372-7992
Canada: Len Finkler Ltd., Ontario

Prices and specifications subject to change without notice.

Circle 13 on reader service card

Have you ever asked yourself, "Can I make it in Electronics?"

CIE may be the answer if you have a technical aptitude and a serious desire to get ahead.

Right now, you're reading a technical magazine with articles that require a certain amount of electronics know-how. And that says a couple of things about you.

First, you're involved in Electronics . . . on the job, or as a hobby.

Second, you obviously realize the importance of staying up-to-date on the latest technical applications and developments. Reading a technical magazine *helps*, but it takes more than that to get you where *you* want to be . . . if you're serious about Electronics.

How can you afford

. . . *not* to continue with your electronics training?

You know the answer to that as well as we do.

To achieve continuing success, you have to keep building more knowledge into the Electronics background and experience you already have. You have to sharpen the tech skills you've already got and add new ones.

And one of the most logical ways for you to get what you need is to seriously consider an in-depth electronics training program that could help you achieve your ambitions in Electronics.

How can you afford

. . . the time and trouble of going back to school?

An excellent and *convenient* way for you to develop and expand your electronics knowledge is to "let the *school* come to *you*."

CIE's independent education plan does just that. Because we can effectively train you with an "education by mail" electronics training program that makes sense. And it makes sense for these reasons:

You can master *career* Electronics without missing one day of work. Without sacrificing one paycheck! Because you study in your free time . . . setting the study pace that best fits your schedule. *You* decide when and where *you* want to study. So you can go right on enjoying your leisure time because there are no *rigid* classroom schedules to be met. *You're* in control!

How can you afford

. . . the expense of the additional education you need?

A lot depends on which CIE course best fits your educational goals and background. We have a variety of electronics courses at beginner, intermediate, and advanced college-level. And there's a convenient payment plan available for every course. But, one way to evaluate your investment in CIE is this . . . you can *graduate* from CIE for about the cost of one year's tuition at some colleges or universities.

How can you afford

. . . to learn Career Electronics from anyone other than an electronics *specialist?*

If you are *serious* about your career in Electronics, you owe it to yourself to investigate *the* home study school that devotes its entire curriculum and instructional efforts to Electronics. That's CIE — Cleveland Institute of Electronics.

We have *specialized exclusively* in Electronics education-by-mail for more than 40 years. Just Electronics. Nothing else. And, the courses we offer today are the result of these years of teaching experience and proven methods of training . . . all based on the expert guidance of our

specialized Electronics Instruction Staff. Our lessons reflect this specialized experience. No frills. No unnecessary fancy stuff. Instruction is thorough . . . designed to meet the demands of electronics employers.

Each CIE course is built on the principle that the best way for you to *learn* and *retain* what you've learned is to *explain;* then to *check* your understanding; then to *reinforce* your comprehension with practical applications. In some courses, you will perform experiments and tests with your CIE Experimental Electronics Laboratory using authentic electronic components and gear. And, if you select a course that includes Color TV technology, you will not only build and keep a big screen Color TV which features digital circuitry . . . you'll also learn how to troubleshoot your TV.

The course you select will be a complete educational program, designed by *experts* to give you the best in Electronics independent home-study education. It will not be a "snap" course. No easy exams. It will make you work . . . and think. So that when you've earned your CIE Diploma, you'll *really* know your stuff.

In education just like in the "real world" of Electronics, your success depends on you and the effort you make. That's a real plus in CIE independent home-study . . . you build a strong foundation of self-discipline. And *that* pays off!

How can you afford . . . to stop now?

There is a lot more to CIE than this advertisement can tell you. And because you're looking for the *best*, we think it's well worth your while to find out what CIE is all about. Detailed Courses of Study outlines. In-depth training programs in Electronics Technology, Broadcasting, Industrial, Color TV, Engineering, and 1st Class FCC License preparation. Special CIE Student Services.

All this information is available to you, FREE, when you mail the card or coupon to us. For your convenience, we'll try to have a school representative contact you to review the benefits of CIE training and assist in course selection. And as soon as we hear from you, we'll mail a complete package of information, including our school catalog, G. I. Bill details, special FCC License information. All the facts you need to start your Electronics career program with CIE.

Send TODAY for CIE'S FREE information.

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

Yes, I want your FREE school catalog and career information package today.

I am especially interested in: RE-75

- ☐ Electronics Technology
- ☐ FCC License Preparation
- ☐ Color TV Maintenance
- ☐ Mobile Communications
- ☐ Industrial Electronics
- ☐ Electronics Engineering
- ☐ Other______________

Print Name ______________

Address ______________ Apt. ______

City ______________

State ______ Zip ______ Age ______

Check box for G.I. Bill information. ☐ Veteran ☐ On Active Duty

Circle 14 on reader service card

EQUIPMENT REPORTS

(continued from page 20)

cally increasing listing of all the M6800 instructions so you can quickly analyze a program and then using the monitor, display its own contents in locations FOOO through FFFF. EPA does not include a monitor listing and it will be useful to get an insight into programming techniques and to really understand what is happening when you use the subroutines in the monitor PROM.

Two Motorola/AMI 6820 Peripheral Interface Adapters are wired into the Micro 68 and are used to scan the keyboard and operate the display. The keyboard input port is wired in parallel to 16 connector pins and are also hooked to pull-up resistors. I haven't tried it, but these can probably be used as external device control outputs or inputs by the user.

If you get serious about this microcomputer, take a good look at my COUNT SIX program listing in Table 1.

The program starts with zeros displayed in all six display digits and then increments the count in steps of 1. The count is stored in the three memory locations starting at 0049, 004A, and 004B. The first eight instructions in the program are a loop that is traversed three times to load these three memory locations with their initial zero values. The bulk of the remaining instructions read these numbers out on the display. The three words consist of two digits each.

The display is set up to begin scanning from the left by the CLRDSPY subroutine. The next loop is used three times, once for each 2-digit word. Each time around the loop displays two digits. First the left four bits of the memory word are shifted right and entered into the digit-display memory words by the LDDSPY routine. Then the same number word is recalled and the right four-bits are stored in the next memory word.

Once this procedure is complete, the actual display takes place in the next loop. The initial setting of the x register to 15 in the program determines the number of times around the loop and the rate of the display count. DSPLY does the actual scan of the six digits and includes a loop of its own, so there is a multiplication effect in the time it takes to finish this part of the program.

Finally the last part of the program increments the number by one. It is a multiword addition that adds the 00 00 01 increment in locations 4C, 4D, and 4E.

I'm sure there are some tricks that can be pulled to shorten this program somewhat, but the display system demands some intricate programming.

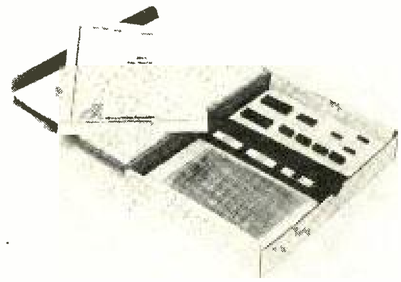
As you can see, quite a few steps are taken to perform this simple exercise so the standard memory of 128 words does not go very far. Additional memory will probably be an early consideration.

The Micro 68 documentation includes the *Motorola M6800 Systems Reference and Data Sheets Manual* and the *Micro 68 User's Manual*. Edge connectors are provided for memory expansion up to 64K words.

This system is not available as a kit. The price of the fully assembled system is $430. A maximum of 768 words of RAM can be contained on the main circuit board and goes for $5.50 per 128 words. When you are ready for a data terminal, the Motorola MIK-BUG TTY monitor can be purchased for $28.50. You will also need the $40 TTY/RS-232C adapter in that case. An optional 8K static memory board sells for $270.

Descriptive literature is available from Electronic Product Associates, Inc., 1157 Vega Street, San Diego, CA 92110. **R-E**

Microcomputer Associates JOLT Microcomputer



Circle 89 on reader service card

JOLT IS AN IMPRESSIVE MICROCOMPUTER designed for the serious application engineer and yet is a viable learning tool for the beginner. A fully equipped JOLT system can have as much as 32K of RAM and 128 bidirectional input/output lines. JOLT is a modular series of 4.25 × 7 inch (108 × 178 mm) PC boards that can be vertically stacked.

The minimum system configuration consists of a single $159 CPU board. Microcomputer Associates has taken the MOS Technology NMOS MCS6502 μP and surrounded it with a powerful complement of 12 other IC's. The JOLT CPU comes equipped with an R–C timing network that runs the on-the-chip clock oscillator at 750 kHz. A crystal can be mounted on the board for applications that call for that kind of accuracy.

Power up the CPU with a 5-volt supply and hook it to a video or printing terminal, and you have a highly usable system. It is one of the most sensible approaches I have seen so far.

How can a single small uncrowded board do such a superb job? By a rational balance between hardware and firmware. The JOLT CPU takes advantage of the family of 6500 devices. The MCS6530 Interface/Memory chip contains many of the vital system components. Some of its input/output pins are dedicated to the terminal, high-speed tape reader and other system functions, but there are still ten left over for user control. The mask programmed DEMON monitor is located in 1024 words of memory on this same chip. DEMON is allocated the top 1K of the first 32K of memory from 7000 to 73FF. It decodes the serial input from the terminal and controls the entire system operation with a minimum of added switches. . . . no control panel is needed.

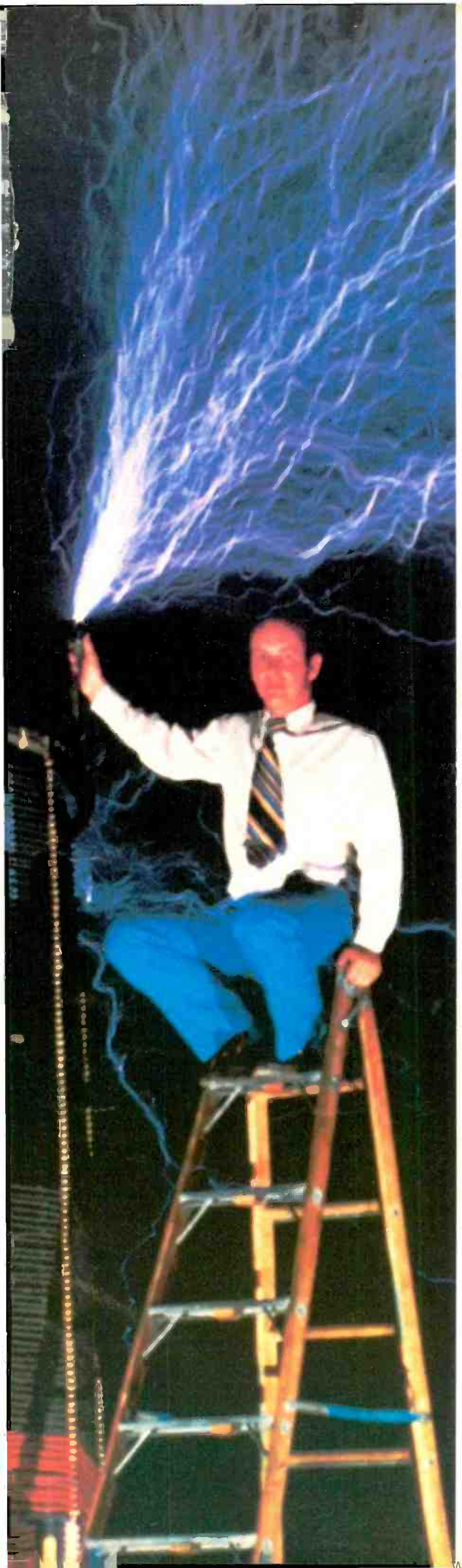
Sixty-four words of RAM used as in-

(continued on page 66)

12-MILLION VOLTS

Recreating the past to solve future needs. Robert K. Golka has duplicated apparatus designed in 1899 by Nikola Tesla, with the hopes of making nuclear fusion a feasible source of energy

FRED SHUNAMAN



IN THE SUMMER OF 1899, NIKOLA TESLA, POSSIBLY THE world's greatest engineer, set up an experimental laboratory or station near Colorado Springs with the intention (he told curious reporters and residents) of "sending a telegram from Pike's Peak to Paris." It is highly possible that long-distance wireless communication was the main objective of his work there, but he was probably also interested in wireless power transmission.

Tesla used a radio-frequency transformer (Tesla coil) of unheard-of dimensions and power—at least 12-million volts were generated. He was not too communicative about his experiments—either their purposes or results—and visitors were not encouraged. (This may have been partly because of the dangerous nature of the work.) So exact details are lacking.

Today—nearly 80 years later—in an Air Force hangar at Wendover, Utah, that 12-million volt record has for the first time been equalled and possibly exceeded. The second man to generate 12-million volts is Robert K. Golka, of Golka Associates, Brockton, Massachusetts. And he is doing it with equipment designed to duplicate Tesla's as closely as possible. Mr. Golka has instituted what is now called Project Tesla to study one of the results of Tesla's experiments that the great scientist almost brushed off as an interesting but unimportant phenomenon.

The exact equipment Tesla used cannot be determined. Probably he made numerous changes, so conflicting reports may be correct for the situation at the time reported. All agree that the primary of the Tesla coil was of heavy copper wire (1½-inch thick) placed at the bottom of the secondary, which was 51 feet in diameter. The type of conductor used for the secondary and the number of turns is not quite clear, but all reports (and the photographs) agree that there was an addition to the secondary—a coil of 100 turns, 8-feet 3-inches in diameter, placed in the center of the larger coil. The main secondary appears to have had a natural resonance of about 50 kHz; the additional coil resonated at the second harmonic, 100 kHz.

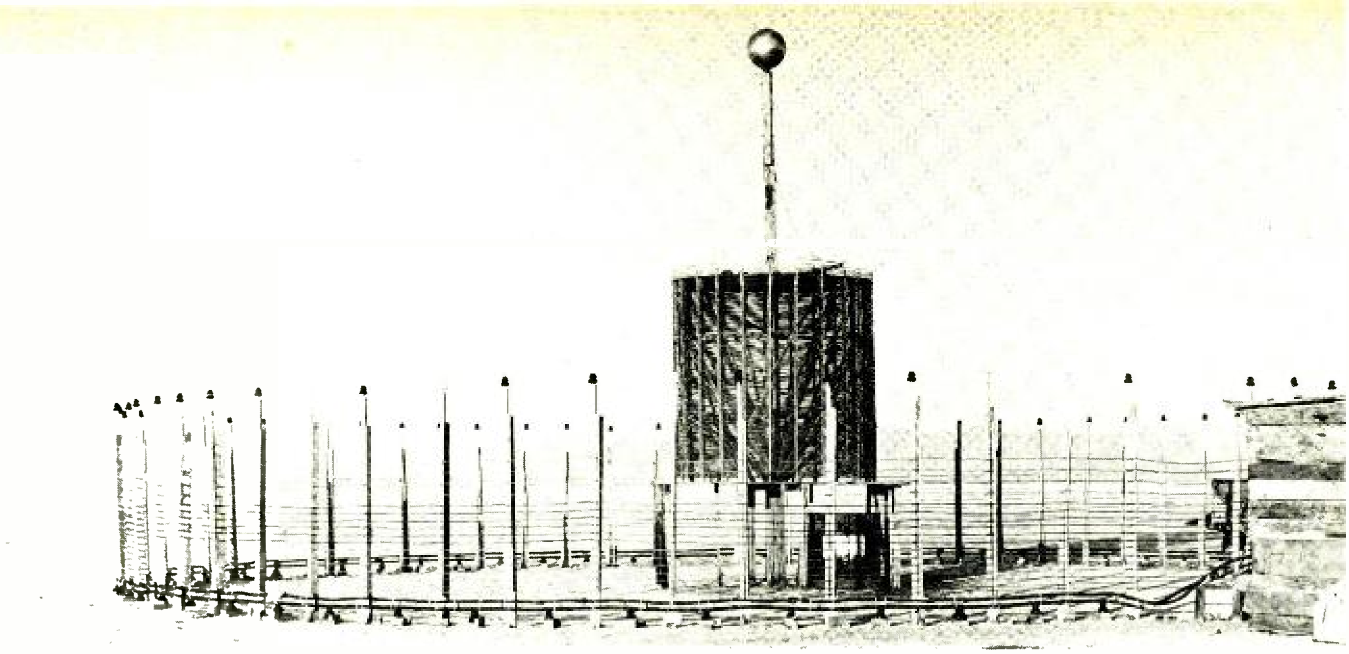
The input power was thought to be up to 50 kW, but when the coil was first energized, it blew out the generator of the Colorado Springs lighting and power system. (Tesla supervised the rebuilding). The blowout may of course have been due to a radio-frequency surge or kickback rather than to the amount of power drawn. (Of little consequence to the Colorado Springs lighting and power system.)

Two important by-products

Tesla made two important discoveries not connected with his original objective. He was an interested student of natural electricity, which the many thunderstorms of the region produced in vast abundance. He made special recording equipment to record their intensity and characteristics. These recordings gave him no room to doubt that he was observing standing waves in the earth. "Impossible as it seemed," he reported, "this planet, despite its vast extent, behaves like a conductor of limited dimensions. The tremendous significance of this fact in the transmission of energy in my system had already become quite clear to me. Not only was it possiblt to send telegraphic messages to any distance without wires, as I recognized long ago, but also to impress on the entire globe the faint modulation of the human voice. Far more significant is the ability to transmit power in unlimited amounts to almost any terrestrial distance and almost without loss."

To illustrate his point, Tesla lit a bank of 200 carbon-filament lamps—consuming about 10 kW—26 miles from the station, a feat that has not since been equalled. This experiment was duly witnessed and recorded by his assistant, Fritz Lowenstein, later to become a prominent electronic inventor in his own right.

(It is doubtful indeed, says Mr. Golka, that power could be sent completely around the world from one



THIS TESLA COIL created the highest voltage ever produced by mankind—12,500,000. Estimated peak current: 1,100 amps.

source, as Tesla envisioned. The resistance losses would far outweigh the power actually used. Some rocky soil has a resistance as high as 1,000 ohms per meter.)

Ball lightning

The second discovery was recorded almost as an aside by Tesla in his description of the electrical displays of the region: "Lightning discharges are, accordingly, very frequent and sometimes of inconceivable violence. . . . Many of them resembled gigantic trunks of trees with the trunks up or down. I never saw fire balls, but as a compensation for my disappointment I succeeded later in determining their mode of formation and in producing them artificially."

Fire balls, or ball lightning, have long been a puzzle to scientists. Many of the scientists have simply denied their existence (as a simple solution to a problem that appeared to have no reasonable answers). They are glowing balls apparently of electrical plasma, a foot or less in diameter, floating a few feet off the ground. Their exact composition and mode of formation is not known. They appear in the wake of thunderstorms and move slowly, bouncing when they strike the earth or a solid object.

Despite earlier doubts, the existence of ball lightning was pretty well established by Niels Bohr, who saw a fireball and reported it. (Possibly lesser scientists have also seen ball lightning but have remained discreetly silent about it, like the sea captain who remained below eating his dinner when the deck crew reported a sea serpent. "I don't want to be called a liar all the rest of my life," he said.)

A few prominent physicists have speculated and formed tentative theories about ball lightning. (Tesla was the first to try to develop a theoretical explanation.) But it was considered a special subject well away from the mainstream of scientific investigation.

All this changed with the coming of the nuclear age. Scientists have been struggling to contain and control the plasma of ionized and superheated gases resulting from the fission or fusion of nuclear materials. A constricting magnetic field in the shape of a large doughnut has been labored with for some years. Its latest name is the Tokamack, given by the Russians, meaning toroidal-confinement. In the earlier days it was known by other names! The Perhapsatron was an interesting name for an early magnetic confinement device. The Theta-Pinch and the Beta device were all variations of this idea.

Since every plasma behaves thermodynamically like a liquid, why not use surface tension to partly help in holding the plasma together? Of course other parameters will have to be exactly right for the effect to take place, but surface tension plays a predominant part, just as in the production of soap bubbles using a soapy liquid.

The various theories about ball lightning agree that it must be a plasma—a ball of ionized air or other gases. Yet it is self-contained and does show evidence of surface tension—bouncing off objects it strikes and regaining its spherical form. True, it is far from permanent, lasting about five seconds on the average—though observers have reported fire balls with a life of minutes.

Ball lightning then, might serve as a model for controlled fusion or at the very least a study of it might produce new knowledge that would be helpful in obtaining controlled fusion. But the problem of observing natural ball lightning is insurmountable. It is much more common in some areas (notably parts of Sweden and Australia) than others, but nowhere does it occur often enough (or long enough) for study.

The lightning maker

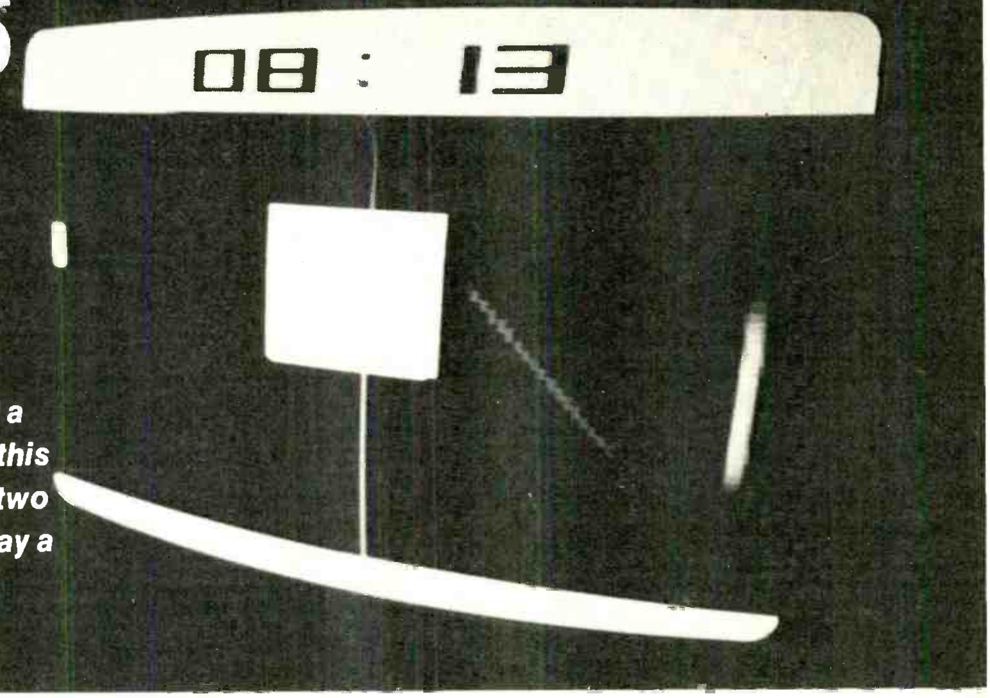
Robert K. Golka became interested in the subject when he read—in O'Neill's *Prodigal Genius*—that Tesla, though he had never seen natural ball lightning, had produced it artificially during his Colorado Springs experiments. Contacting Leland Anderson, long-time Tesla student and historian, he was told that little information was available, but there might be more in Tesla's notebooks in the Tesla Museum in Beograd, Yugoslavia.

After playing with the idea for a year, Golka went to Yugoslavia and was able to get permission to read the Colorado Springs diary. (Fortunately, Tesla wrote his notebooks in English, but Golka reports that the handwriting was such that reading the notebook was almost like translating from a foreign language.) A little experimenting with Tesla coils convinced Golka that he was on the right track, but that a much bigger coil than anything he could construct would be required. What was necessary, Golka believed, is the following.

1. A generator of moderately low frequency and with enough power to be able to excite certain areas of land with standing waves.
2. Land area where electrical reflections can be set up (due to ground faults or other causes) to support standing wave phenomena.
3. High-intensity electrical discharges in which the plasma "ball" can be formed in-channel and disassociated from the discharge

(continued on page 69)

Build This Great TV Game



With on-screen digital scoring and a unique alternate "bumper" game, this ping-pong game can be played by two or four people, or it can be set to play a perfect game against you or itself.

RAY PICHULO

HERE'S ONE OF THE MOST FASCINATING AND exciting electronic projects I've ever seen. A home-built electronic ping pong game that includes a special alternate version called "bumper" (illustrated on this month's cover). The game easily connects to most TV sets and uses the TV screen as the playing field. This particular game offers a challenge for just about every level of playing skill. Here are some of the features built into this special 2-game unit.

- Both vertical and horizontal paddle movement control.
- Controlled ball motion—slam, spin or lob.
- Computer paddle control (one person can play against a machine that plays a perfect game or the machine can play against itself.
- Sound effects when the paddle hits the ball and when the ball rebounds off the game boundaries. Plus a special sound when a player scores a point.
- Randomized ball-speed ball-angle integrator.
- Displayed boundries.
- Paddle size controls.
- On-screen scoring option.
- BUMPER—a second, built-in game.

How to play the game

The combination of vertical and horizontal paddle motion adds an extra dimension to the play. With it you can "rush the net" for a well-played power shot. Or you can chase after the ball to hit an over-the-head return. You can also try for a shot with lots of spin and angle. Or you can send a lob shot in and challenge your opponent to try and recover from that one.

The ball control built into the electronic is a unique randomizing integrator circuit that controls both ball angle and speed. When you hit the ball, it can rebound at any one of ten different combinations of ball speed and ball angle; including straight across, either as a fast "smash" or a slow "lob".

The steeper rebound angles can make the ball bounce once, twice or even three times off the top and bottom boundries before your opponent can try and return the ball.

The built-in computer-control circuit provides automatic feedback to one (or both) paddles. This makes it possible for a single player to match his skills against the game. When this feature is switched on, the computer-controlled paddle automatically chases after the ball and bats it back to you . . . and it never misses.

This special feature also makes the game a cinch to demonstrate as it can be set to play a perfect game against itself.

The sound effects built into the unit add to the excitement and enhance the realism. Whenever the ball hits a paddle or boundary, you hear a "bonk"; and when someone misses a shot the game produces a "brrappt".

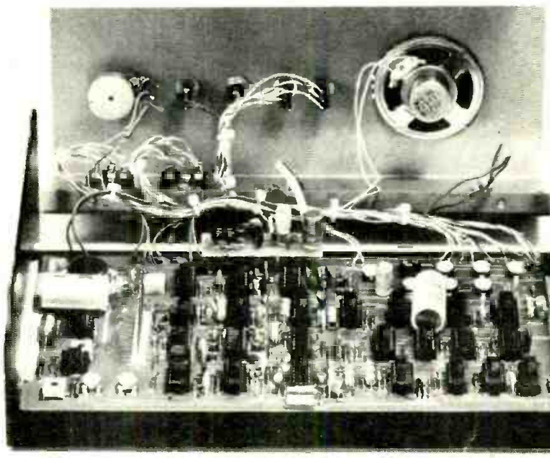
The ability to adjust the paddle size over a 3 to 1 range adds an adjustable skill level. The better you get as a player, the smaller you make the paddles; increasing the skill needed to play.

When you add on the digital scoring feature, you get a visible display on the TV screen. It is updated each time there is a score and the game ends automatically when either player reaches a score of 18. A reset button sets both players scores back at zero, and you're ready to start again.

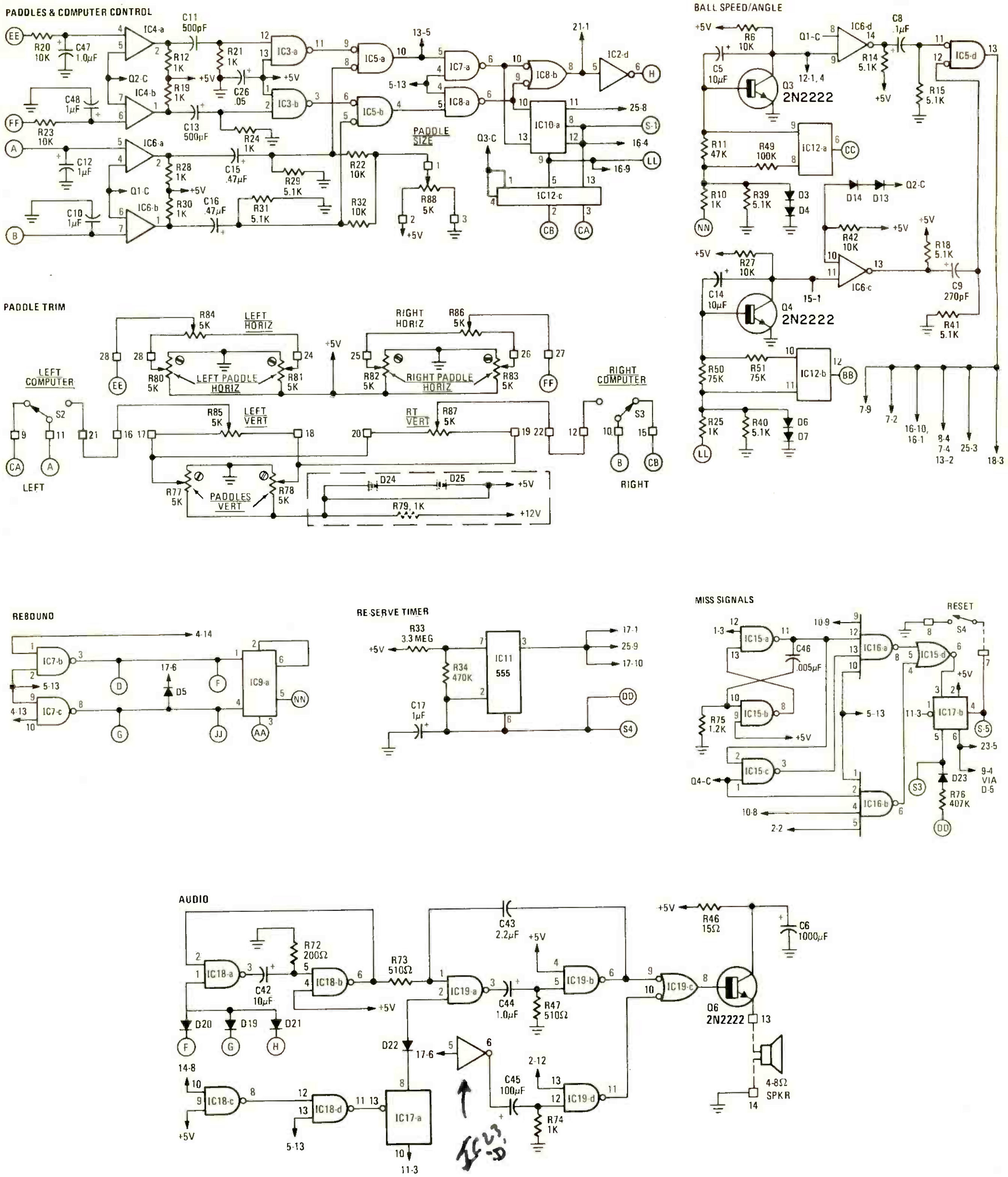
A second game

Bumper, as shown on this month's cover, adds a white "bumper" cube in the middle of the screen. This bumper adds two intriguing challenges to the game. When a player hits a ball that strikes the bumper on one of its vertical sides, the ball rebounds back to him at a random angle

(Schematic on pages 36 & 37)
(text continues on page 79)



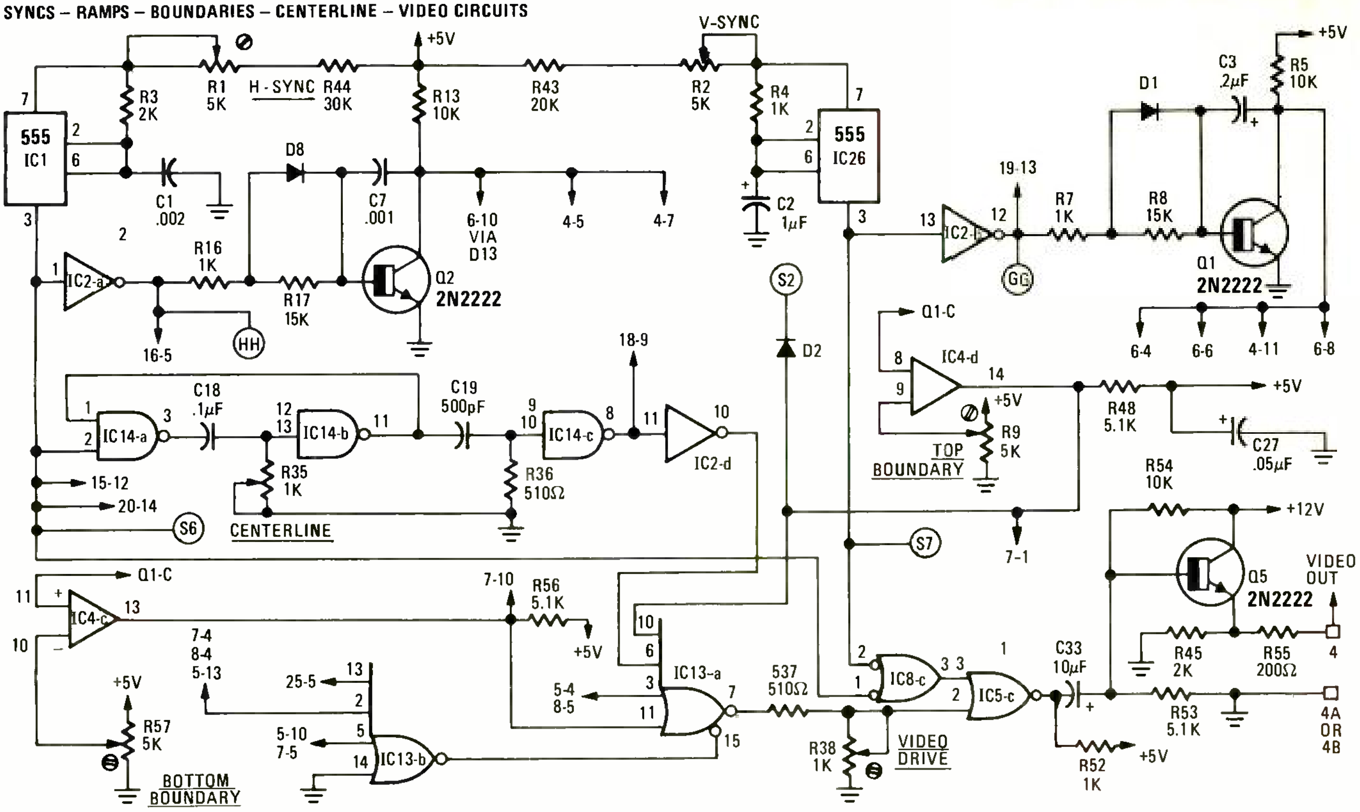
THE TV GAME is built on a single PC board. The optional scoring board (not shown) mounts on top of the main board.



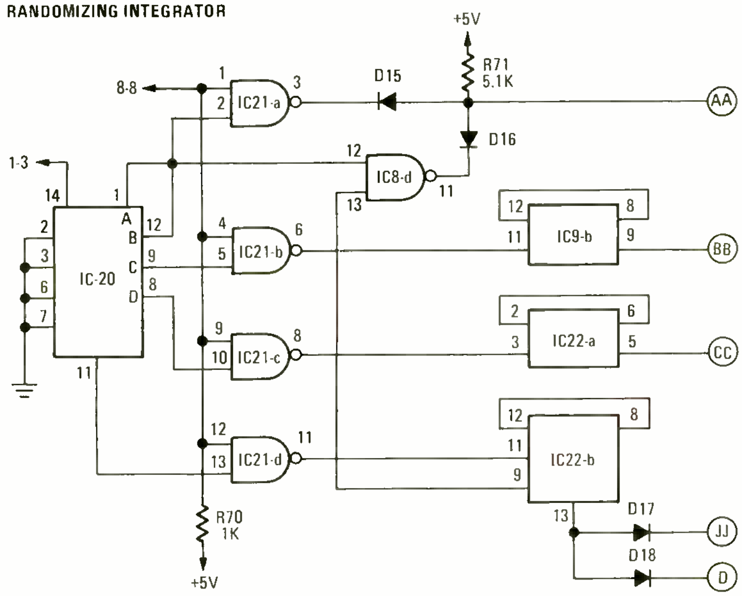
NOTES:
1. LETTERS WITHIN A CIRCLE INDICATE INTERCONNECTIONS BETWEEN TWO OR MORE SIMILARLY-MARKED POINTS. FOR EXAMPLE (AA) AND (AA) ARE CONNECTED TOGETHER ON THE CIRCUIT BOARD.
2. POINTS MARKED BY TWO NUMBERS SEPARATED BY A DASH (AS 16-9) INDICATE AN IC NUMBER AND PIN NUMBER, RESPECTIVELY. THUS A LEAD MARKED 6-8 CONNECTS TO TERMINAL 8 ON IC6.
3. THE LETTER "S" FOLLOWED BY A NUMBER INDICATES A CONNECTION TO THE OPTIONAL SCORING BOARD.
4. NUMBERS NEXT TO SQUARES AS □ ARE CONNECTION TO OFF-BOARD COMPONENTS.
5. CAPACITORS C20-24 AND C26-31 BYPASS VARIOUS V_{CC} AND ARE NOT SHOWN ON THE SCHEMATICS.
6. IC1, IC11, IC26 – 555, IC2 – 7404, IC3, IC7, IC8, IC14, IC15, IC18, IC19 – 7400, IC4, IC6 – 339, IC5 – 7402, IC9, IC22 – 74C74, IC10, IC17 – 7474, IC12 – 4066, IC13 – 7423, IC16 – 7420, IC20 – 74C90, IC21 – 74C00, IC23, IC24 – 74C04, IC25 – 74C10, Q1 – Q6 – 2N2222, D1 – D8 – 1N4148, D9 – D12 – DELETED, D13 – D25 – 1N4148 – SEE PARTS LIST

THE COMPLETE SCHEMATIC of the TV Game, minus the scoring option, is shown divided into the various functional sections. The circuit is built around the readily available 74-series IC's.

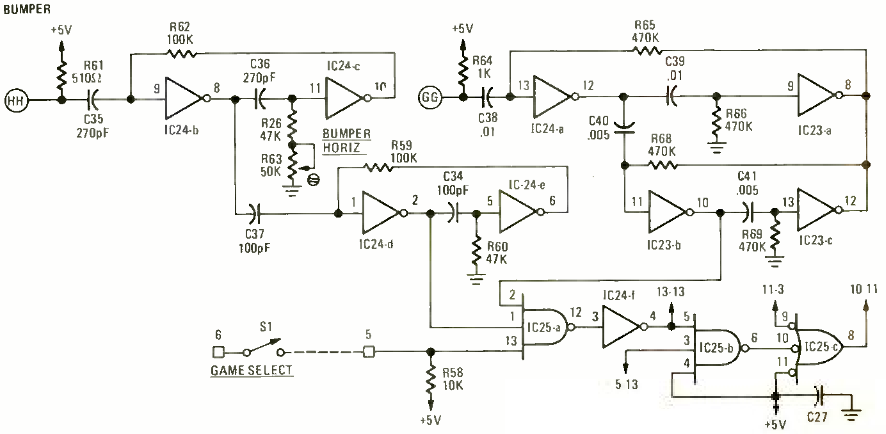
SYNCS – RAMPS – BOUNDARIES – CENTERLINE – VIDEO CIRCUITS

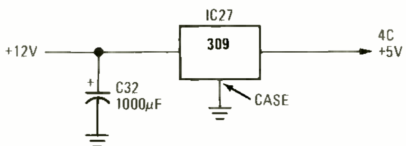


RANDOMIZING INTEGRATOR



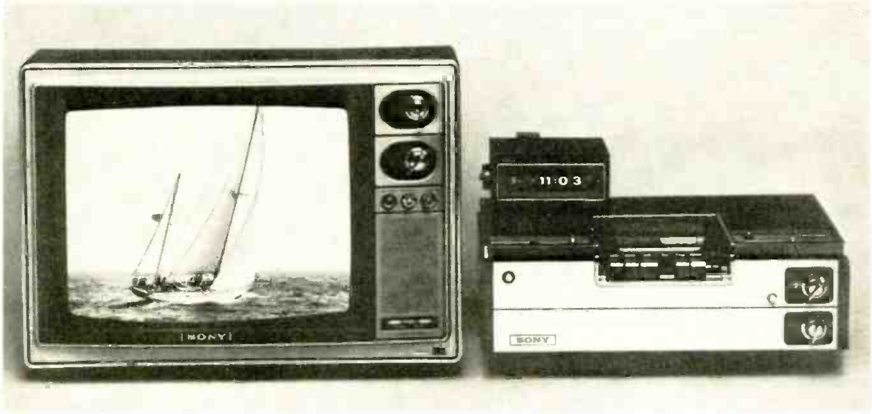
BUMPER





Videodisc-Videotape 1976

ROBERT E. GERSON



FOR THE HOME VIDEOPLAYER, THE DAY of true availability has been a long time coming. In fact, it took 14 years from the time the first home video playback gadget was demonstrated—a longitudinal-scan video tape recorder using ¼-inch tape developed in England by Westgrove—until Sony began marketing its home Betamax ½-inch cartridge VTR. The first Betamax units, combined in a console with 19-inch color receivers, became available late last fall. Betamax decks, designed to hook to the antenna terminals of standard television receivers, are just now appearing on the market.

But to many, the term videoplayer is synonymous with videodisc. To them the VTR, with its off-air and live-from-camera recording abilities, is more of a hobby than an entertainment medium. Nothing less than a play-only disc system, complete with an extensive library of low-cost special- and general-interest programming meets all the criteria needed to bring the "see what you want to see when you want to see it" concept to the mass market.

Even for the purists, the videoplayer era has come although on an admittedly small scale. Since early this year, RCA has been field-testing its capacitance disc system in consumer homes. About 200 of the RCA players are involved in the field-test intended to find

TAPE ECONOMY OF MAJOR VIDEO RECORDER SYSTEMS

System	Speed (IPS)	Tape Width (inches)	Square-feet per hour
ITT[1]	120	¼	18.8
Sony Betamax	1.57	½	20.6
RCA MagTape[2]	1.53	¾	28.7
V-Cord	3.75	½	46.9
BASF LVR[1]	120	½	53.6
American Videonetics[2]	2.88	¾	56.2
Akai	10	¼	62.5
Philips VCR	5.6	½	70.0
U-Matic	3.75	¾	70.3
EIA-Japan Type-I	7.5	½	93.8

[1]Developmental, data subject to change.
[2]Development halted, future uncertain.

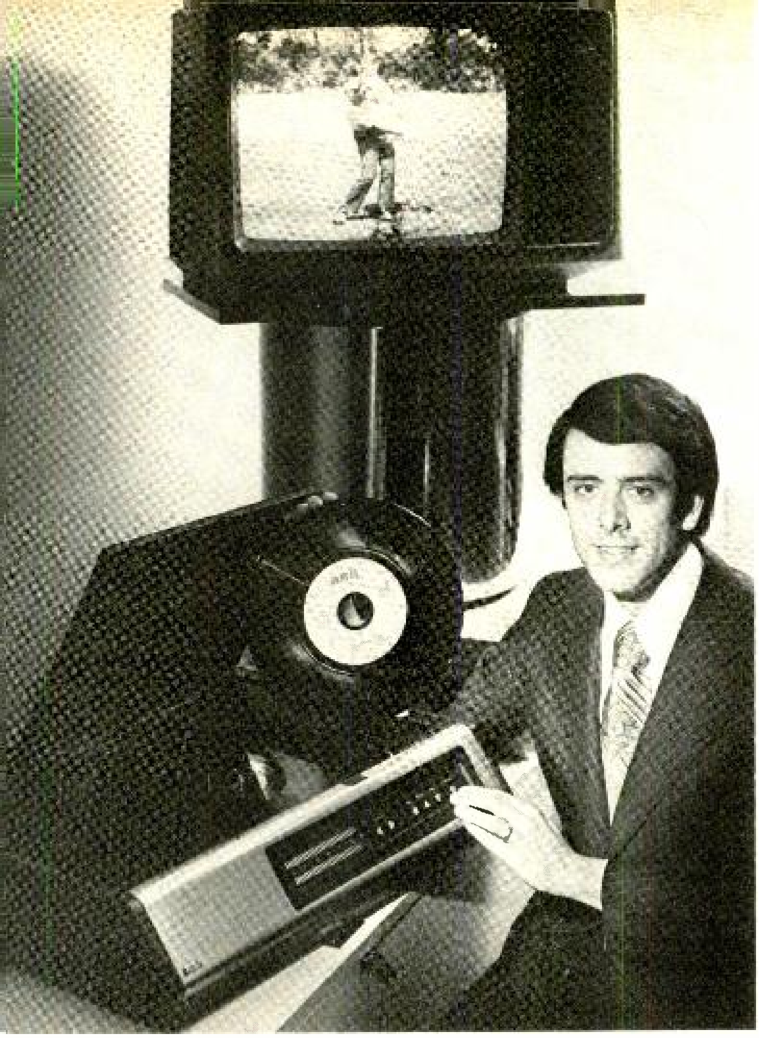
RECOMMENDED STANDARD FOR OPTICAL VIDEODISC SYSTEM*

VIDEO Modulation: FM of composite color video signal. **Blanking level reference:** 8 MHz ± 50 KHz. **Sync-tip to peak-white deviation:** 1.7 MHz ± 35 KHz.

AUDIO Modulation: FM, 2-channel. **Maximum deviation:** ± 100 KHz. **Carrier frequencies:** Left channel, approx. 2.3 MHz; right-channel, approx. 2.8 MHz. Both sound carriers are pulse-width modulated on FM video carrier.

DISC Rotation speed (for NTSC): 1,800 RPM. **Rotation:** counter-clockwise from objective lens side. **Center-hole diameter:** 35 mm. **Refractive index:** 1.5 (approx.). **Thickness:** rigid disc, 1.1 ± 0.1 mm; flexible disc, 0.2 ± 0.1 mm.

*Tentatively agreed to by MCA, Philips and Zenith.



It has been one year since our last report on the progress of commercial videodisc-videotape machines. Although the past year appears to have been static, it really wasn't. Here's a rundown on what has transpired

out how they stand up to in-home treatment. Here's a rundown on where the leading videodisc and home VTR systems stand today, and how they stack up for the future.

RCA SelectaVision

Apparently the closest to actual marketing in the U.S. is RCA's SelectaVision videodisc system, now in field tests and due for test marketing sometime in 1977. RCA's discs have a metallic layer between two plastic layers. Information, recorded in the form of grooves on the plastic, is read out by a sapphire stylus equipped with a metal electrode that measures, by capacitance, the distance from the stylus tip to the metal layer.

Since our last videodisc report (**Radio-Electronics**, June 1975), RCA has raised its estimate of the player's final price from $400 to "under $500." Most other specifications are unchanged: 12-inch disc revolving at 450 RPM. Information is recorded on two sides with a combined 60-minute play time. A full-hour program is to retail for about $10.

Informed sources indicate RCA has invested close to $100 million in its videodisc effort so far, with a good chunk of that going into programming and disc manufacture. RCA has spent in excess of $2 million on the initial equipping of a former audio factory in Indianapolis with disc coating, molding and inspection machinery. Additional millions have been earmarked for program acquisition—RCA says it already has rights to over 1,000 titles.

RCA's progress, and the relative simplicity of its system, has attracted the interest of the Japanese. Six manufacturers there (Clarion, General, Nippon Electric, Pioneer, Toshiba and Sharp) have all taken technology licenses from RCA. This doesn't, however, mean they have made a commitment. The licenses are free until the companies actually make and sell hardware or software.

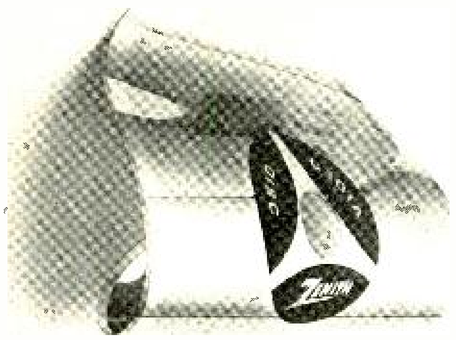
MCA-Philips-Zenith

The progress of the laser-read optical videodisc system, being jointly developed by MCA in the U.S. and Philips in Holland, is currently the industry's big question mark. The problems of the MCA-Philips system are exactly the reverse of those faced by RCA. The disc production appears to be relatively simple, but the player, with its laser and servo-controlled optics, requires significant state-of-the-art advances in order to be rugged and inexpensive enough for the consumer market.

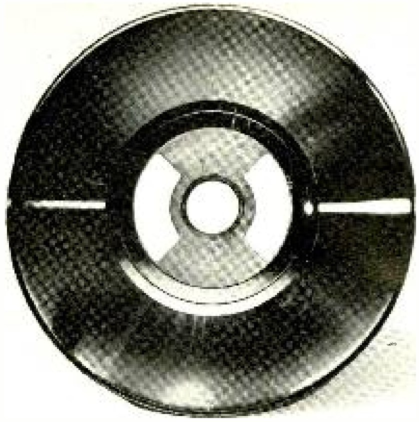
On the plus side, two announcements in the past year indicate that work is proceeding on a schedule that may permit at least test marketing of a minimal number of units by late-1976, early-1977. One is a MCA-Philips-Zenith agreement on a proposal for a compatibility standard. The other is Philips' signing of a letter of intent to purchase several millions of dollars worth of low-cost lasers from Spectra Physics of California. The price of the laser and power supply would have to be in the $20-$30 range if the player is to be marketed at the targeted $500 price, and that would require a 5-fold cut from current levels. Also an indication of progress is MCA's order of broadcast-quality VTR's to be used for disc mastering.

The MCA-Philips disc is reflective, so the laser and all the optics are on the same side of the disc. Until recently, Zenith had been working on a transmissive disc system where the laser shines right through the disc. So Zenith's participation in the standards agreement was something of a surprise. Officially, however, Zenith is fence sitting, saying only it's watching developments and that it won't choose a system to back until 1978. By that time, the market should be in the early development stages.

The MCA-Philips disc will be recorded on one side only though both could be used. Each side provides up to



ZENITH HAS DEMONSTRATED a flexible reflective laser-read disc system. The use of flexible thin discs is supported by MCA which envisions duplicating them on a web-type printing press.



RCA'S SELECTAVISION VIDEODISCS will have handling slots as well as a center hole. The slots permit easier disc handling, thus making it easier to keep fingerprints off the disc surface.

30 minutes of playing time. Disc pricing should be about the same as RCA. Current plans call for MCA to turn out the software. Magnavox, Philips' U.S. subsidiary, will produce the players. MCA and Philips are setting up a corporation to offer patent licenses to other hardware and software producers.

Thomson-CSF

Zenith's former partner in the development of a transmissive optical videodisc, France's Thomson-CSF, says it's sticking to its guns and will produce and market a handful of players later this year for sale in educational and commercial markets. The major claimed advantage of the transmissive disc is that, by changing the focus of the laser, both sides can be played without the disc being turned over. No price has been quoted, but it's expected to be several times higher than that planned for the RCA or MCA-Philips players.

TeD

The first videodisc player available to consumers is the TeD, a mechanical system jointly developed by England's Decca and Telefunken of Germany. The first units were introduced in Europe in spring 1975, with players priced at $600 and discs, with 10-minute playing times, priced from $2 each. The initial offering of some 5,000 players met with public indifference. TeD's lack of success has been blamed on short disc playing time, high player price and poor economic conditions. Whatever the reasons, TeD has lost momentum, and is being written off as a factor by many in the industry. Sanyo, TeD's Japanese licensee, has twice cancelled production plans and is mum on its intentions for the future.

Sony

The first real home video recording system introduced by a major manufacturer is the Sony Betamax ½-inch cartridge recorder. It's currently available in combination with a 19-inch color receiver at $2,295. It is also available in deck form, complete with tuner and timer (but no camera input), at $1,300. A black-and-white camera accessory for the console combination and for future deck models, is planned at about $400. Maximum playing time is 60 minutes (cartridge cost $15.95), but that may be extended by 30 minutes in the near future. Sony is also working on a cartridge changer to provide up to 6 hours of record or play time.

Betamax units are hard to find, most being snapped up by commercial VTR users as substitutes for more expensive ¾-inch cartridge U-Matic machines. The scarcity should be alleviated soon. Sony is now turning out Betamax units at a 10,000 monthly rate, and will expand to 20,000 monthly next year, and by 1977 other manufacturers should have compatible machines on the market. There's also a good chance prices will drop. In Japan, Sony sells a "no-frills" Betamax deck at about $760.

BASF LVR

The moment of decision is arriving for the future of BASF's LVR (Longitudinal Video Recorder) system. The LVR has 28 tracks on a ½-inch cartridge tape. The tape speeds past the head at 120 IPS, reversing at the end of each pass. BASF is currently reviewing the success potential of its system.

IIT

Working at IIT (Illinois Institute of Technology), magnetic recording pioneer Marvin Camras has developed a longitudinal VTR system similar in many respects, including tape speed, to the BASF LVR. The IIT unit, however, has 40 tracks and uses an endless loop of ¼-inch tape. IIT says a color VTR could be made to sell for $300, and that a 30 minute tape cartridge would retail for less than $10. There are no current production plans.

V-Cord

Basically a modification of the EIA-Japan ½-inch VTR standard, the V-cord cartridge system was developed in a joint effort by Japan's Toshiba and Sanyo. Its advantage is half-speed operation, which provides tape economy. Late last fall both companies began offering decks, in limited quantities, at $860. Neither has announced plans to export units to the U.S.

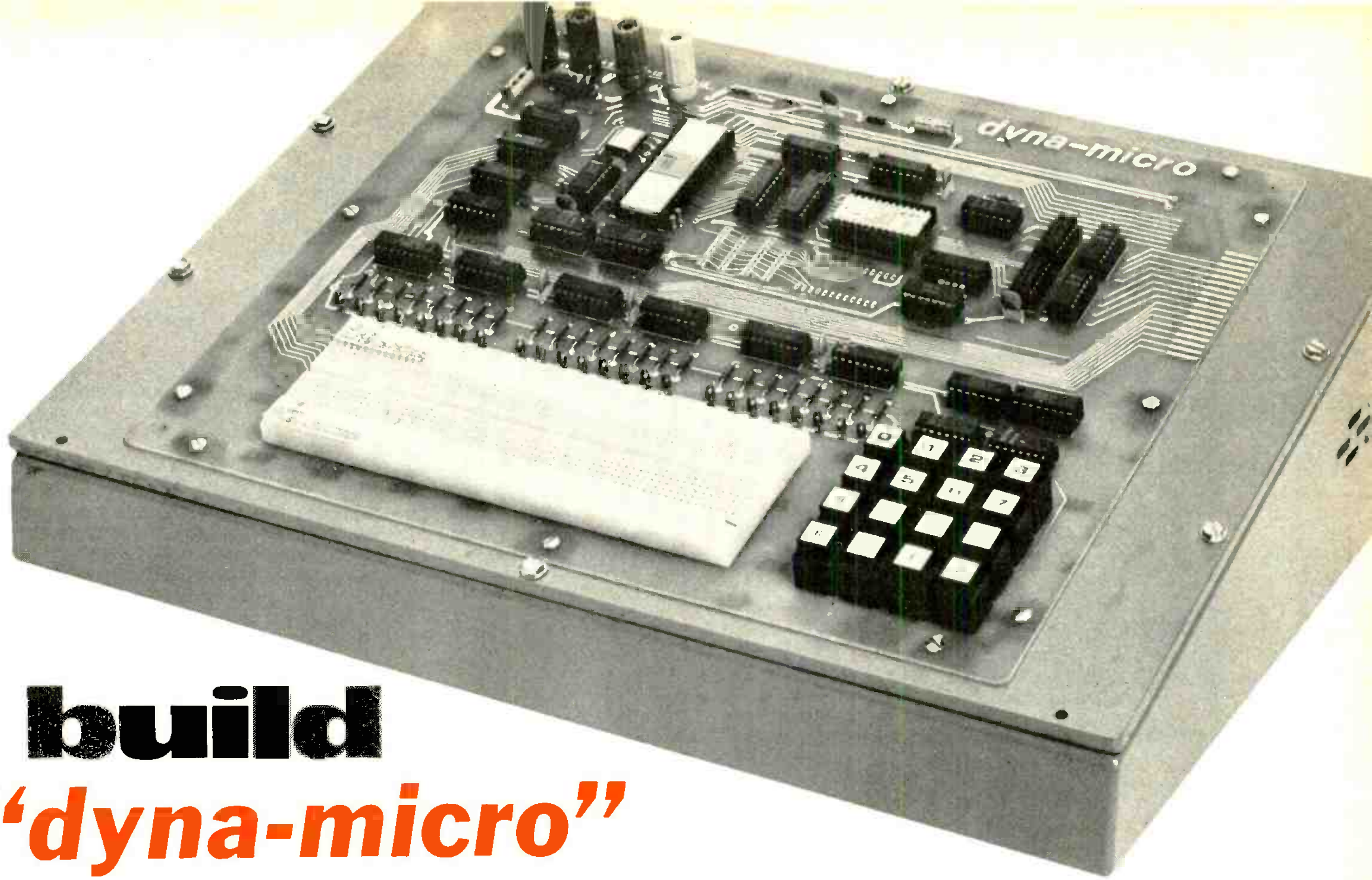
Matsushita

Still another ½-inch VTR format is being test marketed in Japan. This one, called National Home Video, uses a cassette. The VTR deck is being sold for $765, with 60-minute tapes priced at $18.50. Sales are limited to one of Japan's smaller islands, and the future of this system is uncertain.

Other systems

The past year has taken its toll of systems that once appeared to hold promise. RCA has shelved its ¾-inch cartridge SelectaVision MagTape system to clear the way for its work on the videodisc. American Videonetics' work on a slow-speed ¾-inch VTR has been halted by its new parent, Japan's Omron. Not a word has been heard from i/o Metrics since its February 1975 demonstration of a laser-read photographic film system. Of course

(continued on page 88)



build "dyna-micro" an 8080 microcomputer

Complete with keyboard for data entry, LED readout of the address and data, breadboard socket for experimenting, 500-bytes of PROM, 500-bytes of RAM, expandable to 65K and self-contained power supply

JOHN TITUS

LAST MONTH, PART-1 OF THIS ARTICLE described the operation of the Dyna-Micro and presented the schematic diagram and construction details.

This month, the foil patterns and component placement diagram are presented along with a description of how to use the Dyna-Micro.

Final check

All integrated circuits should now be in place, hopefully in sockets. Remove the 8080A IC and check for the correct voltages at its socket. You should find +5 volts at pin 20, +12 volts at pin 28 and −5 volts at pin 11. You should also check the PROM for −9 volts at pins 16 and 24. A PROM must be in one of the sockets for the −9 volts to be present.

Turn on the power with all the IC's in place and check the power supply voltages. They should be at their preset levels of +5 and ±12 volts. If these are correct, your Dyna-Micro system should be operational.

Depress the R key. The LED displays should now indicate 003 (00000011) at the HI and 000 (00000000) at the LO. The OUTPUT PORT 2 LED's may have some random data present. If this doesn't happen, remove the power and carefully check your system. Things to check for are solder bridges, cold solder-joints, unsoldered IC pins and incorrect IC orientation. Plated through holes don't have to be soldered unless there is a component or other lead going through them. Also check for +5 volts and ground at all the IC's.

If the LED's display the correct pattern, depress and release the S key. Each time that this key is pressed, the LO address information should be incremented by 1. If this doesn't happen, check the keyboard encoder section and the I/O sections.

If the LED's are operating correctly, enter some data (0 through 7) from the keyboard. The binary codes for these keys will be entered in the Data-Register (OUTPUT PORT 2) display in the three least-significant bits. You will note that as new data is entered, the old data is shifted to the left where it finally disappears as more new data is entered. The actual operation of the KEX software to input and output data will be discussed later.

How to use the Dyna-Micro

The Keyboard Executive software is the "heart" of the Dyna-Micro system. It allows you to examine data or pro-

PARTS LIST

R1, R2, R4, R5, R6—1000 ohms, ¼ W, 10%
R3—2200 ohms, ¼ W, 10%
R7-R30—220 ohms, ¼ W, 10%
C1—33 μF/6.3V electrolytic
C2—5 μF/50V electrolytic
C3, C5-C14—0.01 μF disc ceramic
C4—3.3 μF/16V electrolytic
D1-D24—Small red LED (Hewlett-Packard 5082-4484, Monsanto MV5075B, or equal.)
D25—1N751A, 5.1V Zener
D26—1N746, 3.3V Zener
IC1, IC22, IC23—SN7404 Hex inverter
IC2, IC3, IC30—SN7400 Quad 2-input NAND gate
IC4—SN74174—Quad type-D flip-flop
IC5—8224 Clock generator (Intel)
IC6, IC7—8216 Bus driver (Intel)
IC8—8080A CPU (Intel) (Must be "A" version)
IC9, IC10—8111-2 RAM memory (Intel)
IC13, IC17—SN74LS05 Open-collector hex inverter
IC14—SN74LS155 Dual 2-to-4 line decoder
IC15—1702A PROM memory (Intel)
IC18—SN74L42 BCD to decimal converter
IC19—SN7402 Quad 2-input NOR gate
IC20, IC21—SN74L04 Hex inverter
IC24-IC29—SN7475 Bistable latch
IC31—DM8095 or SN74365 Buffer
IC32, IC33—SN74148 8-to-3 line priority encoder
S1-S16—Keyswitches with legends
XTAL—6.750 MHz crystal, HC-18/U holder
Solderless breadboard—SK-10 IF18
Chassis—10" x 12" x 3" (Bud type AC-413)
Misc.—Binding posts, IC sockets, hardware

Optional IC's for expanded memory
IC11, IC12—8111-2 RAM memory
IC16—1702A PROM memory

Keyswitches are available from Solid State Systems, Inc., P.O. Box 617, Columbia, MO 65201. Order type LM or LFW-LT, with legends shown in Fig. 7.

Breadboarding socket is available from Circuit Design, Inc., Box 24, Shelton, CT 06484.

The following kits are available from Circuit Design, Inc., Box 24, Shelton, CT 06484. Phone 203-735-8774. All kits, except MMD-1IC, MMD-1 PROM, and MMD-1 RAM come complete with construction details, experiments, and tutorial material.

#MMD-1CBK—Etched, plated-through PC board, keyboard parts and breadboarding socket. $125 postpaid.

#MMD-1K—Complete kit of parts including 1702A PROM preprogrammed with KEX software and power supply. $350 postpaid.

#MMD-1A—Completely assembled and tested system. $500 postpaid

#MMD-1IC—Microprocessor IC set includes one 8080A CPU, one 8224 clock generator, two 8216 bus drivers, two 8111-2 RAM memory, one 1702A PROM preprogrammed with KEX. $100 postpaid.

#MMD-1 PROM—Additional 256-word PROM (1702A). $40 postpaid.

#MMD-1 RAM—Additional 256 words of RAM (8111-2). $15 postpaid.

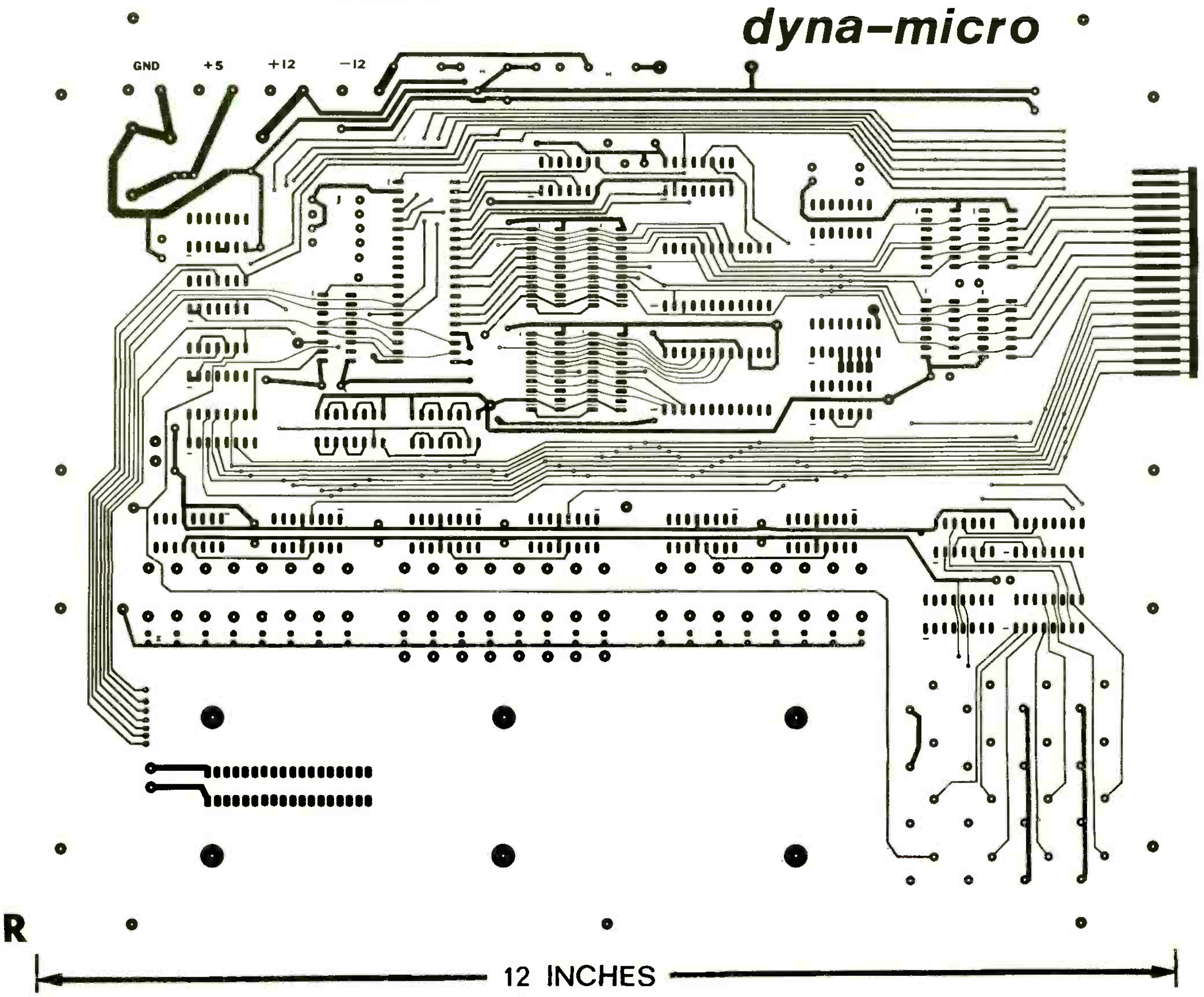


FIG. 3—FOIL PATTERN of the component-side of the double-sided board. The actual board measures 10 × 12 inches (254 × 305 mm.)

gram steps and to change data or program steps stored in the R/W (read/write) portion of the memory. We can also specify any address and start the program there.

The data keyswitches are labeled 0-7. When any one of these keys are depressed, data is entered in the corresponding octal format. The H key designates the HI address and the L key designates the LO address. The G represents Go and S represents See and Store. Three keys are not used by the KEX—A, B and C. The R key will always reset the computer and restart the KEX program. All manual data entry is through the keyboard in the basic Dyna-Micro system.

Whenever you want to start the system, depress keyswitch R. This will reset the KEX program and address the first location in the R/W section of the memory. This is HI=003 and LO=000. If you will only be using 256 words of R/W memory to get started, it must be in the locations allocated for IC9 and IC10. The KEX will not function without R/W memory.

To enter data, whether it will be used for new data or to address a memory location, simply depress the numbered keys as you would on a calculator. Data will be entered into the three least-significant right-most) LED's and it will shift to the left as more data is entered. If a mistake is made, simply re-enter the data. Mistakes are shifted out and lost. The data-register LED's will display the data just entered from the keyboard and this may be used as the HI address by depressing H, or it may be used as the LO address by depressing L. These keys will transfer the data to the proper LED display register and it will be used by the 8080A to address a new memory location.

Whenever a new HI or LO address is specified by depressing either the H or L keys, the KEX program will always display the contents of the specified memory location on the data-register LED's. To examine the contents in the next location, depress the S key. By depressing the S key again and again, we can examine the contents in sequential memory locations. It should be noted that this S function follows increasing memory locations, *not* the sequential *flow* of a program.

To change the contents in a R/W memory location, simply load the address using the data input keys and the H and L keys. The old data presently in the location will immediately appear on the data-register LED's. Enter the new data into the data register using the numeric keys and then enter it into the R/W location by depressing the S key. After S is depressed, the new data is stored and the address is automatically incremented by one to address the next memory location. The data from the next location is now displayed on the data-register LED's.

The S key has two functions, both See and Store. How can we tell the difference? If the data has changed we will store it and see the next location. If the data hasn't changed, it will be stored in the same location that it originally came from and then the contents from the next memory location will be displayed. When we store old data back to the same location, we can't really see

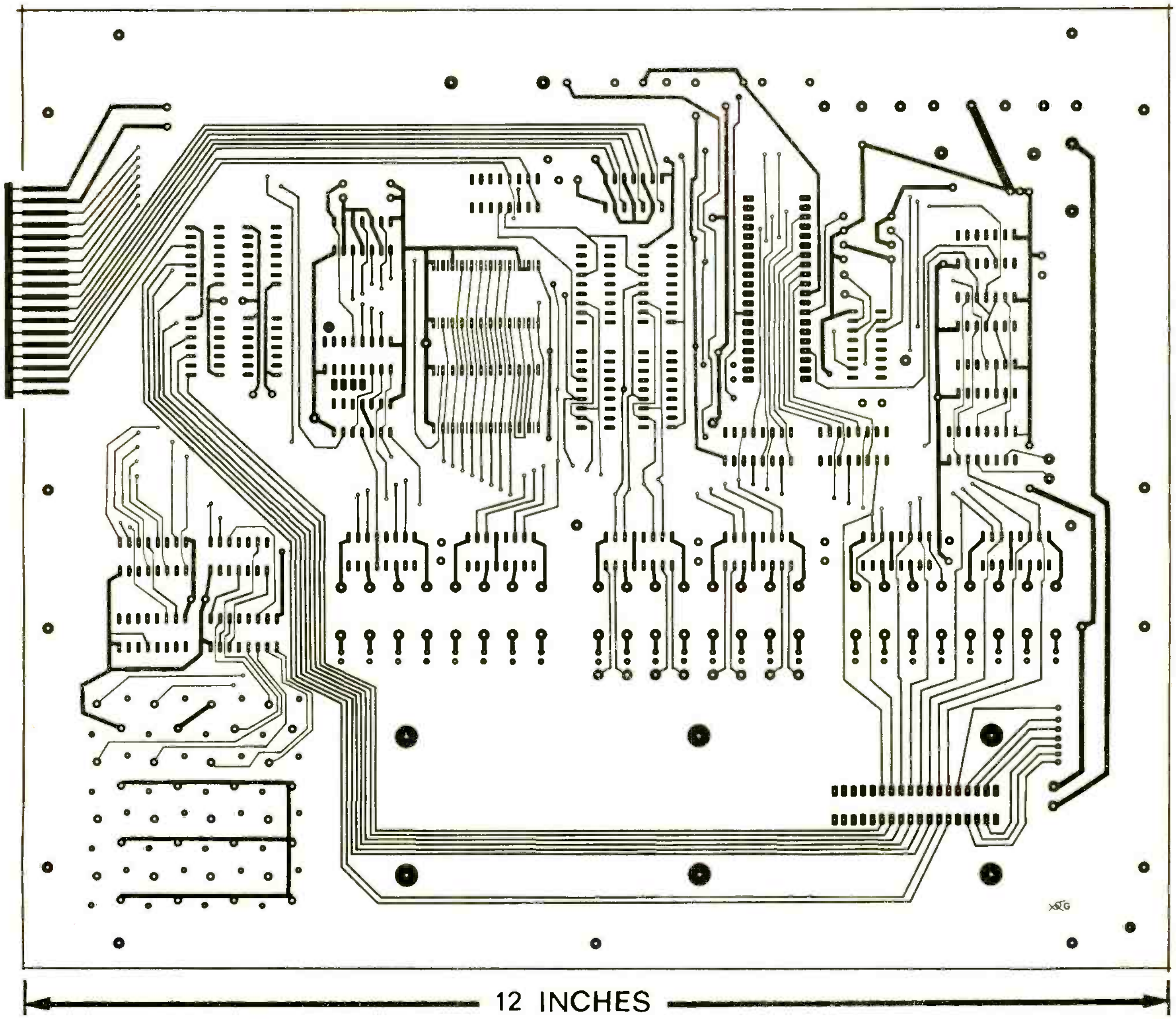


FIG. 4—FOIL PATTERN of the bottom of the double-sided board. A board with plated-through holes is recommended.

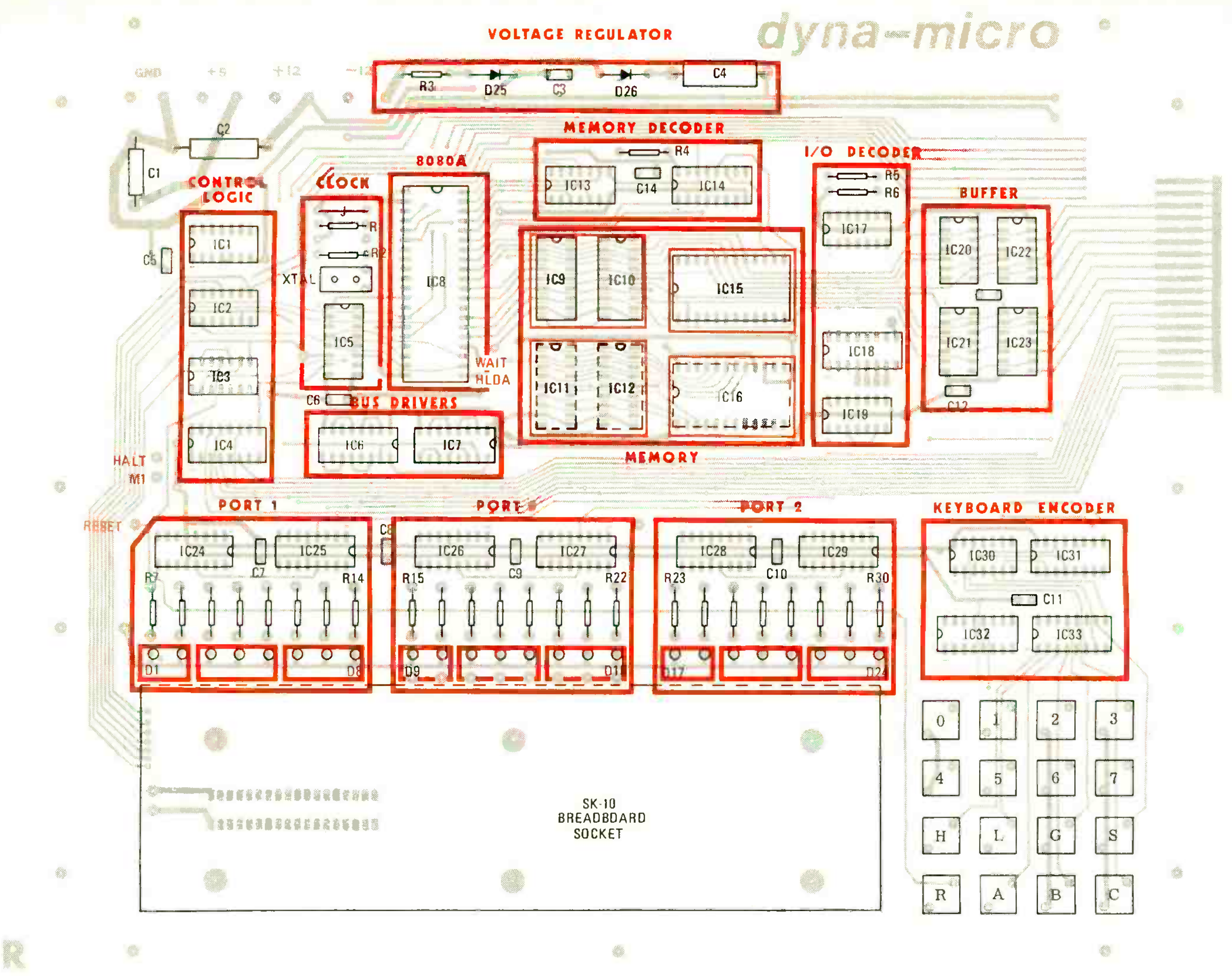


FIG. 5—COMPONENT PLACEMENT diagram. The board is shown divided into functional sections.

any change, but this is exactly what the KEX does. It displays data from a specific location, allows us to make changes and then puts it back. If no changes are made, the old data is restored to its memory location.

Once a program is entered into the computer through the keyboard, we can start it by loading our starting address and actuating the G key. This will transfer control from the KEX software to the program that we want to run. Starting addresses are loaded in the same way as previously described. Starting addresses don't have to be in R/W memory, but can just as easily be in PROM.

If your program starts at the first location in R/W memory (003 000) you can simply depress R followed by G. We can do this because KEX always resets the address back to this first R/W location.

Keys labeled A, B and C are not used by the KEX program. It should be remembered that the three LED output ports and the keyboard are not hard-wired for use with the KEX program only. They are available for you to use in your programs. All fifteen keys may be used in any way you like, using software.

TABLE 1—MEMORY ALLOCATION

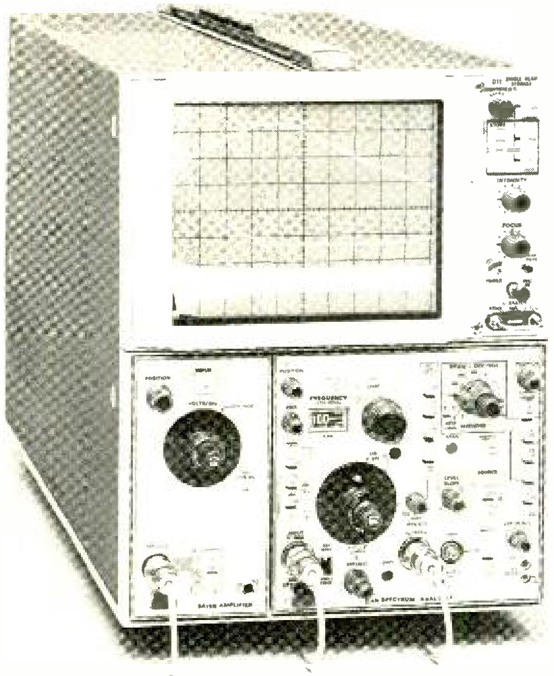
HI	LO	
000	000	KEY PROM
000	377	
001	000	OPTIONAL PROM
001	377	
002	000	OPTIONAL R/W MEMORY
002	377	
003	000	R/W MEMORY
003	377	
004	000	AVAILABLE FOR USER EXPANSION
377	377	

How KEX operates

The keyboard Executive software is contained in a single 1702A type PROM in the location allocated for IC15. This contains all the necessary software to operate the keyboard and the LED displays. This is our software controlled "front panel", since the keys and LED's perform functions determined by the KEX software.

Whenever the R key is depressed, the 8080A CPU will start to execute the program that starts at location 0. Looking at the software listing for the KEX program (Table II), you will see that immediately after starting at location 0, the software instructions cause the computer to jump to location HI=000, LO=070 (HI=000 throughout the KEX program) where we start the program by pointing to the first R/W memory address (003 000.) The address and the data in that location are displayed on the three output ports. This is done between POINTA and POINTC in the program (see Table II). The software between POINTC and POINTD will do the necessary tasks to input new data from the keyboard and shift the data onto the LED's. The shifting is done inside the 8080A with software instructions. Doing this by hardware would require

(continued on page 84)



Testing HI-FI Gear

Measuring the performance of today's hi-fi gear requires state-of-the-art test equipment. Here's a rundown of the equipment and the measurements

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

TODAY'S HIGH-FIDELITY COMPONENT equipment has improved so radically in performance that the laboratory or service shop equipped with mediocre test and measuring equipment can no longer hope to measure some of the excellent specifications and features of the new audio amplifiers, tuners, record players and tape decks now available to audio enthusiasts. As recently as five years ago, an audio signal generator (a key component in any audio service shop or lab) having internally generated distortion of under 1% was considered to be a pretty good signal generator. Now, with high-powered audio amplifiers and even FM tuners boasting harmonic distortion ratings of tenths of a percent or even less, the use of such a generator for test purposes would hardly make sense. Furthermore, new measurement standards and requirements applicable to many types of components have become accepted, and these invariably require more and better test equipment than ever before. We recently compiled a list of equipment that one would need to test and measure everything from a record player to a power amp and divided the list into sub-groups needed for the various component categories. The function and purpose of each item will be described, along with some guide lines as to the minimum performance that one would expect from each piece of equipment in light of the high quality of today's hi-fi gear.

General equipment

Perhaps the most important piece of equipment you will need for checking any hi-fi equipment is a good reliable oscilloscope. The scope is used to observe input signals, output signals, levels of distortion, hum components and more. Because we are dealing primarily with audio frequencies, the scope you choose need not have super-wideband response. A scope that is flat to 1 MHz or so will do nicely. By saving money in foregoing wideband response, you can concentrate instead on features such as dual-trace capability (which enables you to examine the outputs of two stereo channels at once, or the input and output of a single channel simultaneously, or even output plus a separate display of distortion), better triggering circuitry and more accurate calibration, plus greater vertical input sensitivity. Horizontal sweep circuitry should be accurately calibrated, too, so that the scope can be used to fairly accurately determine audio frequency.

Most hi-fi equipment used in this country is rated for operation from a 120-VAC 60-Hz power source. Unfortunately, power companies seldom deliver exactly that voltage to your wall outlet. A power amplifier connected to a 110 volt power source may deliver considerably less audio power than its rating would indicate, so it is important to connect such equipment to a variable voltage transformer that can be adjusted to supply exactly 120 volts under all load conditions. An accurate AC voltmeter is a necessary adjunct to the variable voltage transformer and, if you are interested in measuring the power consumed by the unit-under-test, a direct-reading wattmeter is a worthwhile addition.

Two or more accurately calibrated AC VTVM's complete our list of general items needed in audio measurement work. Digital readout types are easier to read accurately, but if you choose digital AC VTVM's, make certain that their response is "flat" to at least 100 kHz and down to 10 Hz or so. The same frequency response requirement applies to conventional meter-type AC VTVM's.

Audio amplifiers

Figure 1 illustrates the major pieces of test equipment that would be required to measure some of the most important audio amplifier performance

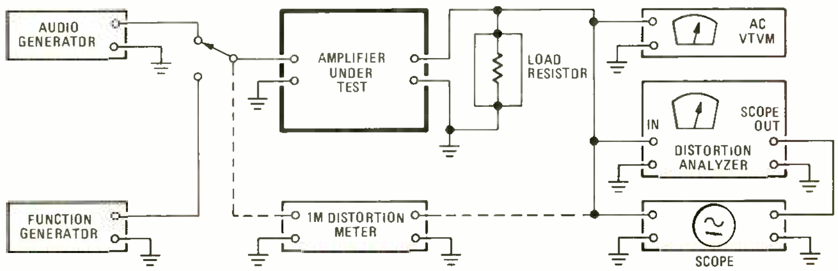


FIG. 1—TEST SETUP for measuring the performance of audio amplifiers.

specifications. The Audio Generator produces signals within and beyond the audio range. To keep pace with some of today's better audio amplifiers, its frequency range should extend at least 10 Hz to 100 kHz or even higher. More important, its own residual harmonic distortion content should be well below 0.1% and its maximum output should be in excess of 2 or 3 volts RMS. Its own frequency response should be considerably better than that of the amplifier being measured, preferably with no more than 0.1 dB amplitude variation over the audio spectrum. This generator will be used to deliver sinewaves to the amplifier for all frequency response measurements and harmonic distortion measurements.

The load resistor shown in the diagram, while perhaps the least expensive item in the overall test equipment setup, is a highly critical component. Ideally, it should be purely resistive (ordinary wirewound high-wattage resistors also have measurable inductance) and its wattage rating should be at least twice as great as the power rating of the most powerful amplifier to be measured. Resistance value should be within 1% of 8 ohms (the normal impedance at which power amplifiers are rated) and, if power measurements are to be made for 4-ohm operation, additional load resistors having that value should be used. Combinations of 8-ohm precision resistors are often connected in series or parallel for 4-ohm and 16-ohm loads, if required. To illustrate the importance of resistive accuracy, if an 8-ohm resistor were 5% on the high side and you were trying to measure 50 watts across such a load while unaware of the resistance error, you would increase output until the AC VTVM showed a reading of 20 volts RMS. (Power $= E^2/R = 20^2/8 = 400/8 = 50$ watts.) If, in fact, the load resistor were really 5% off, or 8.4 ohms in value, 20-volts developed across that resistor would really be equivalent to a power output of 47.6 watts. Accurate calibration of the AC VTVM is even more important for, if that instrument read 5% on the high side, a reading of 20 volts would really be equal to only 19 volts, and that would be equivalent to only 45.13 watts of power delivered by the amplifier.

A distortion analyzer is a device that, through the use of sharp filters, nulls out the fundamental frequency of the output signal of an amplifier under test and reads residual harmonics as a percentage of total signal. The filter nulling process can be slow and tedious, particularly if many repetitive harmonic distortion measurements are to be made. Many modern distortion analyzers are self-nulling and some automatically set the 100% reference point below which distortion is read.

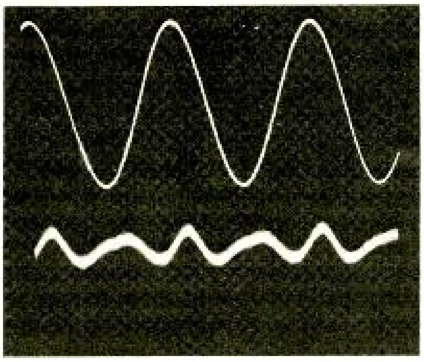


FIG. 2—DUAL-TRACE SCOPE permits simultaneous display of audio output signal and the distortion components via the distortion analyzer output.

Another form of distortion that is of interest in measuring audio equipment is intermodulation distortion. This form of distortion is produced by the addition or subtraction of two or more frequencies being processed by an amplifier, which yields sum and difference frequencies. An IM distortion meter supplies a low- and high-frequency input signal and also reads the sum and difference products produced at the output of the amplifier under test. It therefore substitutes for both the audio generator and the harmonic distortion analyzer when this test is made. The oscilloscope shown connected in parallel across the output of the amplifier serves to display the various output signals being measured.

The block diagram of Fig. 1 shows the setup for measuring the performance of a single channel of an amplifier. Since power output of audio amplifiers is measured with both channels operating, the output of the audio generator must be connected to both stereo inputs at once and loads must be connected to the output of each channel at all times. AC VTVM's are often used in pairs to monitor the signal coming out of the second channel, even if the other measuring instruments are across only one channel at a time.

The oscilloscope described earlier, as shown in Fig. 1, has one of its vertical inputs connected across the output while the other input is connected to a "scope output" terminal on the distortion analyzer. This scope output presents a signal that is an amplified representation of the harmonic distortion components of the output signal and can be displayed on the scope as the second of its two available traces. Often, visual observation of the distortion components permits the technician to analyze the distortion components (e.g. third harmonic, but no second harmonic, etc.) by comparing the repetition rate of the observed waveform with that of the output signal displayed on the alternate trace. An example is shown in Fig. 2. A more precise method of harmonic distortion content evaluation involves the use of a spectrum analyzer.

FM tuner measurements

Figure 3 represents a test setup used to measure FM tuner (or the FM tuner section of a complete receiver) performance. For complete testing, two RF signal generators are required. One of these must be capable of being AM or FM modulated, while the other need not be modulated. Ideally, the primary generator should cover the range of frequencies from 10.7 MHz (the IF frequency of virtually all FM sets) to 216 MHz (twice the highest frequency in the U.S. FM frequency-band allocation). Frequencies above the FM range are needed to determine the unit's susceptibility to spurious signals. The matching network connected between the output of the generator and the antenna terminals of the receiver converts the signal from its output impedance (usually 50 ohms) to either 75 or 300 ohms, as required by the antenna input circuit of the receiver. Fixed filters must be inserted between the output of the unit under test and the various pieces of test equipment that we have already discussed. During most measurements, a band-pass filter having cutoff points at 200 Hz and 15 kHz is used, but for some measurements such as residual hum, the filter must be changed to a 15 kHz low-pass filter while for other measurements (such as residual sub-carrier output during stereo reception, and SCA rejection capability), a 200 Hz high-pass filter is

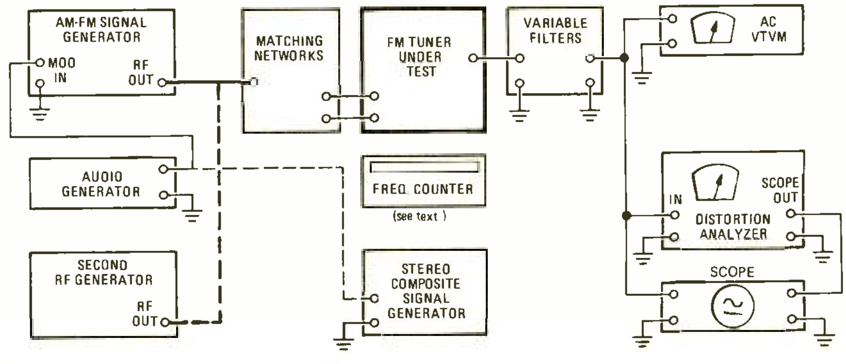


FIG. 3—TEST SETUP for measuring FM performance.

required. For this reason, many labs and shops prefer to use a variable all purpose filter that has adjustable cutoff points to meet the needs of a particular test.

Although the AM-FM generator may have a reasonably accurate frequency calibration, certain tests that use two generators require that the frequency difference between them be very precisely set. Accordingly, an accurate frequency counter capable of reading to above 108 MHz is useful and necessary if accurate results are to be obtained. Assuming both generators are stable after initial warmup, the counter need only be used to set frequency and should be disconnected when actual test measurements are made so that it will not load down the output of either generator and upset the calibrated attenuators. At least one of the generators should be capable of delivering output levels from a fraction of a microvolt to a volt or more, and if such high-level outputs are not possible, wideband or tuned RF amplifiers may be required to increase output range.

Many available FM signal generators are now equipped with internal audio generators, but these usually supply only a few frequencies for modulating the carrier. Since new FM tests involve measurements at audio frequencies from 30 Hz to 15,000 Hz, a separate audio generator may be used to externally modulate the RF generator. Some FM generators also include the necessary circuitry for developing a composite stereo signal needed to modulate the RF carrier for stereo FM measurements. If such circuitry is not part of the FM generator, a separate stereo composite signal generator would be required for making separation and other stereo FM performance measurements. Readers interested in the new measurement standards for FM tuners and receivers can obtain a copy of the new standards by sending $6.00 to the Institute of High Fidelity, 489 5th Avenue, New York, NY 10017, and requesting a copy of IHF-T-200, 1975. This standard gives detailed information regarding exact test setup and measurement techniques that should be employed in testing FM tuners and receivers.

Turntable and tape deck measurements

An important piece of test equipment used in measuring speed variation of both turntables and tape transport mechanisms is called a wow-and-flutter meter. In the case of turntables, a special test record containing a 3000 Hz tone is used with this instrument, while in the case of tape decks, a suitable tape recording of the same frequency is used. The wow-and-flutter meter detects any cyclical variation in pitch of that 3000 Hz tone and presents that variation as a percentage deviation from true speed, as read on a suitably calibrated meter. Some wow-and-flutter meters have certain weighting networks built in and when these are inserted the resultant reading is called the weighted wow-and-flutter reading, sometimes referred to as WRMS wow-and-flutter.

Miscellaneous accessories

In addition to the basic pieces of test equipment already listed, the properly equipped lab or test facility devoted to audio work will also own a variety of less costly accessories. These will include an assortment of test records, each designed for a specific purpose. There are test records designed for the measurement of cartridge frequency response, cartridge tracking ability, turntable rumble, and even overall hi-fi system response including the loudspeakers. Measuring loudspeaker performance, however, is a most difficult assignment and one for which there is very little agreement between experts as to the techniques that should be used. We have purposely omitted any reference to calibrated microphones, graphic chart recorders or anechoic chambers, any or all of which might be involved in any attempt to make meaningful loudspeaker performance measurements.

Certain hum-and-noise measurements for audio products involve the use of various "weighting networks". Essentially, weighting networks take the form of specific filters that modify frequency response in an attempt to take into account the response of the human ear. Normally, three types of weighting networks are commonly used, and these are designated as "A" weighting, "B" weighting and "C" weighting. The circuit shown in Fig. 4,

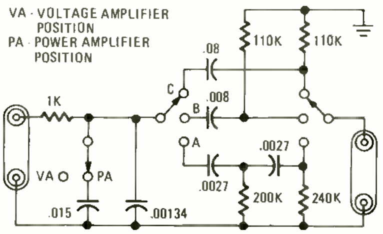


FIG. 4—WEIGHTING CIRCUIT provides A, B or C weighting curves for S/N measurements.

if built into a properly shielded enclosure, will provide the proper response for these three popular weighting filter types.

Combination test equipment

Recognizing the complexity of some of the test setups required for measuring audio products, many test-equipment manufacturers have combined some of the items shown in the block diagram of Fig. 1 into single, multipurpose instruments. For example, there is available a distortion analyzer that incorporates a low-distortion audio signal generator and, more recently, is available complete with an IM distortion reading circuit as well. As we noted earlier, there are also FM signal generators that have built-in stereo signal generators, thereby reducing the number of separate items required for FM product testing. One enterprising manufacturer has assembled a group of precision high-wattage load resistors with a handy switching box that permits four-channel-selection of 4-, 8- or 16-ohm loads and also incorporates a set of monitoring terminals so that any channel's output can be displayed on the oscilloscope at will.

More sophisticated testing

Referring once more to Fig. 1, note that a function generator is also included in that diagram. The function generator will, at the very least, be able to produce squarewaves within the audio range. Some manufacturers prefer to test their products by using squarewave input signals instead of pure sinusoidal tones, and a good function generator is needed to duplicate these tests. Better function generators are also capable of producing tone burts, such as those shown in Fig. 5.

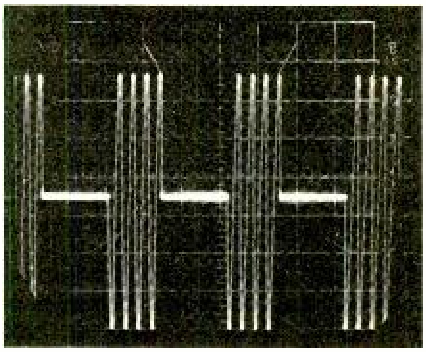


FIG. 5—TONE BURSTS produced by some function generators are useful in audio testing.

Some experts believe that such input signals are useful in analyzing certain aspects of the performance of an amplifier or a speaker system. While most function generators are also capable of producing ordinary sinewave signals, these should never be used in place of the low-distortion audio generator previously discussed. The inherent level of distortion of function-generator produced sinewaves is usually of the order of 1.0% or even higher. If the function generator covers the entire audio range, its sinewave output may be used for a quick plot of frequency response, but not for amplifier distortion or noise measurements. For this measurement, a signal generator with much lower distortion is required.

(continued on page 82)

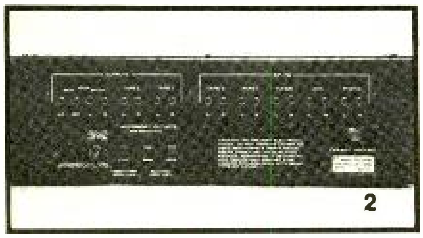
Radio-Electronics Tests Phase Linear Model 2000 Preamp

1

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

THE SUDDEN RENEWED INTEREST IN HIGH-powered basic amplifiers has prompted many manufacturers to design and market a variety of preamplifier-control units. Phase Linear Corporation offers two such preamplifiers, the least costly of which is the model 2000 shown in Fig. 1. Its symmetrically arranged front-panel rotary controls include a SELECTOR switch at the upper left, master VOLUME at the upper right, BALANCE control at the lower right and an AMBIENCE level control at the lower left. Smaller, centrally located rotary controls take care of individual control of bass and treble tonal compensation for each channel so that a total of four tone controls are required. Pushbutton switches along the bottom of the panel include TAPE 1 and TAPE 2 monitoring switches, a STEREO/MONO switch, AMBIENCE switch, a switch labelled EQ that adds a fixed amount of bass-boost below 50-Hz independent of any tone control settings, a pair of turnover switches that determine the frequency at which the BASS and TREBLE controls begin to boost or cut and a tone-defeat switch that bypasses tone control circuitry altogether, if desired. A tiny power indicator along the upper center of the panel tells the user that the preamp is being powered.

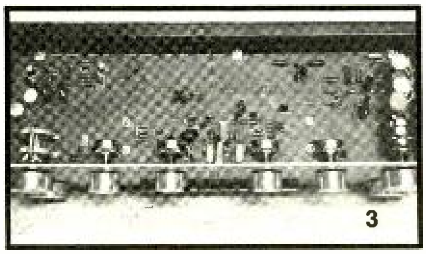
The rear panel of the 2000, shown in Fig. 2, is equipped with five pairs of input jacks (including only one pair for low-level phono inputs), dual pairs of TAPE-output jacks and a pair of FRONT and REAR channel outputs. Three AC convenience outlets (two switched, one unswitched), a line fuse and a CHASSIS GROUND terminal are also located on the rear panel.



2

Circuitry

A view of the inside of the chassis is shown in Fig. 3. If circuitry seems sparse, Phase Linear can thank the makers of today's high-density integrated circuits, several of which are used in this design. The block diagram of Fig. 4 illustrates the relatively simple circuit arrangement used in this preamplifier. Of interest is the amplifier block labelled ambience that is driven with both left and right channel signals via a differential amplifier. The difference information is combined with primary channel information in such a way that the right-rear output jack contains the R — L signal while the left-rear jack contains the L — R signal. Such signals, fed to a secondary stereo amplifier and an extra pair of speakers located behind the listener, tend to create a sense of "concert hall" ambience in listening rooms of modest proportions. It should be noted that this method of ambience derivation can also be achieved passively, as suggested some years ago by David Hafler, then of the Dynaco Company.

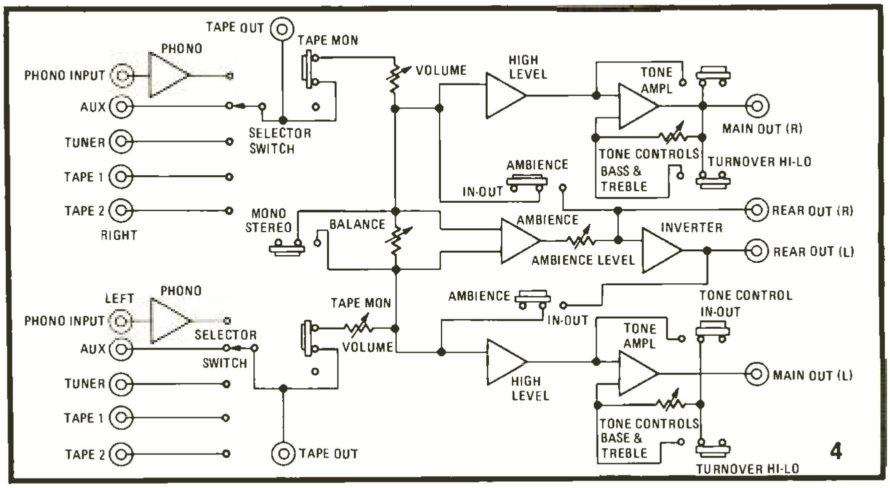


3

A circuit feature not specifically evident from the block diagram is the fixed bass-boost equalizer that Phase Linear calls an active equalizer. Effective for frequencies below 50 Hz (where many speakers require some equalization), this extra fixed bass-boost is push-button selected at the front panel.

Lab measurements

A summary of performance measurements for the Phase Linear model 2000 is listed in Table I. At nominal rated output of 2.0 volts, THD was a mere 0.022%, remaining constant at that level all the way up to 10 volts. Waveform clipping occurred at an output of 11.0 volts. While input overload on phono exceeded published specifications (94 mV instead of 85 mV at 1 kHz), we still consider this to be a bit on the low side in terms of the dynamic range available on some current models of both preamplifiers and integrated amplifiers. Hum-and-noise in phono, reported in our tests as 70 dB, is referenced to the actual input sensitivity (4.0 mV). Translated to a 10-mV input, the figure would increase to 78 dB, or 4-dB better than claimed. RIAA equali-



4

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Frequency Response: (phono) ±0.5 dB of RIAA standard. **Rated Output:** 2.0 volts; maximum 10 volts into 5K load. **Total Harmonic Distortion:** Less than 0.1% at rated output. **Input Sensitivity:** (phono) 3.2 mV; (high level) 350 mV. **Phono Overload Capability:** 80 mV. **Hum and Noise:** (phono) 74-dB below 10-mV input; (high level) 88-dB. **Ambience Signals:** Left rear = L – R; Right rear = R – L. **Bass Control Range:** (50-Hz turnover) ±11 dB @ 20 Hz; (150-Hz turnover) ±13 dB @ 20 Hz. **Treble Range:** (5-kHz turnover) ±10 dB @ 20 kHz; (2-kHz turnover) ±14 dB @ 20 kHz. **Dimensions** 5½" (14 cm) high × 19" (48.3 cm) wide × 6" (15.2 cm) deep. **Weight:** 9-lbs (4.0 Kg), less optional walnut cabinet. **Suggested Retail Price:** $299.00.

TABLE I
RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer **Phase Linear** Model **2000**

	R-E Measurements	R-E Evaluation
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output (%)	0.022	**Excellent**
Harmonic distortion at maximum output	0.022	**Superb**
Output level for clipping	11.0 volts	**Very good**
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ± ___ dB)	0.4	**Very good**
Maximum input before overload (mV)	94	**Average**
Hum/noise referred to full output (dB) (at rated input sensitivity)	70	**Very good**
HIGH LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± ___ dB)	13-28, 1.0	**Excellent**
Hum/noise referred to full output (dB)	82	**Good**
Residual hum/noise (min. volume) (dB)	82	**Average**
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls	See Fig. 5	**Excellent**
Action of secondary tone controls		**N/A**
Action of low frequency filter(s)		**N/A**
Action of high frequency filter(s)		**N/A**
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	4.0 /	
Input sensitivity, auxiliary input(s) (mV)	400.0	
Input sensitivity, tape input(s) (mV)	400.0	
Output level, tape output(s) (mV)	400.0	
Output level, headphone jack(s) (V or mW)	N/A	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		**Good**
Adequacy of input facilities		**Average**
Arrangement of controls (panel layout)		**Very good**
Action of controls and switches		**Excellent**
Design and construction		**Excellent**
Ease of servicing		**Very good**
OVERALL AMPLIFIER PERFORMANCE RATING		**Good**

TABLE II
RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer **Phase Linear** Model **2000**

OVERALL PRODUCT ANALYSIS

Retail price	**$299.00**
Price category	**Medium-high**
Price/performance ratio	**Good**
Styling and appearance	**Very good**
Sound quality	**Excellent**
Mechanical performance	**Very Good**

Comments: The Phase Linear model 2000 is rather unusual in concept. It does not strive for complexity of controls but at the same time does not follow some of the more esoteric preamplifier designs that are conceived to be "straight wire with gain" devices either. We are rather surprised, for example, that Phase Linear would bother to include out-of-phase "difference" (L-R) terminals on a unit of this type. It seems to us that the sophisticated buyer who opts for a stereo preamp/control unit is not about to add a second amplifier and another pair of speakers for what is, at best, a pseudo-quadriphonic effect that the maker of this unit has chosen to call ambience. And, while the action of the tone controls is excellent and the choice of turnover frequencies is a feature we especially welcome, there are integrated amplifiers and even complete receivers on the market that offer as much tone control flexibility, some even adding a mid-range control. I suppose what is troubling us is that the Phase Linear unit does not quite fit into the two well defined patterns associated with separate preamps. It is neither a full-featured control unit (many less costly preamps at least offer dual pairs of phono inputs, for example), nor is it fashioned in the mold of the so-called "pure" preamps that offer virtually no tonal compensation facilities and simply provide a central program switching facility and faultless signal amplificaiton.

Not that we could fault its signal handling and reproduction capability. Aside from the rather limited phono overload capability (in terms of what is available today on competitive units), all programs reproduced using the model 2000 were in no way colored by its presence in the circuit, as evidenced by our direct switching comparisons in which master tapes were fed directly through to a power amp and then through the combination of this preamp and the same power amp, with preamp gain set at unity. We suspect that elimination of the stages and controls needed for the ambience feature might have resulted in a lower selling price for this unit and that, in turn, might have made the model 2000 a bit more of an audio bargain than it presently seems to be.

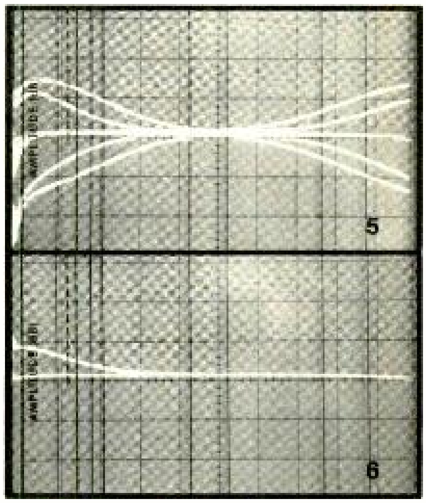
zation was accurate to within 0.4-dB from 30 Hz to 15,000 Hz and overall frequency response (via the high level inputs) was flat within 1-dB from 13 Hz to 28,000 Hz.

The scope photo in Fig. 5 shows the multiple response curves obtained by setting the bass and treble controls to their maximum clockwise and counterclockwise positions and by varying the turnover points from 50 Hz to 150 Hz (for the bass control) and from 5 kHz to 2 kHz (for the treble controls). Note that with the more extreme turnovers, frequency response in the mid-frequency region is affected only very slightly even when controls are used in their extreme positions—a very desirable characteristic.

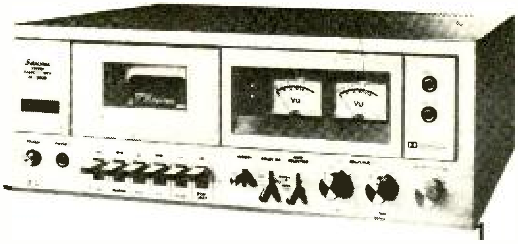
The two traces in Fig. 6 show the response obtained with the tone controls fully bypassed and the response characteristic of the previously mentioned active equalizer.

Use and listening tests

The Phase Linear model 2000 preamplifier is easy to install and to use. Familiarization with its controls takes only a few minutes, and the separately positioned left- and right-channel BASS and TREBLE controls are welcome after dealing with many front panels where the controls have been tandem or concentrically mounted in the interest of space conservation. Our conclusions regarding this unit are to be found along with our overall product summary in Table II, as are our evaluations of the preamplifier's "listenability." It is difficult to try to establish a proper price/performance ratio for a product such as a preamplifier. There are preamp-control units on the market that offer even fewer controls and cost considerably more. Conversely, there are preamps designed for the knob twirler that are crammed with knobs, switches and levers and cost no more than the model 2000. When it comes to the choice of a preamp, personal taste has much to do with one's final choice—as does reproduced sound quality. In the latter category, the Phase Linear 2000 certainly rates high marks. As for whether or not it has too many, or not enough controls, that's something each reader will have to judge for himself or herself. It is a matter of personal taste only. R-E



Radio-Electronics Tests Sansui SC-3000 Cassette Tape Deck



LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

WHILE OTHER MANUFACTURERS OF TAPE cassette decks rushed headlong into the new front-loading configuration for this newest of hi-fi components, Sansui took its time in analyzing the new form and only recently delivered its new model SC-3000 shown in Fig. 1. Evidently, the waiting paid off (at least mechanically), for while this new deck offers all the up-front convenience shared by its competitors there are a few aspects of the compartment design that are worth noting–and which are unique to Sansui's deck. For one, the cassette, when inserted, stands right-side up and is vertically positioned instead of sitting at an angle or horizontally. When the eject button is depressed, the entire compartment pivots forward and the tape is easily dropped in, with tape opening facing downwards. With the compartment illuminated from behind, it is easy to observe tape motion and even to read whatever you have written on the tape identification label. Also, the plastic and metal tape compartment door slips off simply to facilitate head cleaning.

Below the tape cassette compartment are six smooth-acting level controls that actuate the tape transport in its various modes (rewind, play, fast forward), place the unit in the record mode, provide pause control and stop the transport. Pressing the STOP lever a second time ejects the cassette as previously described. It is possible and perfectly safe to go from any tape motion mode to any other without pressing the STOP button in between. Power ON/OFF button and HEADPHONE jack are located to the left of the transport motion controls, while above them are a three digit counter and RESET button that can be used as a memory reset control when the associated memory lever to the right of the transport controls is actuated.

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Frequency Response (record/playback): (normal tape: 30-13,000 Hz (35 Hz to 11,000 Hz ±3 dB); (CrO_2 tape): 30-16,000 Hz (35 to 13,000 Hz ±3 dB). **Wow and Flutter:** 0.09% WRMS. **Signal-to-Noise Ratio** (record/playback): Better than 50 dB without Dolby; Better than 60 dB above 5 kHz with Dolby. **Erasure Factor:** More than 60 dB (at 1 kHz). **Bias Frequency:** 85 kHz. **Input Sensitivity:** (mic): 0.5 mV, 600 to 10,000 ohms. (line): 70 mV, 100,000 ohms. (DIN): 14 mV, 90,000 ohms. **Output Level:** (line): 300 mV with output control at max. **Head Type:** (record/playback): super hard Permalloy; (erase): Ferrite. **Motor:** Electronically controlled, DC. **Fast Wind Time:** Approximately 75 seconds for C-60 tape. **Dimensions:** 17⅜" wide by 6¼" high by 11⁷⁄₁₆" deep. **Net Weight:** 17.6 lbs. **Power Requirements:** 120 volts (can be altered to 220 internally) AC, 50/60 Hz, 10 watts maximum. **Suggested Retail Price:** $360.00.

TABLE I

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Sansui** — Model: **SC-3000**

CASSETTE TAPE DECK MEASUREMENTS

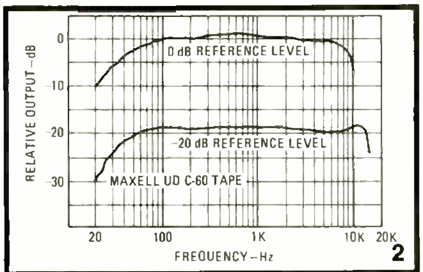
	R-E Measurements	R-E Evaluation
FREQUENCY RESPONSE MEASUREMENTS		
Frequency response, standard tape (Hz-kHz ±dB)	35-14, 3	Very good
Frequency response, CRO_2 tape (Hz-kHz ±dB)	28-13.5, 3	Good
Frequency response, other (see text) (Hz-kHz ±dB)	.... See Fgs.	—
DISTORTION MEASUREMENTS (RECORD/PLAY)		
Harmonic distortion @ −10 VU (1 kHz) (%)	0.7 (Std. Tape)	Excellent
Harmonic distortion @ −3 VU (1 kHz) (%)	1.0	Excellent
Harmonic distortion @ 0 VU (1 kHz) (%)	1.2	Very good
Harmonic distortion @ +3 VU (1 kHz) (%)	1.2	Excellent
SIGNAL-TO-NOISE RATIO MEASUREMENTS		
Standard tape, "Dolby" off (dB)	48	Very good
Standard tape, "Dolby" on (dB)	56	Very good
CRO_2 tape, Dolby off (dB)	53	Excellent
CRO_2 tape, Dolby on (dB)	60	Excellent
MECHANICAL PERFORMANCE MEASUREMENTS		
Wow and flutter (%, WRMS)	0.08	Excellent
Fast wind and rewind time, C-60 (seconds)	65	Good
COMPONENT MATCHING CHARACTERISTICS		
Microphone input sensitivity (mV)	0.6	
Line input sensitivity (mV)	60.0	
Line output level (mV)	280.0	
Phone output level (mV)	140 (8-ohms)	
Bias frequency (kHz)	85	
TRANSPORT MECHANISM EVALUATION		
Action of transport controls		Very good
Absence of mechanical noise		Excellent
Tape head accessibility		Excellent
Construction and internal layout		Very good
Evaluation of extra features, if any		Good
CONTROL EVALUATION		
Level indicator(s)		Good
Level control action		Good
Adequacy of controls		Good
Evaluation of extra controls		Good
OVERALL TAPE DECK PERFORMANCE RATING		Very good

Additional control levers to the right of the MEMORY control include the DOLBY ON-OFF switch and a TAPE SELECTOR with positions for ferric and chrome tapes. Rotary controls include individual channel input record level controls and a single OUTPUT LEVEL control that adjusts the output level of both channels simultaneously. There are no provisions for microphone and line mixing, though either signal source can be connected to the appropriate input terminals.

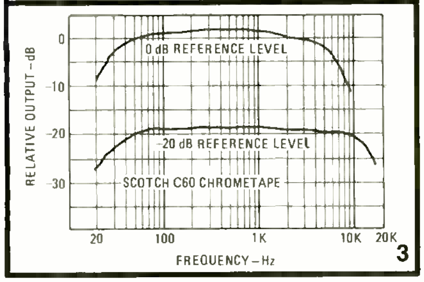
The upper-right section of the front panel is occupied by a pair of record-level meters, calibrated from −20 VU to +3 VU (dB). To the left of the meters are three LED indicators: one to indicate that Dolby circuity is turned on, the next serving as a record indicator and lastly, an LED that lights when the recording peaks are 6-dB higher than 0-dB as indicated on the meters. The LED will, of course, flash when transient peaks occur too quickly for the slow-acting VU meters to register. Left- and right-channel microphone inputs are also front-panel mounted at the extreme right. The rear-panel contains only the usual line input- and output-jacks (of the phono-tip variety) plus a combination 5-terminal DIN socket.

Circuit and construction highlights

The Dolby circuit portion of the Sansui deck is essentially derived from a single integrated circuit and Dolby calibration is factory adjusted with no customer-accessible controls. The equalizer-amplifier electronics consists of a two-stage negative feedback circuit and when the chrome position of the tape selector is chosen, the new equalization value of 70 microseconds with a 3180 Hz turnover frequency is introduced along with the necessary increased bias for CrO_2 tapes. Each channel of the microphone preamp section consists of two low-noise transistors and the VU meters are driven by a separate two-stage transistor amplifier. The meters are designed to operate during playback as well as during record.



2



3

A high-torque DC motor, governed by an electronic control system, is used to drive the capstan and take-up reels in the SC-3000. Capstan drive includes a heavy flywheel and an electronic switch senses end-of-tape motion to disengage the drive motor and return all transport levers to their neutral positions. Total semiconductor complement includes 24 transistors, 2 IC's, 18 diodes and 3 LED's.

Laboratory measurements

Performance measurements made using the SC-3000 deck are listed in Table I, while frequency response measurements using high-output ferric tape and chrome tape are plotted in Figs. 2 and 3, respectively. Surprisingly, we saw no advantage in using chrome tape with this machine, as compared with a good grade of high-output low-noise ferric tape. While in theory the CrO_2 tape is supposed to yield better signal-to-noise ratios, in practice, at least in the case of this machine, the CrO_2 tape provides much less "headroom" than does the normal tape. This can be further understood by examining the 0-dB record level response curves for both tapes. Since S/N is measured relative to the 3% THD point, and since that point occurs at a lower record level in the case of the CrO_2 tape, the ferric tape actually turns out to be better in combined terms of S/N and THD, yielding a figure of 48-dB without Dolby (unweighted) and 56-dB with Dolby. If an "A" weighting network is used, the S/N number improves to 54-dB without Dolby, a good deal better than claimed by Sansui (which also publishes "weighted" figures). Distortion at 0-VU record level for the ferric tape measured a low 1.2% while under the same metering conditions it increased to 1.7% when CrO_2 tape samples were tried.

Wow and flutter measured 0.08% WRMS, just a bit better than the 0.9% claimed—and a very acceptable value for a deck in this price category.

Mechanical operation of the transport was smooth and silent, and the machine handled C-90 and even C-120 tapes of good quality without breaking or stretching them. Automatic sensing of end-of-tape conditions occurred within a matter of a second or two after end-of-tape was reached. In listening tests, the somewhat restricted frequency response capability of the SC-3000 was more than offset by the low noise and distortion levels heard in musical test recordings played back on the machine.

A summary of our reactions to the Sansui SC-3000 cassette tape deck is included in Table II. **R-E**

TABLE II

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Sansui** Model: **SC-3000**

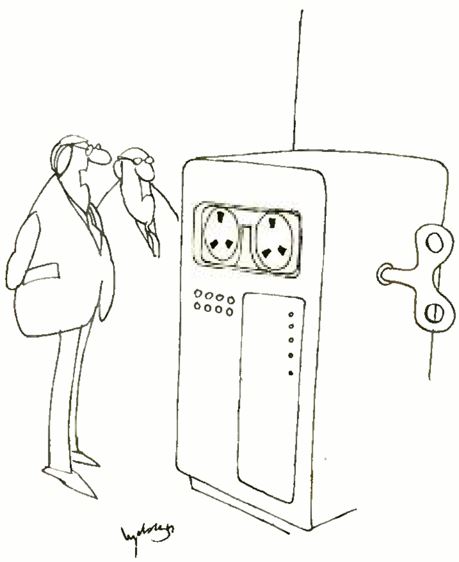
OVERALL PRODUCT ANALYSIS

Retail price	**$360.00**
Price category	**Medium/High**
Price/performance ratio	**Good**
Styling and appearance	**Very good**
Sound quality	**Very good**
Mechanical performance	**Excellent**

Comments: In the design of any cassette tape deck, one always deals with a series of trade-offs between signal-to-noise ratio, total harmonic distortion, and frequency response. Sansui has elected to combine excellent transport motion with S/N ratio and low distortion but has given up a bit of high end response in the process. Since many new tape formulations have particularly high output at the high frequency end of the spectrum, this seems like a proper course of action to us. As far as we know, the "right side up" insertion of the cassette in this front loading deck is a first, and one that takes the fear out of having to insert the cassette (and one's hand) into the unknown recesses of a horizontally oriented compartment. Tape head cleaning is facilitated by this configuration as well.

Our single important criticism has to do with the absence of line and mic mixing facilities that we have come to expect in a unit in this price category. We would also have liked to see a tape selection position for the new Ferri-Chrome combination tapes which seem to be gaining in popularity. The excellent "headroom" provided when using standard high-output tape with this machine suggests that the use of Chrome tapes in this model may constitute an unnecessary expenditure since, with Dolby in use, signal-to-noise is more than adequate with ordinary ferric tapes and distortion is considerably lower than with the more costly CrO_2 varieties. The peak reading LED's are a useful addition, as is the memory rewind feature, though both of these are by no means exclusive in decks at this price.

All in all, the Sansui CS-3000 is a carefully engineered unit that is easy to use effectively for a variety of home recording work.



"If you're not interested in speed this one saves money."

Engineers design electronic circuits –so can you!

Only CREI offers you a choice of 18 home study programs in electronics with circuit design, plus special arrangements for engineering degrees

Circuit design is perhaps the one qualification that distinguishes advanced technical personnel and engineers from the average electronics technician.

If you can design electronic circuits, you can more readily understand the circuitry of all types of electronic equipment. Thus you can more easily handle the repair and maintenance of such equipment, as well as assist in the development of new electronic systems.

The ability to design electronic circuits to solve practical engineering problems is one of the most valuable skills you can possess. Those with this ability are sought after and command positions of far greater responsibility, prestige and pay than the average technician.

If you are going to have a worthwhile career in the field of electronics, the ability to design circuits is a skill you will want to acquire.

Circuit design in all CREI programs

CREI covers circuit design in its home study programs in electronics. This is one of the factors that makes CREI training different from most other home study schools. CREI programs, of course, are college level—the same level of training you will find in any college or university offering programs in electronic engineering technology.

CREI training, however, is designed for home study. The programs give you effective, step-by-step training to help you move up in your career in electronics by using your spare time for technical self improvement.

Unique Design Lab

CREI gives you both theory and practical experience in circuit design with its Electronic Design Laboratory Program. The professional equipment included in this program allows you to construct, test out and correct the circuits you design until you have an effective circuit.

This Lab Program helps you understand advanced electronics. It also gives you practical experience in many other important areas of electronics, as in prototype construction, breadboarding, test and measurement procedures, circuit operation and behavior, characteristics of electronic components and how to apply integrated circuits.

Career Training at Home

Only CREI offers this unique Lab Program. It is a complete college lab and, we believe, better than you will find in most colleges. The "Lab" is one of the factors that makes CREI training interesting and effective. And the professional equipment in this program becomes yours to keep and use throughout your professional career after you complete the training.

Engineering Degree

CREI offers you special arrangements for earning engineering degrees at certain colleges and universities as part of your home study training program. An important advantage in these arrangements is that you can continue your full time job while "going to college" with CREI. This also means you can apply your CREI training in your work and get practical experience to qualify for career advancement.

Wide Program Choice

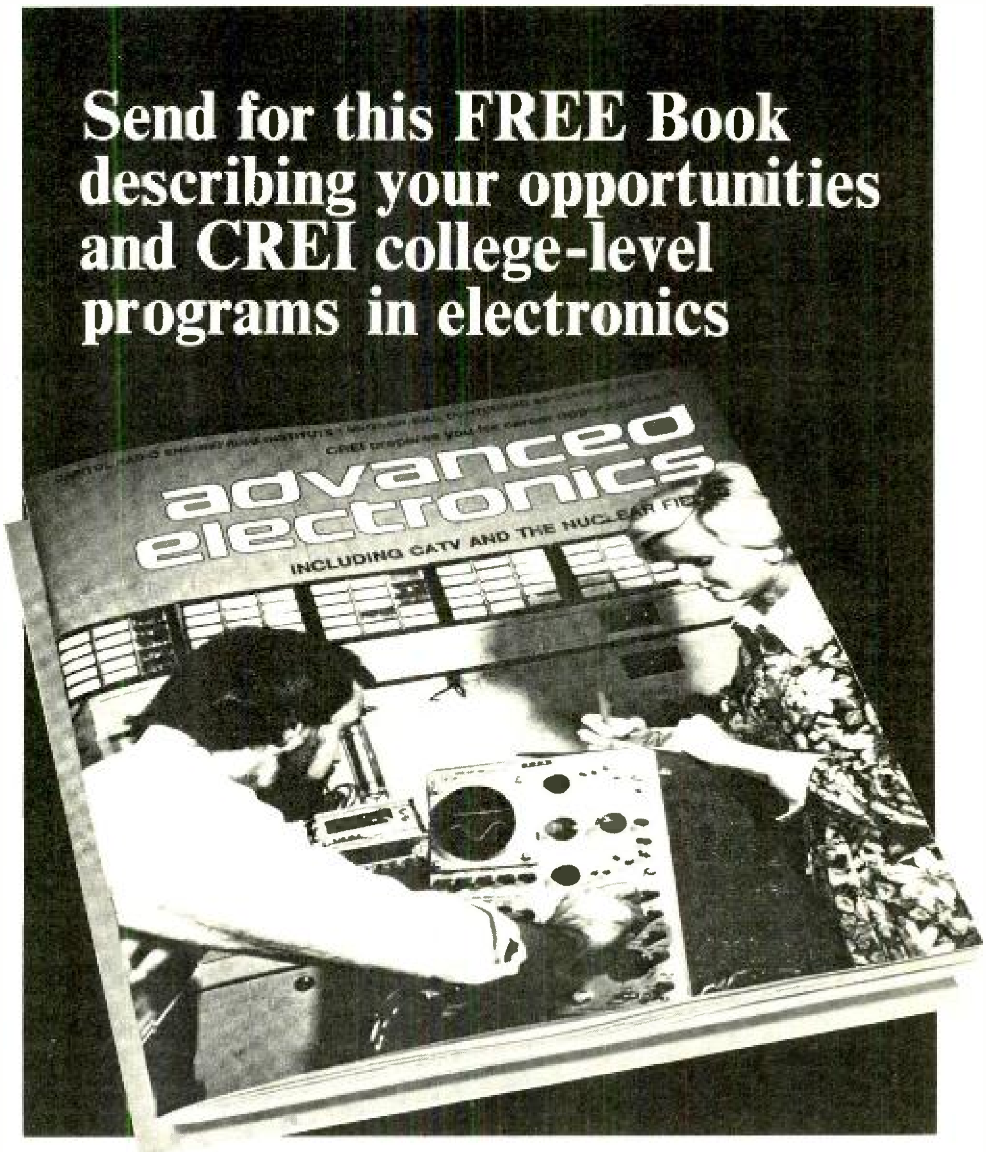
CREI gives you a choice of specialization in 14 areas of electronics. You can select exactly the area of electronics best for your career field. You can specialize in such areas as computer electronics, communications engineering, microwave, CATV, television (broadcast) engineering and many other areas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

FREE Book

In the brief space here, there isn't room to give you all of the facts about CREI college-level, home study programs in electronics. So we invite you to send for our free catalog (if you are qualified to take a CREI program). The catalog has over 80, fully illustrated pages describing your opportunities in advanced electronics and the details of CREI home study programs.

Qualifications

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



Mail card or write describing qualifications to

CREI CAPITOL RADIO ENGINEERING INSTITUTE

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

Accredited Member National Home Study Council

GI Bill

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

The function generator is now occupying more service benches than ever before. This concluding part of a 2-part series of articles covers the operation and applications of this instrument

all about function generators

CHARLES GILMORE*

AS PREVIOUSLY NOTED, THE FUNCTION GENerator puts out a sinewave with a total harmonic distortion of 1% or so. What is unique about sinusodial signals from a function generator is their frequency range, their ability to have controlled DC offset, and the feature that when the wave shape is selected, the output signal is of the correct shape, amplitude and frequency even during the first cycle. This feature is especially important at ultra-low frequencies where a single cycle may represent a major span of time. The sinusoidial oscillator fails in this respect; it needs a number of cycles to become truly sinusoidial and stable in amplitude.

At the upper frequency limits, the function generator is able to analyze most operational amplifier and power supply circuits for frequency response and phase shift characteristics. With the ever-increasing use of integrated operational amplifiers in consumer as well as industrial products, it is important to determine the inherent stability of these circuits in actual operating situations.

Power supplies and other devices designed with operational amplifiers are forms of closed loop servo systems. The servo system derives its high stability from large amounts of negative feedback. The proper technique for analyzing problems in servo systems is to break the loop at some convenient point and substitute a theoretically correct signal at that point.

The function generator is an ideal source of such substitute signals. Not only can it provide signals of almost any frequency, but generally at sufficiently low impedance to stimulate any source without introducing special characteristics of its own. Function generators with DC offset capability are even better suited for this job. The break in the servo loop may not occur at a point where there is no DC offset, and the substituted signal must supply not only a signal with the desired amplitude and frequency, but also a signal with the required amount of DC offset.

Once the function generator has been inserted in the loop, an oscilloscope may be used to monitor the returning signal at the break (a dual-trace oscilloscope is very handy for this type of testing). With the function generator, the frequency can usually be increased to the point where the total phase shift through the system will be 360 degrees. At this point, the returning signal, displayed on the oscilloscope, should indicate a gain of less than one, or oscillations may occur. The loop may remain DC coupled and the test signal inserted through a capacitor. This makes it unnecessary to find the DC operating point of the loop as well as the AC value for test.

As noted before, the wide tuning range of many function generators is especially useful for analyzing the frequency *vs* amplitude response characteristics of an amplifier. When frequency response is being tested, the flatness of the output signal is an advantage of the function generator.

Function generators with VCG (*V*oltage *C*ontrolled *G*enerator) capability may be used as sweep generators if some form of a sweeping signal is available. This signal can be a sawtooth output from an oscilloscope, the signal from an internal sub-generator (if available), or, as shown in Fig. 6, one function generator can be used to sweep another using the triangle wave as the sweep signal. If this method is used, the oscilloscope or other display device must also be swept with the triangle wave. When using the sweep function, remember there may be considerable high frequency roll-off across the uppermost decade of the generator.

Square-wave testing

The unique characteristics of the square wave from a function generator are identical to those of the sine wave. Square-wave testing of an amplifier again becomes important, as the upper and lower ranges of frequency that cannot be reached with the conventional sine/square oscillator can be reached with the function generator. Fig-

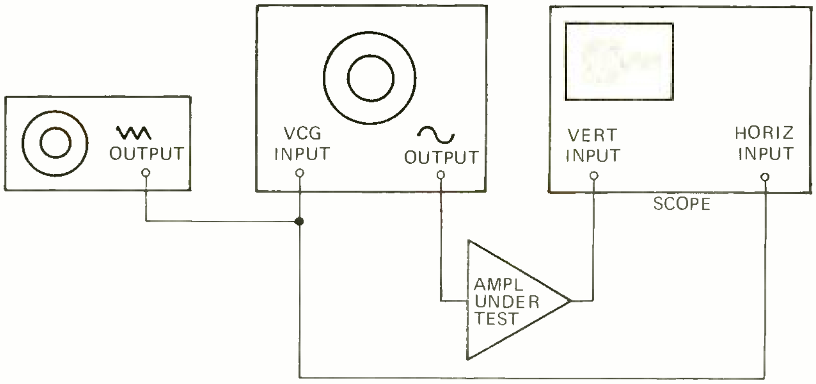


FIG. 6—TWO FUNCTION GENERATORS produce a sweep signal. The sweeping generator (left) may be of a simple type—can be the sawtooth output from an oscilloscope.

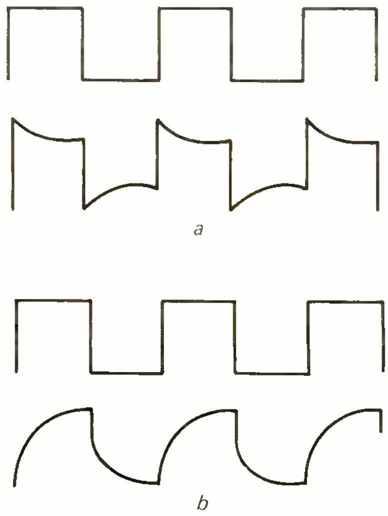


FIG. 7—SQUARE WAVE DISTORTION. The effect of poor low-frequency response is shown in a, and poor high-frequency response is shown in b.

*Manager Design Engineering, Heath Co., Benton Harbor, Mich.

ure 7 shows the characteristics of overshoot and high-frequency roll-off commonly used for square-wave analysis of amplifiers.

Because of the ultra-low-frequency capability of the function generator, it is often used to drive some form of gating circuit to provide a burst or gated sinusoidal signal. Figure 8 shows a function generator being used to drive a reed relay, which is in turn being used to gate a sinewave output from a second generator.

Figure 9 shows the square-wave output of one function generator being used to drive the VCG input of a second generator. This creates a frequency shift keyed (FSK) signal which might be used for the testing of teletype circuits, etc.

The output impedance of the function generator is usually low enough (50 ohms) to serve as a source for logic signals of the TTL, DTL, RTL, and ECL families. MOS circuits can be driven by most function generators. With most MOS circuits there is no requirement for a low-impedance drive, so the 600-ohm generators will work in this application as well. As noted before, the trigger output of many function generators is a TTL signal and may be used to drive RTL, DTL, and TTL circuits directly.

Triangle wave testing

The triangle wave is unique to the function generator and is probably more versatile for general laboratory and service work than either the sine or square waves. An amplifier driven with a triangle wave will reveal a great deal about its characteristics if the amplifier output and input waveforms are compared.

When making simple gain measurements, the exact amplitude of the triangle wave can be readily determined on an oscilloscope by measuring from tip to tip. The ambiguity evident when making this measurement with a sine wave is gone, due to the preciseness of the triangle wave peak.

Comparing the input and output triangle waves permits a linearity analysis of the amplifier. The question of whether or not the amplifier is doing a proper job becomes simpler, for there is no argument about what the straight line of a triangle should look like, whereas there may be considerable interpretation when a sine wave is analyzed for aberrations.

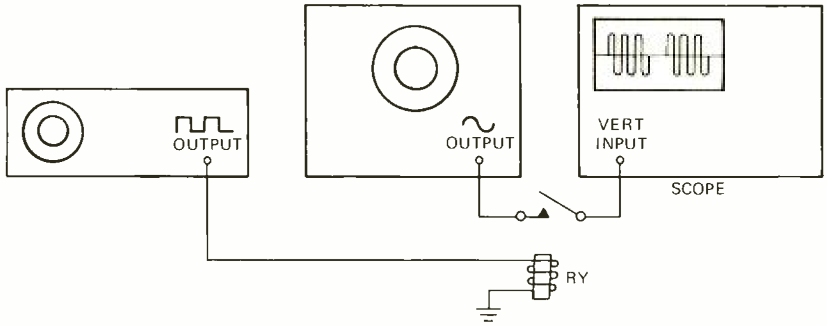


FIG. 8—LOW-FREQUENCY CAPABILITY of the function generator, plus low output impedance, permit its use in a circuit to drive a mechanical gating circuit directly.

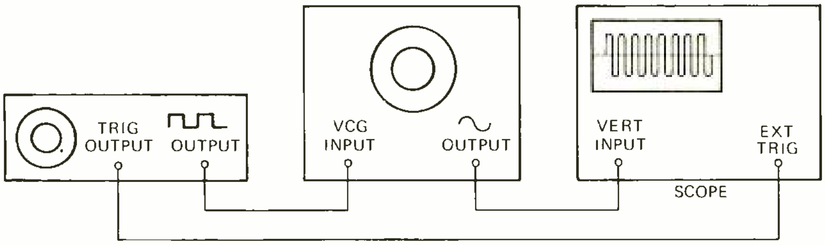


FIG. 9—A KEYED FREQUENCY SHIFT can be produced by this generator combination.

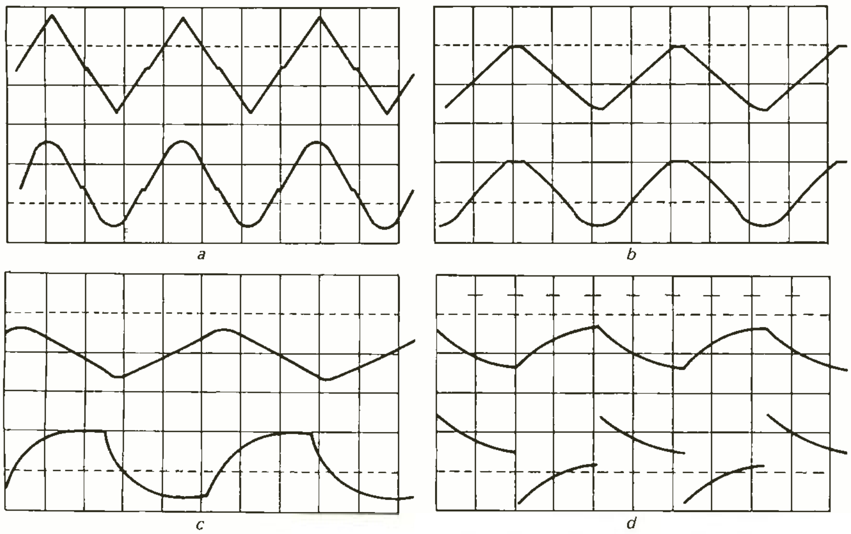


FIG. 10—COMPARISON of triangle *vs* sinewave testing. Effects of crossover distortion is shown in a, and clipping is shown in b. Square wave *vs* triangle wave testing. The effects of poor high-frequency response is shown in c, and poor low-frequency response is shown in d.

A common problem on modern amplifiers with complementary output is crossover distortion. As can be seen by the examples in Fig. 10, crossover distortion becomes even more noticeable on a triangle wave. Similar improvements will be noted in the other comparative examples of Fig. 10. These show other common amplifier faults as commonly diagnosed with a sine or square wave, and are presented here with the triangle wave test for comparison.

Although much of our electronic world is becoming digital, almost all digital equipment still has to connect to the analog world. Frequently these are the most complex areas of circuitry to design and the most common causes of service problems. A circuit often used is the Schmitt trigger. The Schmitt trigger converts slowly moving analog signals, such as sine waves, to square waves with voltage levels and rise and fall times compatible with the logic being used. To avoid false triggering on noise, hysteresis is built into the Schmitt trigger. Hysteresis causes the trigger to change output state at a higher input voltage level for positive-going signals than negative-going signals. Insufficient or improperly adjusted hysteresis will cause erratic operation of the trigger. The function generator can be used to measure the hysteresis in a trigger. Figure 11 shows the measurement, using the triangle wave output of the generator and an oscilloscope.

These connections may be used to adjust the trigger sensitivity. First reduce the signal level of the generator until the trigger just fails to respond. Adjustments are then made in the circuit to cause triggering. This procedure is repeated until there is no further improvement in the sensitivity of the trigger.

The interconnections shown in Fig. 11 may also be used to measure the pull-in and drop-out voltages of a relay. The relay is swept with a low-frequency triangle wave from the function generator and the contact operation is monitored with an oscilloscope or a meter. When contact operation is detected, the value of the triangle wave amplitude is measured, yielding the respective pull-in and drop-out figures.

The triangle wave of a function generator may be used to replace a manually swept DC control signal when analyzing a circuit. For example, a manual gain control circuit is suspected of causing an amplifier problem. With the gain control disconnected, a triangle wave from the function generator is substituted. With the frequency set to a low value, such as 0.5 Hz, the gain of the amplifier may be swung through its complete range twice every second. The output of the amplifier can now be monitored with various input signals to determine if the suspected problem exists.

The triangle wave can be used as the sweep signal for either an oscilloscope or an X–Y recorder in many applications. Frequently an experimental setup will require the signal sweeping the oscilloscope to be in exact synchronism with the signal driving the experiment. The triangle wave form is excellent for this purpose. (The user must remember the sweeping waveform is a triangle and not a sawtooth.) In some of the more sophisticated function generators, a variable time symmetry control will permit the output of the function generator to be changed from a triangle wave to a sawtooth with a 95 to 5 percent duty cycle.

In the perfect triangle wave, the rate of voltage change in time is constant between the turn-around points. The circuit of Fig. 12 is called a differentiator. The output of a differentiator is zero if the rate of change of the input signal is constant. If the rate of change is not constant, an output signal is developed. This circuit may be used to further improve the analysis of a linear circuit being driven with a triangle wave. If the circuit is perfectly linear, there will be no output from the differentiator circuit except at the turn-around points of the triangle. If the circuit is causing variations on the triangle due to distortion introduced in the signal at different levels, the output will no longer be zero between turn-arounds and the aberrations can be detected. The advantage of using this circuit is that small changes can be considerably magnified.

The VCG

As noted above, the VCG (*Voltage Controlled Generator*) can be used to develop a sweep generator or a frequency shift keyer. There are many other uses for this versatile input to the function generator. Phase-lock-loop circuits are becoming common in electronic equipment today. One of the major building blocks in a phase-lock-loop is the voltage-controlled oscillator. In either experimental work or service work, it may be desirable to break the loop and substitute external signals to aid the analysis. The function generator is used for this purpose. Not only can the function generator be used to substitute signals within the loop, but the function generator with VCG capabilities can be used to replace the voltage-controlled oscillator.

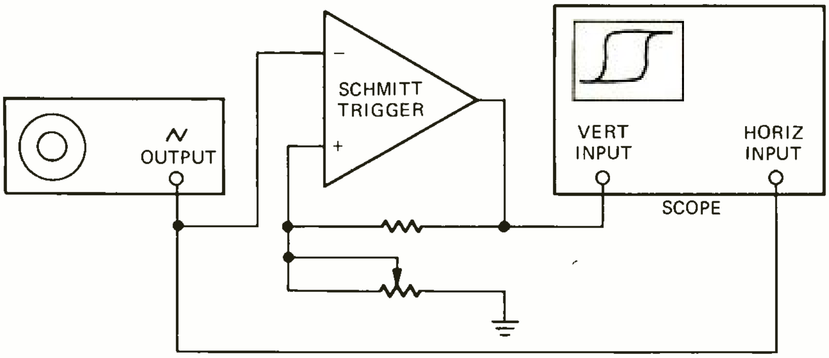


FIG. 11—TRIANGLE OUTPUT OF FUNCTION GENERATOR is used to measure and adjust hysteresis on a Schmitt trigger, as shown on the oscilloscope display.

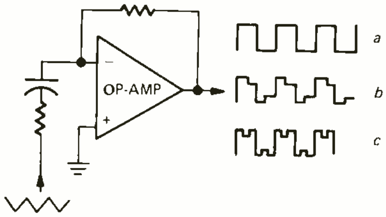


FIG. 12—A DIFFERENTIATOR CIRCUIT. Output is uniform except at crossover points if the rate of change on the input is constant. Output with perfect triangular wave at its input is shown in a. Output if input is not perfectly linear is shown in b. Effect of crossover distortion is shown in c.

Some function generators offer a feature which allows the main tuning dial of the generator to control the generator frequency, even when external VCG signals are applied. This allows the user to frequency-modulate the generator about a center frequency, with deviation governed by the external VCG voltage.

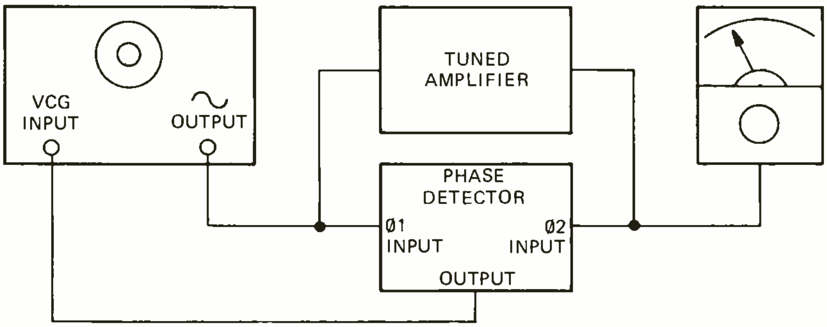


FIG. 13—TUNED AMPLIFIER TESTING. Drifts in amplifier frequency are tracked with a phase detector, output of which makes the generator track the amplifier's frequency.

A digital voltmeter can be created using the VCG and a digital frequency counter. The unknown voltage is applied to the VCG input of the generator, and the digital frequency meter is applied to the generator output. For example, a generator that will sweep from 100 Hz at the rate of 100 Hz per volt will give a reading of 450 Hz for a 4.5-volt DC input signal. The linearity of this voltmeter will be the linearity of the VCG.

Figure 13 shows interconnections used to test the gain stability of a tuned amplifier over a period of time. The gain of the amplifier can be measured only if the driving frequency keeps track of any drifts in the tuned circuits of the amplifier. The phase detector at the output of the amplifier detects changes in the phase of the output signal relative to the input signal. Changes in phase will occur when the resonant frequency of the tuned circuits begin to change. The output of the phase detector is connected to the VCG input of the function generator, so changes in phase at the amplifier output will be converted into corrective changes in the generator frequency.

Measurement errors

The function generator is relatively simple to operate, and only a few errors tend to surface. Errors in frequency settings are common. These errors may be of accuracy or may be of improper range. Errors of accuracy are usually caused by failure to remember that frequency setting tolerance is given as percentage of full scale. This can lead to considerable error at the lower portions of the function generator scale, especially where the tuning range is 100 or 1,000 to one. The function generator should not be considered a frequency standard. A frequency meter is always advantageous. When a generator has a wide tuning range, it is not uncommon for the user to become confused about the range setting. This often leads to operating frequency errors of an order of magnitude.

Errors in estimating the output amplitude based on attenuator setting are common. Frequently the user forgets the output level is not defined unless the generator is operating into either an open circuit or into its defined load impedance. Again, the best way to be certain of the output level of a function generator is to measure it. This is particularly easy with the function generator. As the output amplitude is constant, the amplitude can be measured at a frequency where the voltmeter is accurate, and the frequency may be then adjusted to the desired value. This should not be done if the wave shape is to be changed, as the peak amplitude between all waveshapes may not be constant. Output voltage levels may also be measured at one particular step attenuator setting and then the attenuator changed by either 10 dB to reduce the voltage to one third, or 20 dB to reduce it by a factor of ten.

A common error is improper voltage/power ratios in relationship to dB changes of attenuators. Consult the table until it is familiar.

Change in Output Attenuator	Voltage or Current Change	Power Change
− 3 dB	×0.707	×0.5
− 6 dB	×0.5	×0.25
−10 dB	×0.333	×0.1
−20 dB	×0.1	×0.01
+ 3 dB	×1.414	×2
+ 6 dB	×2	×4
+10 dB	×3	×10
+20 dB	×10	×100

When the function generator is being

(continued on page 69)

Step-by-step TV Troubleshooters Guide

AGC circuits may appear to be complicated, but they aren't. By following logical troubleshooting procedures, AGC problems can be rapidly diagnosed and cured

JACK DARR
SERVICE EDITOR

AUTOMATIC GAIN CONTROL CIRCUITS (AGC) seem to baffle a lot of novices and a few working technicians. They shouldn't. The AGC circuit is basically very simple if you boil it down. All it does is automatically adjust the gain of the "controlled stages" —IF and RF amplifiers—so that the video signal at the detector remains at the same level. It does that by developing a small DC bias voltage, which decreases the gain of those stages. If the signal level rises, the bias goes up with it, so the gain is reduced. If the signal falls, the bias is reduced and the gain increased. That's all there is to it.

The circuitry may look complicated but it isn't. It's very well adapted to step-by-step troubleshooting methods. A few simple tests will instantly identify AGC troubles, and these can be easy to find and fix.

The first and simplest form of AGC was the negative voltage developed across the video detector load resistor. Figure 1 shows this type. This voltage is, of course, directly proportional to the incoming signal strength. It was fed back to the grids of the controlled stages through a network of resistors, bypassed with capacitors (R and C in Fig. 1); this is the "AGC bus". If the signal got stronger, a higher negative voltage was produced, reducing the gain of the IF stages.

It wasn't too satisfactory. There were disadvantages; one of them was its response speed. It couldn't cope with a rapidly varying signal. Also, it "read" the whole signal, video, sync and all. So, it would fluctuate when the scene changed from dark (high modulation) to bright (low modulation). It did have the advantage of low cost; I was mildly surprised to find it still in use in a small black-and-white TV of quite recent vintage!

Keyed AGC

So we needed a more accurate system. This led to the development of a circuit called "keyed AGC" (gated AGC is the same thing.) The action was the same but the circuitry was different. In a TV signal, the horizontal sync pulses represent 100% modulation. (Really, it's "maximum modulation" since it is just a bit less than 100% modulation to avoid clipping.) The video modulation varies constantly, but the tips of the horizontal sync pulses always represent the actual maximum signal-level. So if we had a circuit that would develop AGC voltage based on the sync tips, it would be much better.

We got it. We feed the detected video signal to the grid of a tube (see Fig. 2). This tube has no plate voltage! (This is one of the puzzling points about this circuit.) Actually, of course, it *does* have plate voltage, in the form of very sharp positive-going *pulses* fed to it from the flyback. So, the tube conducts *only* during the horizontal sync interval. The pulse turns it on (keys or gates it) at this time, and it is tightly cut off during the scan period so that the varying video signal has no effect.

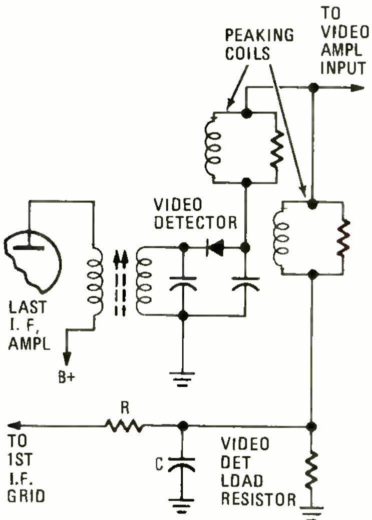


FIG. 1—EARLIEST FORM OF TV AGC. Voltage across video load resistor is filtered by R and C and applied to IF stages.

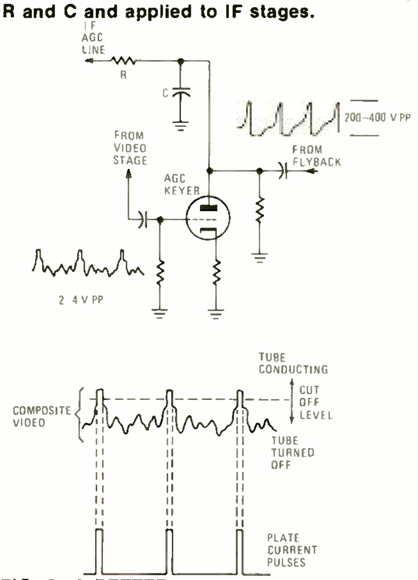


FIG. 2—A BETTER KIND: KEYED AGC. Tube works only when sync pulses are at grid.

The keyed AGC circuit thus operates only while the horizontal sync pulses from the signal are being received on its grid. Plate current flows through a resistor, and as usual, develops a DC voltage drop across a capacitor. Now, here comes the other puzzling thing; the voltage on the plate of the tube is *negative*. How does that happen? Fig. 3 shows how.

Note that the plate load resistor goes to ground. While the keying pulse is present, the plate is highly positive; there is a signal on the grid at the same time, (the sync is positive-going to make the tube conduct). So, electrons flow from cathode to plate, and then through the resistor to ground, and back to the cathode to complete the circuit. When electrons flow through a resistor, the end they flow *into* becomes more negative than the other end. Since there is no *steadily applied positive* DC plate voltage, the plate reads negative *to ground*. The value of this negative voltage is directly proportional to the value of the video signal on the grid.

So, we did it! We got a DC voltage directly proportional to the amplitude of the video signal, and we can use it as a control bias. One more point must be remembered; the source of this voltage is a series of very short pulses. We must have a pure DC voltage for our AGC bias. So the pulses are fed into a capacitor, and charge it up to the maximum level. This is exactly the same thing that the diode and input filter capacitor are doing in the DC power supply!

One more point before we leave. The capacitor, and the resistor next in the circuit, are the two parts that determine the AGC *time constant*. This means the speed with which the AGC can react to a change of signal level. We don't want this time constant to be too long, or we'd be back with fluctuations in the picture. So it is usually pretty short. When these parts are replaced, the same values must be used.

Delayed AGC

Almost all circuits now use delayed AGC. Translated, this means that we apply our AGC voltage to the IF stages, but we leave the RF amplifier in the tuner running at maximum gain until the signal gets so high that the IF AGC cannot control it without clipping. Too much bias applied to the IF stages will cause them to clip, and when that happens, the first thing that gets chopped off is the sync!

To get a delay action, we bias the RF amplifier in the tuner so that it stays at full gain until the IF AGC voltage reaches a certain level. This is easy to do; we simply feed in a very small positive voltage to the RF AGC line. Let's plug in some figures

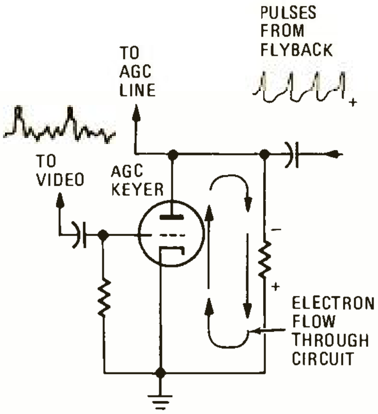


FIG. 3—WHY VOLTAGE IS NEGATIVE. The plate is grounded through a resistor, and electrons drawn to it by the heavy sync pulses have to find their way back to ground through the resistor, causing a voltage drop.

for illustration; say that the IF AGC will work OK up to a level of —5 volts. So, we make the RF AGC +5 volts in normal operation. If the signal goes away up, the IF AGC might go to say —7 volts. This will override the +5 volts on the RF amplifier, and we come out with a —2 volts of bias to reduce the gain to the point where the IF can handle it. So, we have "delayed" any RF AGC action until the IF AGC gets up to a —5 volt level.

Solid-state AGC

How does AGC work in transistor TV circuits? *Exactly the same* as in tube sets! The AGC bias developed is of a polarity that reduces the gain of the controlled stages. The only thing we need to remember is that this may be *either* positive or negative! Transistors come in two polarities, NPN and PNP. Also, there are two ways of biasing them; "forward AGC" which means applying control bias in the polarity which makes the transistor conduct more, and "reverse AGC" which is what it says; reverse polarity. Negative for NPN, positive for PNP. We don't really need to bother too much with this; you'll find the correct voltages and polarities given on the schematic diagram. In Sams Photofacts, they thoughtfully give you the *range* of AGC voltages to be expected. This is *very* helpful.

Before we go on, here is a very important point. If you forget it, you can get into a lot of confusion. To check the DC voltages around an AGC stage, always remember that the voltages given on the schematic are *no-signal* voltages! This is the only way we can get a "standard" set of test conditions. One more: these voltages will *change* when a signal is applied. (If they don't, the AGC isn't working. This is one of our most useful tests.) If the DC voltages shown on the schematic don't match what you read, look out. This usually means that the AGC isn't working properly. The DC voltages on the controlled stages are such that the amplifiers are in a "maximum-gain" condition. Remember that one, too. We'll put it to good use in just a minute.

AGC controls

To get the best results from any TV set, we need an adjustment in the AGC circuit. This will let us set it up so that it will work best on weak signals or strong signals. Actually, the AGC control is needed more in very strong-signal metropolitan areas, to reduce the gain and prevent overload. Practically all the later TV sets have very good sensitivity, and will work in deep-fringe areas.

AGC is a gain control; so, the AGC control is a "gain control for the gain control." By varying the bias on the AGC tube or transistor, we can set it up so that the set makes the best pictures in any location.

The *reaction* of this control is one of our best and fastest tests for AGC trouble. Just turn the control from one end to the other and watch the picture. Normal reaction (tube sets) should be a "whiteout" at one end, meaning a very pale picture or even a clear, blank raster, and a "blackout" at the other. At this end, the picture will become very contrasty, and will probably bend and writhe, with a buzz in the sound. (This is "AGC buzz"). In many color TV sets, the raster will go completely dark.

The whiteout is due to too much negative bias; blackout, too much positive bias (tube sets). Somewhere in the middle, you should be able to get a good clean picture with plenty of contrast. If this control shows no reaction at all on the picture, or only a very little effect, look out. It's a very good clue that the AGC isn't working as it should.

In quite a few transistor TV sets, you'll find dual AGC controls. One will work on the IF AGC, the other on the RF AGC. You may find an unusual reaction when adjusting the IF AGC control. At one point, you'll see snow in the picture, even on a fairly strong signal; the proper setting is usually just out of the snow, where the background clears up and the picture is sharp. This one is set up first, and the RF AGC control is then set for the best picture.

Filtering and clamping

AGC voltage is distributed to the points where it's used through a network of resistors; each point is well bypassed. The impedance of the AGC line to ground must be very very low. If one of the bypass capacitors should open, signals from one stage will get into others, causing oscillations, beats and many other symptoms.

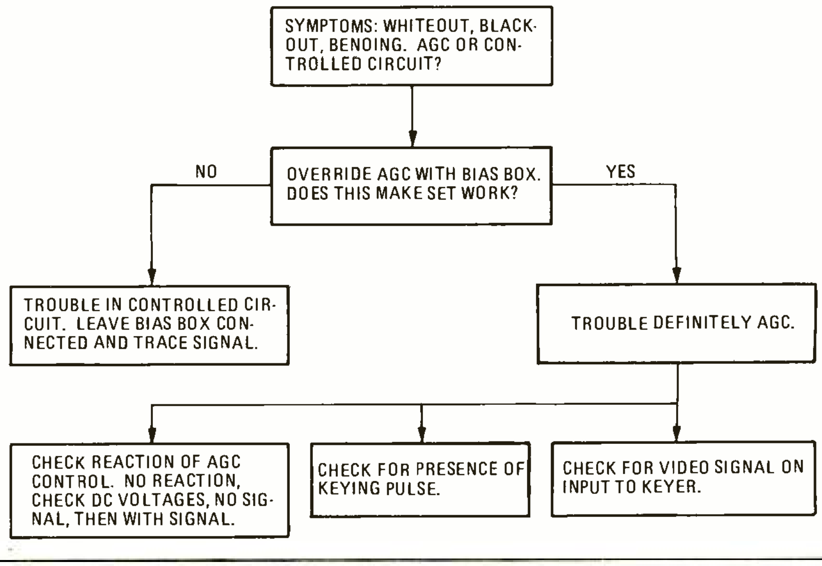
The RF AGC delay circuit is often made by connecting a high value resistor, 10 megohms or so, from a source of positive voltage to the RF AGC line. This is a "clamp" resistor; it feeds in a very small positive DC voltage to keep the RF amplifier from being affected until the IF AGC voltage reaches the desired level. Remember this one, too!

AGC testing

Testing for AGC trouble can be very easy. Check the symptoms: common troubles which can be due to AGC are whiteout or very pale picture; overloaded or bending picture, with buzz; loss of sync (usually both vertical and horizontal, but sometimes only vertical); and beats, "squiggles" and oscillation. There may be others. This multiplicity of possible symptoms might be one of the reasons why so many people have trouble with AGC.

However, there is a very simple test which will always identify AGC trouble. In all cases, the trouble could be one of *two* things; a fault in the *controlled stages*, or a fault in the control circuitry. To isolate this, simply *clamp* the AGC voltage with a bias-box. This is a small DC power supply, which can be adjusted to any voltage needed. Check the schematic to see what the no-signal voltage should be on the AGC line. Say that this is given as —2.5 volts. Connect the negative lead of the bias-box to the AGC test point, and the positive to chassis. Now, set the box to 2.5 volts and look at the picture. If your original symptom was "clean white screen, no picture," this might bring back the picture and sound. If the

TROUBLESHOOTING CHART—AGC circuits.



picture is overloaded, turn the bias-box to a higher voltage. If you can adjust the AGC voltage and get a good clear picture and sound, this makes it definite; the fault *is* in the AGC. If you can *not* get a clear picture, this clears the AGC of suspicion! The fault is in the controlled stage, somewhere. Leave the bias-box connected, set at maximum gain voltage, and you will be able to check out the IF stages, or tuner, to find out what the real cause of the trouble is.

This test should always be used if you can't get a normal reaction from turning the AGC control. Reason: it is possible to have a fake AGC fault, if there is a fault somewhere in the IF, such as a bad tube or transistor. This can upset the AGC because it causes the loss of the *video* signal which must be present on the AGC keyer grid (base) before the AGC circuit can work.

The DC voltages

If the trouble is definitely in the AGC, take the signal off the set. Now, read all the DC voltages around the AGC keyer stage. These should be pretty close to the values given on the schematic. If any of them are quite a bit off, trace out the circuit to find out why. In the typical set, almost all of these DC voltages will be fed through voltage-divider networks. If either of the resistors goes far off value, this will upset the DC voltages on the AGC stage and it won't work properly. You will probably have to lift one end of the resistor to get an accurate test; there are always several shunt paths in these circuits that throw the in-circuit resistance readings off.

Always check for the presence of the keying pulse on the keyer. In tube sets, this will be several hundred volts positive-going. (Make sure of this! One of the most curious troubles I ever ran into was a case where the keying pulse *was* present, and of the right amplitude. However, it was *negative*, due to an incorrect connection to a new flyback! For some reason, no one noticed the polarity for quite a while!)

In transistor circuits, the keying pulse may be positive or negative going, depending on the type of transistor. In all cases, it will be of the polarity that makes the transistor *conduct*: positive if it's an NPN and negative for PNP. The peak voltage will be much lower, sometimes only 25 to 30 volts. The pulses are often fed through a diode.

A scope is the easiest way to check this. However, you can make continuity tests from the keyer plate back to the flyback, and substitute a new capacitor for the pulse-coupler. Some sets feed the keying pulse through a little coaxial cable from the flyback. Check this to make sure that it has continuity, and is not shorted; if the plastic cable has touched a hot tube, it may have melted and shorted.

In tube sets, always try a new keyer tube. A tube with low emission, or some leakage, can upset the AGC very badly. In transistor circuits, check the transistor for leakage. Also, check the pulse-coupling diode; leakage in it can cause trouble.

Always check the video waveform on the keyer grid (base). This is usually picked up in the output circuit of the video amplifier stage, but may be taken off the video driver. It will be fed through a coupling capacitor or a resistor network. Some of the video may be deliberately clipped off. Watch out for signs of clipping on the *sync-side* of the waveform. In a positive-going sync circuit, this will be the top. The sync pulses must be clean and sharp. If you can get a good picture on the screen by clamping the AGC, but the video signal at the keyer is missing or distorted, go back to the video stage and trace it through the network with the scope.

In cases of oscillation, beats, etc., the trouble can be due to an open bypass capacitor in the AGC circuit. Once again, the scope is the best check. It should show absolutely no sign of any signals, pulses, or other activity on the AGC line. If you see anything, bridge good capacitors across each of the original bypasses; one of them will be open.

Offset DC voltages

The normal AGC voltage in most sets will show a variation of only about 4-5 volts. If the controlled grids or bases are close to ground, this is what you'll read. However, watch out for sets that have offset bias voltages. You may read up to 35 volts or more from the AGC line to chassis. Check the schematic; in circuits with grid or bases near ground, such a high positive voltage would definitely mean trouble. However, if you can see that the *cathode* voltage on the 1st IF tube is set at +35 volts, and the control grid at +34 volts, this is normal. The actual bias voltage (and AGC as well) is the *difference* between grid and cathode voltages. In this case, the bias is −1 volt. To override this AGC bias, set the bias box to +35 volts and you'll actually have zero bias voltage. Adjust the bias box around this point to see if you can get a good picture. Always check the no-signal DC voltages on the controlled stages, on the schematic.

The AGC reaction

There is another easy check to make sure that the AGC is or isn't working. Read the DC voltage on the AGC line, without signal. Now hook the antenna up and read the voltage again. With a strong signal, in a tube set, the AGC voltage should show a definite swing toward more negative voltage. If there is no change at all, the VTVM is telling you that the AGC definitely is not working. If it changes in the wrong direction (goes more positive in a tube set, for example), this too is a sign of trouble.

Summation

There you are. That's how an AGC circuit works. Follow the step-by-step method of testing it, and you'll be able to identify and correct any kind of AGC problem. Here they are again; see the chart, also:

1. Check the symptoms on the screen. If these could be caused by AGC trouble, try the AGC control; note its reaction.
2. If the reaction is wrong, apply override bias to AGC test point. Vary voltage. If you can get a good picture, this is definitely AGC trouble.
3. Read the no-signal DC voltages around the AGC stage. If these are off by more than 5%, check for presence of *both* the keying pulse and video signal on the AGC stage. Substitute new tube or transistor.
4. If there is oscillation or instability, check AGC bypass capacitors. **R-E**

THIN HORIZONTAL LINE

The vertical sweep on this Philco M2610 black-and-white TV is gone. Just a very thin horizontal line. Injecting a 60-Hz test signal into the vertical output grid or plate does nothing at all to the line. I don't know the resistance of the vertical output transformer or yoke.—J.G., Arlington, VA.

I had exactly the same symptom on a different brand not too long ago. Turned out to be a dead short between the ends of the vertical output transformer *primary*! The tube was pumping into a dead short. The normal resistance of this transformer is 160-ohms primary, 7.5-ohms secondary (yoke disconnected). The yoke winding should read 33-ohms.

Suggestion: unhook the vertical winding of the deflection yoke, feed a signal into the primary, (with the set turned off) and scope the secondary to see if the signal gets through.

OUTPUT TRANSISTORS

The output transistors in this Symphonic C-85 stereo are out. They're marked SC-4131, and are in the hex shaped heat-sinks with a stud. It had a bad hum that cleared up by replacing the two 100-μF filter capacitors. Now we need data on those output transistors.—F.O., Mena, AR.

A HEP-245 will work with these. The cases are different but the ratings are OK. I've used them for replacements in this chassis. Be sure to get the cases tightly bolted to the chassis on general principles although I ran one for quite a while without a heat-sink just to find out!

FINAL CURE FOR SYNC PROBLEM

I tried everything I could think of to clear up a screwy sync problem on this Admiral. Then I tried everything you could think of. Finally, I tried realigning the IF's. That did it! The curve showed that the IF's were off just enough to cause the vertical sync and AGC to act up!

The scope is a marvelous invention, and thanks to Mr. Dumont! Can you tell me why a scope just sits around and we won't get off our duffs and REALLY use it?—G.Y., Yellowstone, MT.

No, I can't. I've burned out three sets of tonsils in the last 15 years yelling at people to USE a scope! It will give you vital data that you can't get with any other test instrument.

R-E's Service Clinic

Low Voltage DC Power Supplies

A new look in an old circuit

by JACK DARR
SERVICE EDITOR

A READER ASKS "WHAT KIND OF LOW-voltage power supply is this? I can't find half of the DC voltages!" Since we have gotten the same question on several occasions of late, it sounded like a good idea to go over some of the circuits used. He had a small black-and-white solid-state TV set; a Sylvania A12-1, in fact. (Not having a schematic added to the confusion!)

Once upon a time, missing voltages like this were due to something really complicated, like an open resistor or shorted capacitor. No more. We have a different kind of animal to cope with now.

The DC power supply circuit in the Sylvania A12-1 is a good example of a nice simple design, so let's look at it. Figure 1 shows the main parts of the power supply. They're basically very simple. You start out with a stock half-wave rectifier circuit, like those used for many years. This gives you about a +145 volts. This is dropped through resistors to give a +127 volt and a +110 volt DC supply. (We'll do something with these in a minute)

Now comes the new stuff. This is an all solid-state set. So, we need low voltages for all of the transistors except two or three stages. This comes from an unexpected source—the flyback! The +127 volt source drives the horizontal oscillator, driver and output stages. A special secondary winding on the flyback provides about a 60-volt negative going pulse. This is rectified by a simple half-wave circuit that produces +35.1 volts. This voltage is dropped through resistors to produce +21.5 and +21.2 volts.

So now you can have what seems to be a perfectly normal DC power supply, yet the whole set won't work! If you run into this, check to see if the set uses a power supply of the type just described. There is a tertiary winding on the flyback; this gives us 8.6 volts that is used to power the heater of the picture tube. There is a handy-dandy eyeball clue. If the picture tube heater isn't glowing, this indicates a fault in the flyback power supply. No glow, no go. (Sorry!) A bad transistor in any of the three horizontal stages or any of the familiar defects that can keep the horizontal stages from operating. Ohmmeter tests can give you a good idea. A quick check is to scope the horizontal pulses.

This type is sometimes called a "scan-derived" power supply. It's been used for several years in some of the larger color TV receivers. Quite a few of these get all of the low DC voltages di-

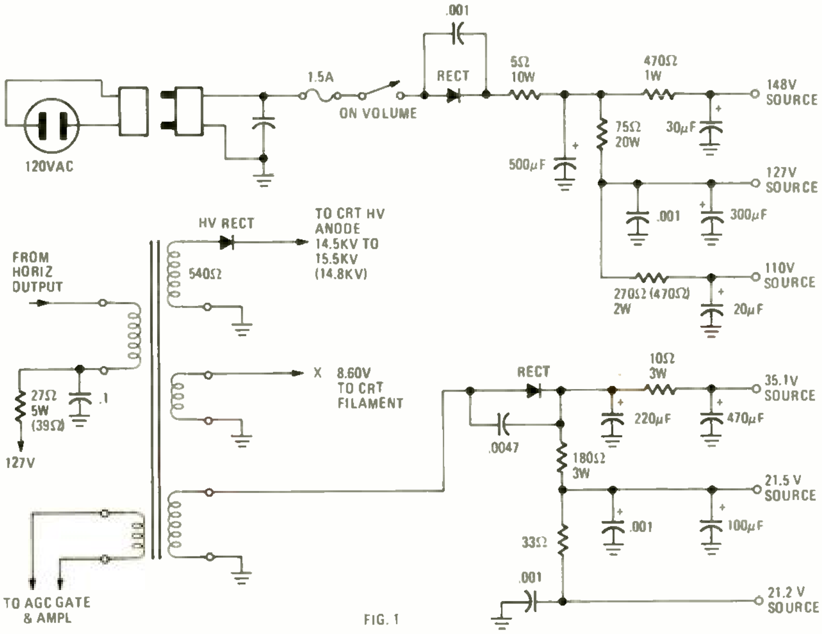


FIG. 1

rectly from the flyback circuits. In the Sylvania circuit shown in Fig. 1, the higher DC voltages from the primary power supply feed the video output transistor, picture tube cathode and screen and the sync separator. The last was probably included to make sure that the horizontal oscillator gets started in sync just for luck!

You can trace out the primary and secondary power supplies in the circuit shown in Fig. 1. Note that the flyback winding supplies a negative-going pulse to the diode. This diode conducts during the *scan* time. If the winding is reversed so as to feed a positive going pulse to the diode, we get a "flyback" or pulse-derived supply. The diode conducts during horizontal retrace time. Figure 2 shows the difference between the two rectifier circuit types. The output is the same; the only difference is in the polarity of the applied pulses. The original of these circuits are used in the General Electric JA, QA, QB, XA and YA color chassis.

The circuit shown in Fig. 2-a can provide about 140 volts DC from a half-wave rectifier and filter. The circuit shown in Fig. 2-b can easily provide any low voltage you want from the flyback, which "has to work anyhow"! The much higher *frequency* of the flyback supply makes filtering a lot easier. Capacitors can be a lot smaller for the same filtering efficiency. The "choke" can be a 10-ohm resistor, as you can see in Fig. 1.

So if you find oddball reactions like this in any of the new sets, check to see what kind of low-voltage power supply they're using. The first thing, of course must be the primary +145 volt supply. If this isn't OK, nothing will work. If this is up to normal, then look for the eyeball-clues such as the picture-tube heater. Scope the horizontal output stage to see if it is working. They're no more difficult to service than the older types if you know what to look for. **R-E**

reader questions

VERTICAL BARS

This is a weird one! Whenever I turn this RCA CTC-16 on, I get quite a few dark, ragged vertical bars on the screen. They're "fuzzy" on the edges and make little rainbows. The real weird part is that I get the same kind of thing on other color sets that are nearby! I can stop it by turning the CTC-16 off. What the heck is going on here?—L.C., Oden, AR.

From much sad experience, I'll bet I know! Loosen the back cover of the flyback cage, lift it up, and check to make SURE that the plate-cap of the

Circle 17 on reader service card

3A3 tube fits firmly into the socket on the top of the high-voltage winding. If the back cover (which has the 3A3 socket on it!) isn't precisely positioned, the 3A3 cap will miss the socket and sit on the edge. It will arc from the winding to the tube; this generates the vertical bars and all the rest of the garbage that you're radiating from it. Tighten the back cover firmly and make sure the screws are all the way to the bottom of those slots!

YOKE RETURN CAPACITOR

Capacitor C16, a 0.1 µF, in the horizontal deflection yoke return in this Magnavox T979 chassis keeps blowing out. It shorts and the raster folds up to about 3 inches wide. What can I do about this?—M.D., Chicago, IL.

Repeated failure of this capacitor indicates that either the original or the replacements haven't got enough safety factor to stay in there. I'd suggest replacing it with one of the same capacitance, but with a minimum 3-kV voltage rating! That ought to hold.

FUZZY RIM AROUND FACEPLATE

This set has a 19EYP22 picture tube. It has a "frosty" look all the way around the outside of the faceplate; comes in about an inch or more. What causes this, and is there anything I can do about it?—H.M., Largo, FL.

This could be due to the safety glass separating from the actual faceplate of the picture tube. It's not too common, but I've heard of it. I am told that most picture tube rebuilders can re-cement a loose safety glass back in place, if the tube itself is in good shape. Check around your area and see who does this kind of work.

COLOR BAR GENERATOR PROBLEM

We built the "IC Color Pattern Generator" (R-E, January 1970). Everything works fine except the color bar pattern! I keep getting 15 or 20 horizontal rainbows between the dark vertical bars. What to do to correct this?—J.D., Diamond Bar, CA.

The original answer was "Check that 3.56 MHz crystal." The reader solved the problem by putting the crystal trimmer in series with the crystal. He had gotten a parallel-resonant type, and what was needed was a series-resonant crystal. This cleared up the problem and the 3.56 HMz oscillator is now on-frequency and making color bars.

HORIZONTAL OUTPUT PROBLEMS

I had a horizontal output problem in a Magnavox TS982. You suggested the use of a variable-voltage transformer. Thanks for that; it helped me solve it. The cause was a short in the collector of the regulator transistor. If the screw was tightened too far, it grounded the collector to the heat-sink, thus killing the 28-volt supply!

This started as an intermittent. Owner stated that original symptom was a loss of width that could be cleared up by hitting the cabinet. I found that just the right amount of tension on this screw caused a low-resistance leak which resulted in a chain reaction of blown parts. Replacing the insulator and tightening the screw properly fixed the whole thing.

Sincere thanks to Marion R. Delfert, Bridgeton, MO, for this one.

PURPLE GREEN PIX

This RCA CTC-16 has a peculiar problem. On a B&W picture, it's purple with greenish highlights. Same on color programs. Tint and color controls have no effect at all. Voltage readings in the color difference amplifier section seem to be all right. Any help will be appreciated.—M.M., Whitestone, NY.

The crystal-ball says that your 3.58 MHz oscillator is probably dead! This will cause just such a set of symptoms in quite a few sets. The odd colors seem to be due to just a little bit of the burst getting through, which has a phase somewhere very close to blue-green. I have seen sets with this problem, on a color bar pattern, which looked just like a "no red at all" symptom!

TUBES WITH SPRING CLAMPS

To take 6BK4 or other tube out of an inaccessible place if it has the spring-clamps holding the base, just slide the cardboard roll out of a roll of bathroom tissue down over the tube. This will depress the clamps and the tube comes right out. Thanks to Frank Pisano, Staten Island, NY. In England, I guess this could be called a "Loo-Roll Loosener!" (Sorry about that!)

IGNITION NOISE ON FM

We've found that ignition noise on the FM band in 1970 Cadillacs can be caused by a crumbling of the material in the tower of the distributor cap. This has a carbon contact. When the plastic fails, the spring contact of the rotor rubs on a brass retainer in the cap tower generating the noise. Cure; try replacing both the distributor cap and rotor.

Thanks to H. Miller, Miller's Service, Orovilla, CA. I thought that MGB's were the only cars that did this! Mine did. **R-E**

EQUIPMENT REPORTS
(continued from page 30)

terrupt vector locations are also on the 6530 chip. A programmed timer is the last major element which DEMON uses to time the terminal input pulses so it can automatically operate over a range of data transmission rates.

Then there is the PIA Peripheral Interface IC that adds 16 more input/output lines for a grand total of 26. Any of these can be configured as either inputs or outputs under the guidance of the programmer.

Four NMOS memory chips on the CPU board add 512 words of RAM which is on the whole available for user programs. A small part of this memory is used by DEMON. User RAM is assigned to the first 512 bytes of memory space from 0000 to 01FF. The rest of the IC's are terminal interfacing components and address decoding gates.

This effective hardware-firmware combination is supported by an apparent basic philosophy: Don't make a keyboard-display a standard CPU feature. Most serious users and even the beginner, once beyond the early phases of experimentation, will be using a data terminal. The terminal user is not saddled with the unnecessary expense of an unused feature. All bases will be covered since a keyboard-display board is under development for those who want to start out without a terminal.

The terminal interface has been designed to work with virtually any data terminal. Standard 20-mA teletype loops are handled by using an additional −10-volt supply: TTL terminals such as TV typewriters run with the single 5-volt supply. The third option, the one I used, is the EIA interface that requires two additional supplies—+12 and −10 volts. These supplies are low current and in some cases can be tapped off the terminal itself. The only other real requirement is a SPST RESET switch. An additional NMI (Non-Maskable Interrupt) switch and debouncing circuit is a helpful add-on.

I encountered one minor problem when connecting the JOLT to my fairly sophisticated TI ASR733 terminal. I hooked everything up according to directions but the printer would not receive anything. Frankly, I suspected the microcomputer since it was the item I was least familiar with at that point. As it turned out I was missing an interconnect wire! My terminal has a data-carrier detector lead that an external modem uses to disable the printer. When a modem is not used, this pin must be tied to the DSR (Data Set Ready) lead on the JOLT board. As soon as I made

TABLE 1—DEMONSTRATION PROGRAM

```
 ♦  7052 30 40 FF 01 FF
.LH
NAMECHECK7
;180100A020A9338532205400A2008A4820E972A868AA989530CAC90A79
;1801180DD0F08A49FF8531E631A00EA95C8532205400A431A930D80B01
;10013038E5318532205400208A72004C0001700493
.
;1800304A0B25002020455245482045 4D414E2052554F592052455405E1
;1800484E4520455341454C50202020B13220C67288D0F86020554F08DC
;10006059204B4E41485 4200A0D200D0A11E11903D8
;0200F6000100F9
.G   PLEASE ENTER YOUR NAME HERE   JACK SPRAT
 THANK YOU JACK SPRAT
 ♦  013C 32 00 00 00 FF
.G   PLEASE ENTER YOUR NAME HERE  ABCDEFGHIJKLMNOPQRSTUVWXYZ
 THANK YOU ABCDEFGHIJKLMNOPQRSTUVWXYZ
 ♦  013C 32 00 00 00 FF
.M  0100 A0 20 A9 33 85 32 20 54
.M  0108 00 A2 00 8A 48 20 E9 72
.M  0110 A8 68 AA 98 95 30 CA C9
.M  0118 0D D0 F0 8A 49 FF 85 31
.M  0120 E6 31 A0 0E A9 5C 85 32
.M  0128 20 54 00 A4 31 A9 30 D8
.M  0130 38 E5 31 85 32 20 54 00
.M  0138 20 8A 72 00 4C 00 01 70
.M  0030 41 1B 15 00 20 20 45 52
.M  0038 45 48 20 45 4D 41 4E 20
.M  0040 52 55 4F 59 20 52 45 54
.M  0048 4E 45 20 45 53 41 45 4C
.M  0050 50 20 20 20 B1 32 20 C6
.M  0058 72 88 D0 F8 60 20 55 4F
.M  0060 59 20 4B 4E 41 48 54 20
.M  0068 0A 0D 20 0D 0A 11 E1 19
```

this connection, it took right off and worked perfectly.

Table 1 is an actual printout from my terminal. I had previously written a simple demonstration program called NAME-CHECK. Seven versions later it was finally debugged and running. About 120 words of memory are used for program and variable storage to perform an elementary task, but one that uses some interesting programming techniques. A program loop reads sequential addresses in memory for printout of text messages.

Tape, of course, is a tremendous convenience during the program development stage since it eases the job of reentering the program after power interruption or memory wipeout due to faulty program execution. My terminal has a dual tape transport built-in. I was not using an audio cassette option.

I turned on the power, pressed the RESET button and hit the carriage return key producing the first line of printout prefixed by the asterisk. DEMON measures the terminal transmission speed of the carriage return, sets some constants in memory, and echoes and transmits characters at the same rate. It adapts to speeds from 10 to 30 characters per second.

The first four-digit number is the program counter 7052 which is the next address following a BRK (break) instruction. In this case, the printout is caused by a BRK instruction in the monitor ROM at location 7051. The next number is the status condition that shows the settings of the various μP flags such as the carry and interrupt flags. Next are the accumulator, the X and Y index registers and the stack pointer. The stack pointer always starts at the top of page zero at FF and decreases as the stack is filled.

The machine then printed out a period that is DEMON's prompting character telling me it is waiting for a command. The command list includes M for list memory, R for list registers, G for go, WH for write hexadecimal, WB for write binary, H for high speed reader, LH for load hexadecimal and a colon (:) for alter.

Ready to load my program, I typed LH after which the microcomputer issued a line feed and carriage return. I then started the cassette tape and fed in the next portion of the printout starting with NAME-CHECK7 and ending with the terminator —;00. The first two-digit number, 18, indicates there are going to be 18_{16} or 24_{10} sequential memory entries in that block. The following 0100 is the starting address where the first entry will be made. Excluding the last four characters, the rest of the line are the instructions and data in hexadecimal. The last four characters are the check-sum the computer uses for error checking. Disagreement between the computer's running count during data input and the check-sum at the end of the block causes a ? to be printed pointing out an error.

To make the program self-starting, I have included the starting address of my program on the tape. DEMON stores the program starting address in locations 00F6 and 00F7, hence the 0200F6000100F9. Using the previous format it says enter 00 at 00F6 followed by 01 at 00F7 which is the starting address 0100 in reverse order.

Now all I do is type the G command for go and the program prints out PLEASE ENTER YOUR NAME HERE and waits. Anything I type from that point on until the carriage return will be stored in memory within the space limitation I have left. So after I type JACK SPRAT, the program returns with its THANK YOU statement. A simple example that tells that things are really working. On the bottom of Table 1 is the memory printout using the M command to list the program in a more readable format. The first section of the program actually ends with the 01 at location 013E and the final "70" is just what happened to be in that memory word at system powerup. Likewise, the second block is terminated with the OD at location 0069 (the second 2-digit column in the 0068 row). Here the OD and OA in locations 006B and 006C are the results of a previous programming try. Incidentally, OD is the hexadecimal notation for a carriage return and that particular program element causes the carriage return just before the THANK YOU statement.

If the system does not have a cassette tape, the program is entered from the keyboard in an almost identical format to the memory printout. The only difference is that the alter command (:) replaces the M and you do the typing instead of the terminal.

The subroutines in the monitor PROM such as the character write and read, WRT and RDT routines are available to the programmer. For example, the write subroutine begins at address 72C6. The symbol to be printed is stored in the accumulator by a load accumulator instruction and then a JSR WRT (20 C6 72) prints the character. You can see this sequence in my program at locations 0056, 0057, and 0058 in the listing.

Inserting breakpoints using the break (00) instruction is a powerful debugging method. The break causes interruption of the program at that point followed by a register printout as shown in the first line of Table 1. Memory locations can then be examined with the M command. NAME-CHECK7 has a break instruction at location 013B (the fourth column in line 0138). The break is used to stop the program but the register printout is the same as if debugging were in progress. It is this instruction that causes the register dump at the end of the program execution starting with the asterisk and the program counter contents 013C.

As with other microcomputer kits, the assembly was straightforward and is mainly mounting IC sockets and bypass capacitors. Molex pins are used for economy. Good soldering technique is required and an experienced kit builder with a small clean iron should have no problems. A beginner should proceed a little cautiously and might seek the help of someone skilled in soldering. After assembly, use a magnifying glass to check for solder bridges, cold solder joints, and shorts between adjacent Molex pins.

One of the real nice things about the JOLT kit is that you are not left in the dark. Plenty of documentation is included in the package. The answer to your particular problem is probably somewhere in the supplied literature.

The two-volume MOS Technology manual is a $10 option but one that I heartily recommend. It is a masterpiece. Standard documentation includes a JOLT CPU Assembly Manual, a JOLT CPU Hardware Manual, and a JOLT schematic diagram. JOLT Application Note no. 1 shows how to connect a terminal to the CPU and Application Note no. 2 provides tips on initial powerup and expansion of the system. The DEMON software manual is complete and includes a program listing with programmer's comments.

Interface boards, a power supply, and 4K RAM memories are already available. A single-pass resident assembler was recently announced. Under development are a keyboard/display board with an audio cassette interface and a TV interface board. Boards and complete systems can be purchased as kits or factory assembled.

Write for a JOLT brochure to Phaeco Corporation, JOLT Sales Agents, Microcomputer Associates, Inc., 111 Main Street, Los Altos, CA 94022. **R-E**

PC-76

5000 CB buyers, reps, and distributors filled the Las Vegas exhibition hall each of the first two days of the show. More than 200 manufacturers displayed their products.

12-MILLION VOLTS

(continued from page 34)

path by changing the primary coil frequency abruptly.

4. Reinforcement of the energy contained in the "ball."

Taking his conclusions and plans to Washington, D.C.—where more than one agency was interested in any research that might lead toward solving the problem of confining a dense highly heated plasma for thermonuclear applications—Golka succeeded in securing backing for the present Bonneville Flats installation.

The work is still in the early stages, but results are already promising. Golka has achieved voltage discharges up to 15 million (the highest yet made by man) for a period of 8 minutes, and "sparks" (or lightning bolts) rivalling the 20 to 30-footers attributed to Tesla. Already small discharges resembling ball lightning—with a life of about 0.1 second—have been observed.

This is a far cry from controlled nuclear fusion, yet there is more than a chance that—like Faraday's "new-born infant"—it may be the first step toward techniques that could have as great an effect on our future civilization as Tesla's development of alternating-current electricity has had on our present one. **R-E**

FUNCTION GENERATORS

(continued from page 58)

used with an amplifier having a frequency response less than the operating frequency of the generator, the user must be sure the correct waveform is employed. A triangle wave with some high-frequency attenuation is difficult to distinguish from a sine wave on an oscilloscope. At sufficiently high frequencies, a square wave will begin to look like a triangle wave.

With most generators it is easy to have the total peak voltage of the signal and the DC offset exceed the output capabilities of the generator's amplifier. When this happens, clipping will occur and a distorted waveform may be unknowingly created. When analysis shows clipping and DC offset is being used, suspect an error in setup.

As noted before, it is the opinion of this author and many others in the instrument industry that the function generator will soon completely replace the classical sine/square oscillator as the general-purpose laboratory and service signal source. At this time, the basic function generator has been well defined and the low-cost unit has started to make its way on the market. In the future, we should expect to see even more for the low-cost dollar. Increases in the high-frequency limits and greater continuous tuning range should be the major improvements to watch for. In any case, the simplest of function generators available today are a great improvement over the best sine/square oscillators. **R-E**

We'd like to compare our
But there's no

(Simulated TV Reception)

COMPARE OUR TRAINING PROGRAMS: NTS Electronics programs are considerably different from those of other schools, and, we believe, better designed to prepare you for entry-level opportunities in the field of your choice. For example, our Master Course in Electronics Technology includes over 170 lessons; another school offers fewer than half that many in a course with the same title.

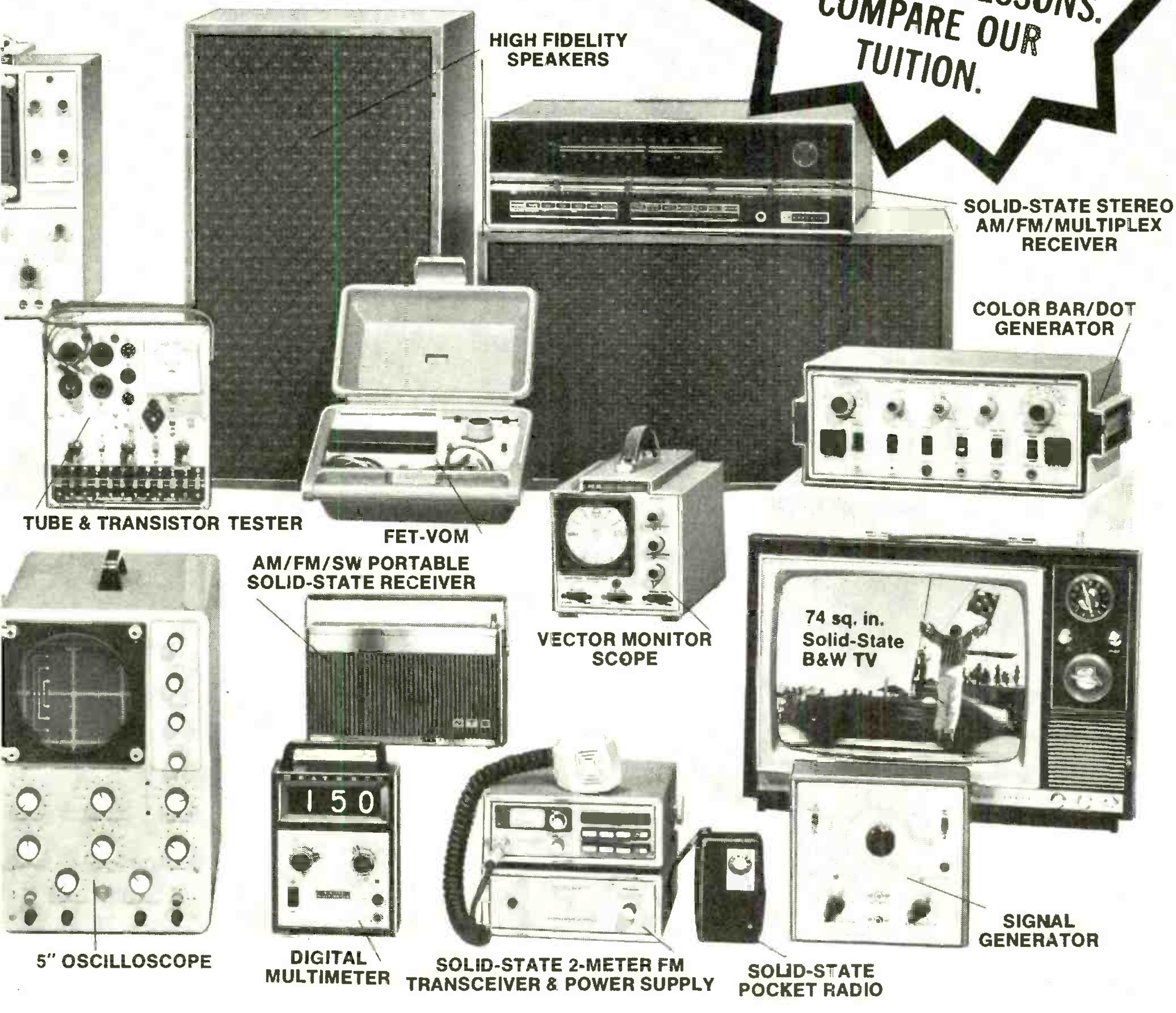
Our course includes 26 kits to build an Electro-Lab, a Solid-State Digital Computer-Trainer with transistor-diode logic circuits; a 5" wide-band solid-state Heath Oscilloscope; a Heath FET-VOM, and slide rule. Their course offers 10 kits to build a private label VOM and 2 experimental circuit chassis.

And even though you need an oscilloscope to perform their experiments, they don't provide it. You have to buy your own. And their course does not even include a Digital Computer-Trainer. The closest thing to our program they offer costs over $200 more than ours. Another school's course in Electronics Technology offers even fewer lessons, and kits to build only a VOM. That's all. Think it over, and check it out, course by course, program by program. There's no comparison.

COMPARE OUR EQUIPMENT: NTS selected Heath equipment because of Heath's international reputation as a prime designer of commercial and professional electronic equipment in kit form. Cooperation between Heath and NTS assures you of highest quality components, design, function and training. What's more, Heath equipment is the kind you'll meet in the field - not limited to training only. For instance, the Heath GR 2000 25" (diagonal) Color TV included in our Color TV courses is acclaimed as ahead of its time in features and engineering. And the Heath AM-FM

school to other schools. comparison.

COMPARE OUR KITS AND LESSONS. COMPARE OUR TUITION.



Multiplex/Receiver offered in our Audio course is a 30-Watts-RMS-per-channel set that's designed for true High Fidelity performance, not built for training only. As for reliability, that's another word for Heath.

The same holds true for Heath Oscilloscopes, FET-VOM, Digital Multimeter, In-Circuit Transistor Tester, Solid-State 2-Meter FM Transceiver, and much more included in over a dozen NTS courses. Check it out! There's just no comparison.

COMPARE OUR LOW TUITION: We employ no salesmen, pay no commissions. You receive all home study information by mail. All kits, lessons and experiments are fully described in our Catalog and all equipment needed for your training is included in the tuition price. Nothing extra to buy for your training with NTS. Liberal refund policy and cancellation privileges spelled out.

Make your own comparisons. Check the number of lessons, check the subjects covered and check the amount and value of training equipment you will receive for your tuition dollars. Then make your own decision. Mail card today, or write for FREE Electronics catalog if card is missing. FIND OUT!

NO OBLIGATION. NO SALESMAN WILL CALL

APPROVED FOR VETERAN TRAINING

Get facts on new 2-year extension

NATIONAL TECHNICAL SCHOOLS

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

new products

More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Reader Service Card inside the back cover.

VOM, *model 60-NA,* has 50 separate ranges for improved accuracy and versatility. Includes a large 4½" mirrored scale meter, DC accuracy of ±1½% of full scale value, AC accuracy of ±3%, plus a multiplier switch that permits more readings to be taken at the upper portion of the meter

scale for greater accuracy. Measures 0-1000 VDC in 16 scales. 0-1000 VAC in 10 scales, and DC current from 0-1000 mA in 10 scales. Five resistance ranges from ×1 to ×100K are provided in addition to a −20 dB to 52 dB range. AC current reading from 0-300 amps may be obtained by using a *model 10-C* AC adaptor with this unit. $130.00.—**Triplett Corporation,** Bluffton, OH 45817.

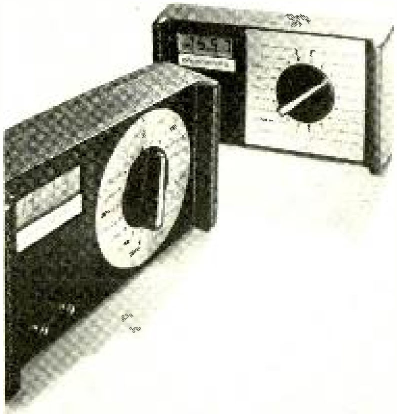
Circle 31 on reader service card

MICROPROCESSOR COMPUTER SYSTEM, *model B6800,* consists of a 500 character-per-minute heavy-duty printer, 42-character keyboard, tape reader, tape punch, card edge reader, card edge punch, central processing unit with memory, BEA-BUSS card extender, all cables, power supplies, and full documentation. The system can be set

up and be in operation in less than one hour. The *model B6800* features up to 1 million non-memory accessing operations per second. Up to 64, 128 locations may be addressed in memory. Memory can be any combination of RAM, ROM, or PROM. Battery backup supply is available as an accessory. Memory can be expanded in 1K, 2K, 4K, 8K byte increments. Price $1,250.00.—**Beacon Computer Corp.,** 3 Lexington Drive, Metuchen, NJ 08840.

Circle 32 on reader service card

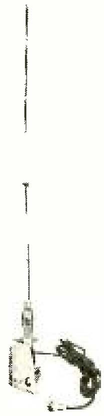
DIGITAL MULTIMETERS, *Danameter 200A and Danameter II 2100A,* are two new 3½ digit multimeters for field or lab applications. Both feature a high-contrast LCD readout. DC voltage measurements from 1 mV to 1000 V, AC measurements from 1 mV to 1000 V peak, DC current capability from



10 nA to 2 A. Basic DC accuracy of the *2000A* is 0.5%. DC accuracy of the *2100A* is 0.25%. Both have 50-dB normal-mode noise rejection and 10 megohm input impedance. Powered by a 9V battery that will last for one year without recharging. Single control switch for easy operation.—**Dana Laboratories, Inc.,** 2401 Campus Drive, Irvine, CA 92713.

Circle 33 on reader service card

GUTTER MOUNT CB ANTENNA is ideal for beginning CB'ers. Simple to install on any vehicle rain gutter, the *INDEPENDENCE model 10-245* low-profile 27-MHz antenna



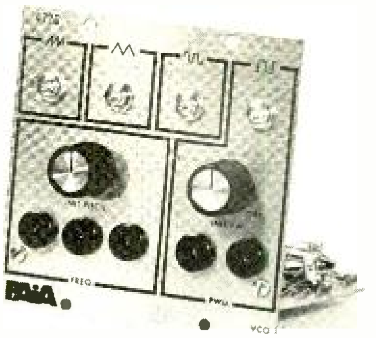
delivers plenty of talk power. Only 28 inches long, the top whip is a soft luster stainless steel and the base rod is brilliant chrome-plated brass. The antenna may be mounted quickly with the corrosion-resistant, chrome-plated steel bracket designed for long wear and ample door clearance.

The whip includes a static arrester for ultra-quiet reception and has a pre-tuned heavy-duty ABS encapsulated center load coil for optimum efficiency over the entire class-D band. An auto-flex stainless steel spring relieves whip shock.

Allen wrench for fine tuning the antenna, plus a 10-foot coax cable with a PL-259 plug that mates with any standard SO-239 transceiver antenna receptacle . . . all for only $22.95.—**Breaker Corp.**, Marketing Department, 1101 Great Southwest Parkway, Arlington, TX 76011.

Circle 34 on reader service card

VOLTAGE CONTROLLED OSCILLATOR KIT, *model 4720,* features simultaneous ramp, triangle, sine and pulse/squarewave outputs; manually-set or voltage-controlled pulse width and 16 Hz to 16 kHz frequency response corresponding to 5 volt peak control voltage. Front-panel range control allows multiple oscillators to be offset and track one another chromaticly over the entire operating range. A self-zeroing front-end and active on-board voltage regulation make the *4720* extremely linear and stable.



Although designed as a wide range voltage controlled oscillator for electronic music synthesizer applications the *4720* is useful as a signal generator for the test bench, an audio sweep generator for testing frequency response in amplifiers, tape recorders and other audio gear and can be applied to narrow-band frequency analysis of system equalization or room acoustics.

Step-by-step, well illustrated instructions assure ease of assembly and guaranteed operation of the unit. $34.95 postpaid.—**PAIA Electronics,** 1020 W. Wilshire Blvd., Oklahoma City, OK 73116.

Circle 35 on reader service card

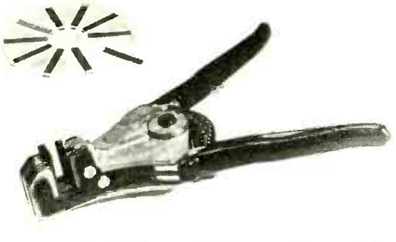
PLASTIC-BLADE WIRE STRIPPER uses space-age plastic Stilan® blades with cutting edges harder than insulation, but softer than copper. This enables them to strip the insulation from wire or cable without any damage to the conductors and without separating them. The new hand wire stripper removes the insulation from twisted pairs, multi-conductor cable, ribbon cable, twin-lead antenna wire, electrical cable, automobile wiring, lamp cord and telephone wires, just as quickly and easily as it does from ordinary hook-up wire, all without separating the conductors. The *Plastic-Blade Stripper* strips at least 25% faster than manual models using steel blades. The new stripper offers these advantages over models with metal blades: The wires being stripped do not have to be carefully positioned between the stripper blades. Also, a number of different wires can be stripped at the same time. This stripper requires no adjustment for wire sizes, type, or number of conductors.

Circle 23 on reader service card

Circle 24 on reader service card

Circle 25 on reader service card

The tool strips any size wire from AWG 12 through AWG 28 with just about any type of insulation, including PVC (vinyl), cross-linked polyethylene, rubber, neoprene—nearly all the insulating materials in use to-



day, except Teflon and Kynar. The cutting edges last up to 50,000 strips on simple hook-up wire. Replacement injector blades slide easily into place. There is no need to use tools to disassemble the stripper jaws for blade replacement. $39.95 with three sets of blades.—**Alpha Wire Corp.,** 711 Lidgerwood Ave., Elizabeth, NJ 07207.

Circle 37 on reader service card

C/MOS PROBE, *Model P-1 Milli,* converts a VTVM, TVM, or VOM into a sensitive FET-input millivolt meter. Even when connected to an ordinary 1-volt panel meter with a 1 mA meter movement, *"Milli"* will increase meter sensitivity up to 1000 megohms/volt, give full scale deflection for only 10 mV input, measure current as low as 1 nA full-scale, and cost a lot less than a new FET meter.

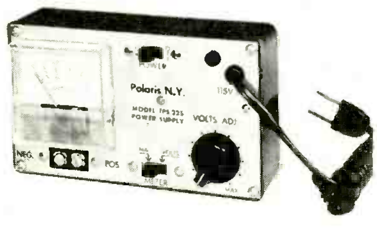
Milli is a self contained, battery operated, DC millivolt amplifier that is housed in a 5" probe. A three-position range switch provides straight through measurements in the off position, and amplified measurements of 10 or 100 times in the other positions. *"Milli"* utilizes a sophisticated IC which combines a P/MOS FET input for that very-high-input impedance, a bipolar transistor

amplifier, and an unusual C/MOS output stage all on the same chip.

Milli comes complete in kit form with everything except battery and output lead connectors to fit your voltmeter. Available only by mail (*Model P-1*, $11.95 plus $1.00 for shipping and handling).—**Dage Scientific Instruments,** Box 1054, Livermore, CA 94550.

Circle 36 on reader service card

DC POWER SUPPLY, *model TP-225*, a multi-function unit for service work, industrial and circuit design applications. Delivers 0-25 volts DC, incorporates voltage regulator and



short-circuit protection. 250-mA current carrying capacity. Meter monitors both voltage and current. May be used as negative or positive ground power supply. Useful as an adjustable bias supply. Handy as bench battery eliminator and battery charger. Measures 6" × 3" × 1½".—**Polaris,** 2862 Fulton Street, Brooklyn, NY 11207.

Circle 38 on reader service card

COMPACT TOOL CASES. The *Xcelite TC-100ST* tool case for technicians, servicemen and field engineers contains a total of 41 individual tools, 16 of the *Series 99* interchangeable screwdriver/nutdriver blades and handles, and five specialized space-saving kits. The multi-use variety of tools includes such essentials as seven types of pliers, an adjustable wrench, electrician's knife, electronic snips, straight nose seizer, and wire stripper/cutter. The sets and kits cover Phillips, slotted and hex screwdrivers, hex nutdriver blades, and a selection of handles and other specialty blades.

The case, measurng 19½ × 13 × 6¾ in.

Circle 26 on reader service card

and covered with leather-grain fabric, holds a removeable pallet and tray with see-thru plastic tool pockets, leaving the spacious partitioned lower section for additional tools.

A smaller case, the *model TC-200ST* containing 38 tools and kit sets, is also available.—**Weller-Xcelite Electronics Div.**, The Cooper Group, Apex, NC 27502.

Circle 39 on reader service card

TV MODULE REPAIR SERVICE. Same-day service is being offered on repair of Zenith, RCA, Quasar and G-E modules at this time with plans for adding additional lines in the near future. Each module undergoes stringent testing and temperature cycling after repair and alignment to insure proper operation of module. All modules carry a one-year warranty. Repair price is $5.95 to $12.50 depending on type of module.—**PTS Electronics, Inc.**, 5233 South Hwy #37; Bloomington, IN 47401.

Circle 40 on reader service card

MOBILE MICROWAVE RECEIVER, the *Senturion*, is a highway radar detector designed for the professional driver who demands the ultimate in security. It detects and gives early warning of all modern traffic control radar systems, including the "Speed Gun" and VASCAR moving radar systems. Warning is a simultaneous light and audible alarm. The manufacturer claims the range to be

approximately twice the distance at which you can be tracked.

The *Senturion* can be mounted on the dashboard or sun visor and can be wired directly into the vehicle's 12-volt electrical system or plugged into the cigarette lighter. —**Radatron Corp.**, 2424 Niagara Falls Blvd., North Tonawanda, NY 14120.

CB LICENSE HOLDERS are nearing the 3 million mark. December, 1975, ended the year with a total number of incoming applications for that month equalling 515,557. This brings the total authorized CB stations (Classes A, C & D) beginning the new year to 2,963,033.

next month

JULY 1976

■ **New Digital Clock**

Display brightness adjusts automatically to room lighting conditions. Simple IC and circuit board construction.

■ **Deluxe Darkroom Timer**

Digital display and keyboard entry of desired time. Display counts down and controls enlarger or other electric-powered device.

■ **Gas Sensor Alarm**

Detect fumes before they become a hazard. Inexpensive device does this task effectively.

■ **CB Antenna Roundup**

Base-station antennas come in a variety of sizes and shapes. Selecting the one that's best for you is vital.

PLUS

Komputer Korner

Service Clinic

Looking Ahead

And much more

and speed. Then that player must hit the ball again or lose a point to his opponent.

The second challenge occurs whenever the ball touches the top or bottom of the bumper cube. Instead of rebounding, the ball enters the cube . . . and then after a brief random interval comes flying out. Both the path and speed of the ball are controlled by the randomizing integrator circuit. Also the ball may be angled from the bumper toward either player.

Look at the circuitry

The entire schematic for this game (with the execption of the scoring circuit) is shown on pages 36 and 37. The game provides a complete video image. It also generates the vertical and horizontal sync pulses necessary to provide a raster on the TV screen. You should think of this game as having eight separate functional areas. These are the vertical and horizontal sync, paddle circuits, playing field circuits, ball circuits, hit-and-miss circuits, audio, scoring, and video.

The vertical and horizontal sync pulses are generated by two 555 IC timers (IC26 and IC1). The vertical sync frequency is generated by IC26, the horizontal sync by IC1. The frequency of the vertical sync is determined by the combination of R2 and R43 and C2. Similarly, the horizontal sync frequency is determined by R1, R44 and C1. For long-term frequency stability both C1 and C2 are specially selected for their low temperature coefficients.

The outputs of both 555's are used to provide the required tuning signals within the game. Sync for the TV set is provided through IC8-c which is used as an OR gate to combine the vertical and horizontal sync pulses. IC8-c's output goes to the video combiner, IC5-c. This circuit will be discussed later. A vertical sync pulse defines the beginning of a TV frame, and a horizontal sync pulse defines the beginning of each line.

The vertical and horizontal sync signals are used to generate vertical and horizontal ramp signals. These are then used to provide position reference signals for the paddles, ball and both boundaries. The vertical ramp is generated by transistor Q1 and its associated components. The vertical sync pulses from IC26 are inverted by IC2-b and fed via R7 and R8 to the base of transistor Q1.

At the beginning of a frame, Q1 is momentarily turned on by the inverted vertical sync pulse, bringing the vertical ramp

(continued on page 80)

PARTS LIST

All resistors ¼-watt 5% unless noted
R1, R2, R9, R57, R77, R78, R80, R81, R82, R83—5000 ohms, trimpot
R3, R45—2000 ohms
R4, R7, R10, R12, R16, R19, R21, R24, R25, R28, R30, R52, R64, R70, R74—1000 ohms
R5, R6, R13, R20, R22, R23, R27, R32, R42, R54, R58—10,000 ohms
R8, R17—15,000 ohms
R11, R26, R60—47,000 ohms
R14, R15, R18, R29, R31, R39, R40, R41, R48, R53, R56, R71—5100 ohms,
R33—3.3 megohms
R34, R65, R66, R68, R69, R76—470,000 ohms
R35, R38—1000 ohms, trimpot
R36, R37, R47, R61, R73—510 ohms
R43—20,000 ohms nominal (V sync)
R44—30,000 ohms nominal (H sync)
R46—15 ohms
R49, R59, R62—100,000 ohms
R50, R51—75,000 ohms (or 68,000 or 82,000 ohms)
R55, R72—200 ohms
R63—50,000 ohms, trimpot (or 100,000 ohms, trimpot)
R67—Not used
R75—1200 ohms
R79—1000 ohms, optional, see text
R84, R85, R86, R87, R88—5000 ohms, potentiometer linear taper (or any value between 5000 and 25,000 ohms)

All capacitors 15 volts or more
C1—2000 pF, temp stab polystrene
C2—1.0 or 1.2 μF, temp stab tantalum
C3—0.2 μF, dipped tantalum
C4—not used
C5, C14, C33, C42—10 μF, axial
C6, C32—1000 μF, radial
C7—.001 μF
C8, C18—0.1 μF, dipped tantalum
C9, C35, C36—270 pF
C10, C12, C44, C47, C48—1 μF, axial
C11, C13, C19—500 pF or 470 pF
C15, C16—0.47 μF, dipped tantalum
C17—1 μF, dipped tantalum
C20, C22, C23, C24, C38, C39—.01 μF
C21, C26, C27, C28, C29, C30, C31—.05 μF
C25—not used
C34, C37—100 pF
C40, C41, C46—.005 μF
C43—2.2 μF, dipped tantalum
C45—100 μF, radial
C49—6.8 μF, tantalum
C50—not used

Diodes
D1 to D8—1N4148 (or any signal diode)
D9 to D12—not used
D13 to D23—1N4148 (or any signal diode)
D24, D25—1N4148 (optional for low-resistance joystick)

Transistors
Q1 to Q6—2N2222

Integrated Circuits
IC1, IC11, IC26—555
IC2—7404
IC3, IC7, IC8, IC14, IC15, IC18, IC19—7400
IC4, IC6—339
IC5—7402
IC9, IC22—74C74
IC10, IC17—7474
IC12—4066
IC13—7423
IC16—7420
IC20—74C90
IC21—74C00
IC23, IC24—74C04
IC25—74C10
IC27—LM309 (5v, 1A regulator)

Switches
S1—spst toggle
S2, S3—spdt toggle
S4—spst N.O. momentary push button
SPKR—4 to 8 ohms, 2¼ inch diameter

signal to 0 volts. The ramp voltage then rises as Q1 is switched off and capacitor C3 charges through R5, R8 and R7. The output of IC26 is at ground during this period.

The horizontal ramp circuit operates in a similar manner with a separate but rather identical circuit. Thus for each TV frame, the vertical ramp makes one complete cycle and, for each TV scan line, the horizontal ramp makes one complete cycle.

The following items are available from Visulex, P.O. Box 4204, Mountain View, CA 94040

Main circuit board, with pre-aligned horizontal and vertical sync oscillators soldered in place. Includes circuitry (but not components) for ball, paddle and boundary display, sound effects, computer-control module, paddle size selector, ball speed/angle randomizer, game action electronics for bumper and power filters. Order Kit MB-3: $29.50

Component kit for main board. Contains all additional ICs, IC sockets, transistors, resistors, diodes, trimpots and 5V regulator Order kit MBK-3: $48.50

Assembled and tested main board. Order MBA-3: $105.00

On screen scoring circuit board, including LSI character display generator IC. Order kit SB-3: $18.75

Component kit for scoring board contains all additional ICs, IC sockets, resistors, capacitors, diodes and trimpots. Order kit SBK-3: $20.50

Assembled and tested scoring board. Order SBA-3: $55.00

Accessory kit contains parts for external game control. Includes paddle potentiometers for horizontal and vertical motion, 6-wire cables for remote use of paddle motion potentiometers, paddle size potentiometer, switches for computer control and game selection, score reset push button, speaker and hook-up wire, knobs. Order kit AK-3; $25.75

Power supply, 12 volts DC. Powers the entire game including scoring module. Order kit PS-3; $8.70

Cases. Including main cabinet plus remote player control boxes. Order kit CC-3: $22.50

The Everything Package. Supplies everything needed. Includes CP-3, MB-3, MBK-3, SB-3 SBK-3 AK-3, PS-3 and CC-3. Order EP-3: $162.50

The playing field is comprised of the top and bottom boundaries and the centerline. The centerline is generated by three sections of IC14 (a, b and c), C18, C19, and R36. Control R35 sets the position of the centerline. IC14-a, IC14-b, C18, and R35 form a one-shot multivibrator, whose period is approximately 30 microseconds. This is approximately one-half the horizontal sync interval. It is triggered by the horizontal sync. Thus for each line, a 30-μs pulse is generated. The trailing edge of this pulse is coupled through C19 and is inverted by a IC14-c to produce a very narrow low-going pulse, which is the centerline.

Since this occurs approximately midway between the horizontal sync pulses, the resulting signal, when displayed on the screen, will be at the center.

The top boundary is generated in a manner similar to the bottom boundary with one major exception; the sense of the comparator is reversed so that the output at pin 13 of IC4-c goes high when the vertical ramp voltage reaches the reference voltage. Resistor R57 supplies the fixed voltage and determines the height of the bottom boundry. The bottom boundry signal is also used to control the ball rebound. This will be described a bit further on.

The paddles

The paddles are generated by four comparator circuits, two in IC4 (a and b) and two in IC6 (a and b), and their associated logic networks. For each paddle there are two comparators. One is used to position the paddle vertically, the other horizontally. Since both paddles are generated in an identical manner only one will be discussed.

Each paddle is produced by comparing the voltages on the external vertical and horizontal player potentiometers with the vertical and horizontal ramps, respectively. When we look at the left paddle, the horizontal player potentiometer voltage is applied to pin 4 of IC4-a and the vertical voltage to pin 5 of IC6-a.

When the voltage of the horizontal ramp equals the voltage on pin 4 of IC4-a, the output at pin 2 of IC4-a goes high. The leading edge of this high-going pulse is differentiated by C11-R21 and is inverted in IC3-a, delivering a narrow negative-going pulse at pin 9 of IC5-a. This pulse appears at every scan line and gives the horizontal position of the paddle.

However, we must still determine the vertical position of the paddle. This is done by the other comparator, IC6-b. The sense of this comparator is reversed so when the vertical ramp voltage reaches the vertical player potentiometer voltage, the output from pin 2 of IC6-a goes low. This low-going signal is differentiated by C15 and R29 giving a negative pulse at pin 8 of IC5-a. The two negative pulses, at pin 8 of IC5-a and pin 9 of IC5-a, are ANDed by IC5-a to produce a series of positive pulses on output pin-10 of IC5-a. These pulses occur at the horizontal sync rate and comprise a total paddle signal. It is displayed on the screen via IC13 and is also used to determine a ball hit.

Paddle height is determined by the width of the output pulse at pin 2 of the vertical comparator IC6-a. The height of the paddle is controlled by varying the width of the pulse on pin 8 of IC5-a.

Still to come: completion of how it works, the foil patterns, component placement diagram and assembly procedure. **R-E**

Circle 66 on reader service card

HI-FI TEST GEAR

(continued from page 47)

Spectrum analysis

We mentioned earlier that it is possible to gain some information regarding the makeup of harmonic distortion by observing the distortion components themselves on an oscilloscope. A much more powerful tool for this purpose is a separate audio-spectrum analyzer. While such analyzers are relatively expensive, you can actually display separately the individual harmonics that constitute the total harmonic distortion figure. A spectrum analyzer also permits more detailed examination of residual noise in audio products, rapid visual plotting of frequency response, tone control action, filter response and a host of other frequency versus amplitude characteristics not possible to observe in detail with the rest of the equipment already discussed. Examples of the use of a spectrum analyzer may be found in any of the **Radio-Electronics** Hi-Fi Equipment test reports, including those in this issue.

In this article we have highlighted only the major items that go into a properly equipped audio test facility. Enterprising and innovative test equipment manufacturers constantly introduce a variety of test equipment designed to make the audio tester's job easier and more accurate. We could have included a good deal of additional equipment, but have limited this discussion to the basics. Even so, it's pretty obvious that today's better audio equipment requires test procedures and test equipment that is at least as sophisticated and complex as the products we are trying to measure and service. **R-E**

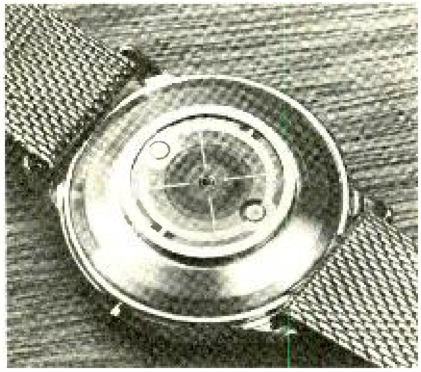
Veteran Wireless Operators Present awards to five

The Lee deForest Gold Medal Audion Award of the Veteran Wireless Operators Association (VWOA) was presented this year to Francis T. Cassidy, president of the United States Transmission Systems, a subsidiary of ITT. The award was granted for "a quarter century of dedicated research and development work in the field." Mr. Cassidy holds a number of patents in communications, including the patent for the channel combiner and divider system for automatic alternate voice and data communications.

The Marconi Memorial Gold Medal of Service was given to John McKenna, president of RCA Service Operations, and to Lt. Commander Russell A. Langdon (USN Retired). The Marconi Memorial Gold Medal of Achievement went to William A. Leonard II, radio and TV broadcasting executive of the Columbia Broadcasting System (CBS). The Marconi Gold Medal of Honor went to Arthur C. Goodnow for research and development of broadcast transmitters.

Wrist-watch pulse detector privides digital readout

A new opto-electronic transducer is expected to make it possible to provide a digital watch readout of human heart-beat rates. Invented by an Englishman, Commander Thomas Orr, the transducer is a light-emitting diode (LED) mounted in the center of an annular thin-film photovoltaic detector. Light from the LED penetrates the skin into the blood-rich tissue. Part of the light—modulated by changes in light absorption by the blood resulting from the arterial pulse—is reflected back to the detector. The electrical signal thus produced can then be electronically processed and the pulse rate displayed or recorded.



THE ORR HEARTBEAT TRANSDUCER consists of a light-emitting diode surrounded by a ring-shaped photovoltaic detector. The whole is designed to fit on the back panel of a standard wrist watch.

The developers of the device, International Research and Development Co. of Newcastle, England, plan development of a counter that can be interfaced with a digital watch module for a digital wrist-watch readout.

RCA introduces new, fast, low-cost microprocessor

RCA has introduced the CDP1802 microprocessor, a chip measuring less than 0.2 × 0.25 inch (5.08 × 6.35 mm) and containing about 5,500 transistors. It is less than half the size of RCA's earlier microprocessor. The reduction in size was achieved by technical advances in processing, which also made it possible for the chip to execute calculations in less than 2.5 microseconds—a cycle time comparable to speeds of any MOS microprocessors currently offered.

The same technical advances have also resulted in significant cost reductions, making possible a price of less than $25 in quantities of 100.

The power required is low, making it feasible to run a complete microprocessor system on batteries. This single microprocessor chip, in conjunction with solid-state memories and other peripherals selling in total for probably less than $100, can now perform the same functions as some of the large computers that sold for tens of thousands of dollars less than 10 years ago.

BUILD A COMPUTER
(continued from page 44)

many more IC's, but it takes relatively few software steps.

The software routines at POINTD, POINTE, POINTF and POINTG make up what is called a command decoder. The software decodes the key-switches into real actions. Depressing H or L causes the data temporarily stored in the 8080A as numeric key inputs to be output to either the HI or LO set of LED's. The S key causes the current or new data to be put back into the current memory location. Depressing G causes the computer to use the HI and LO address as the starting point for a new program.

The TIMOUT and KBRD software subroutines have specific tasks. The TIMOUT will count its way through various loops for about 10 milliseconds, while the KBRD subroutine will input a code from the keyboard. The KBRD subroutine has some unique features that illustrate an interesting hardware-software tradeoff. The keyswitches used in the Dyna-Micro are not bounce free, so that when the switches are opened or closed, they can often remake or re-break the contacts. This can be confusing to the computer since it can't distinguish between a real switch closure and a bounce. We don't want

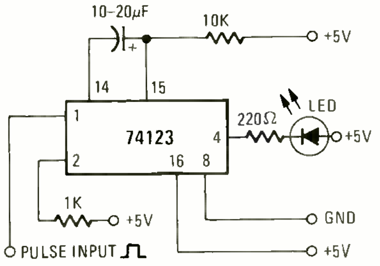


FIG. 6—MONOSTABLE-LED circuit is used for check-out of the Dyna-Micro.

0	1	2	3
4	5	6	7
H	L	G	S
R	A	B	C

FIG. 7—KEYBOARD LEGENDS are oriented as shown.

A user's group has already been formed for the Dyna-Micro. Interested people should contact:
Dr. Frank Settle, Jr.
Digital Directions
Box 1053
Lexington, VA 24450

WE GOOFED

WE SURE DID! Last month we ran the first part of this construction article on the Dyna-Micro and we erred. It seems that one or more gremlins (little green people) found their way into our editorial offices and stole—that's right, stole—74 lines of text from the article. The text was stolen between the last paragraph on page 36 and the opening paragraph on page 74. To correct this evil crime, we are reprinting the two paragraphs in italics along with the missing text. To prevent this from happening again, we have tightened security around our offices.

The clock circuit uses an Intel 8224 integrated circuit. This is a crystal clock oscillator that provides the proper MOS clock levels for the 8080 system. It also contains circuitry for a TTL level clock (Ø2), RESET *and* READY inputs. Construction of the clock circuit begins by inserting components R1, R2, the 6.75 MHz crystal, IC5 and the jumper. Good quality IC sockets are recommended for all the integrated circuits.

After inserting and soldering the parts, the clock section should be checked. To do this, apply power and check for voltages on the 8224 chip. You should observe +5 at pin 16, +12 at pin 9 and ground at pin 8. Clock operation can be checked at pins 10 and 11. These are the MOS level outputs that swing between +12V and ground. The signals can be observed with a good scope. The TTL output on pin 6 can also be checked with a scope or with a monostable-LED circuit. The monostable circuit can be constructed on the SK-10 socket before it is added to the system.

With the 6.75-MHz crystal, the output frequency will be 750 kHz. This is slower than the maximum 2-MHz frequency that the 8080A will operate at, but a slow frequency was chosen to allow for slow access times of the PROM's.

The output ports are constructed next by inserting and soldering all the LED's (D1 through D24). Be sure to observe the polarity as shown by the symbol near D1. Add all the 220-ohm resistors (R7 through R30) and insert the SN7475 latches. Be careful to orient the IC's in their sockets. The foil pattern has a small mark near pin 1 for all the IC's.

With the latches and parts installed and soldered, apply power to the system. All of the LED's should light. If any are not on, check the associated SN7475 latch. With power still applied, ground the input pins to the latches, one at a time. Since all the inputs are on eight common data bus-lines, only eight inputs must be grounded to check all the LED's and latches. Ground pins 2, 3, 6 and 7 on IC24 and IC25. One of the LED's in each group of eight should go out, one at a time. If this doesn't happen, again check the SN7475's.

The keyboard section consists of 16 keyswitches—15 are used to input data and one is hardwired to the 8224 chip to reset the Dyna-Micro. The keyswitch closures are encoded by two SN74148 octal encoders and the encoded binary data is gated onto the bus through a three-state DM8095 or SN74365 IC.

Insert and carefully solder the keyswitches to the printed-circuit board and then insert the four integrated circuits, IC30 through IC33.

The keyboard section is tested by monitoring the data on the LED's. Carefully ground pins 1 and 15 on the three-state driver, IC31. This will cause data from the keyswitch encoders to *constantly be fed to the bus. With these two pins grounded, apply power and depress the keys, one at a time. The binary data for each keyswitch will be indicated on the LED's at all of the output-ports simultaneously. Note that the most significant bit, D7, will be on whenever one of the keys is depressed. This is often called a 'flag' since it is used to flag down the computer and tell it that one of the switches is ready with data.*

the computer to sense each bounce as a key closure so we would like some way to filter them out. Additional circuitry including latches, clocks and monostables could do this for us, but it complicates the system. We can also do the debouncing via software.

The KBRD subroutine will recognize any key closure, but it will only input the key codes after being sure that the key is closed and not bouncing. It does this by waiting after sensing a closure and then rechecking the switch to be sure it is still closed. It also checks when we release a key to be sure that it has stopped bouncing before it tries to sense another key being depressed by the user. We have traded some additional software steps for a great deal of hardware. Since there was plenty of PROM left, it was easy to include.

The TIMOUT and KBRD software

(Table II is on page 86)
(Text continues on page 90)

BUILD A COMPUTER
Text continues on page 90

TABLE II—KEYBOARD EXECUTIVE (KEX) PROGRAM

```
                              *000 000
000 000  303                  JMP
000 001  070                  START
000 002  000                  0

                              /JUMP UP TO R/W MEMORY TO
                               BE USED BY RESTARTS &
                               VECTORED INTERRUPTS
                              *000 010
000 010  303                  JMP
000 011  010                  010
000 012  003                  003
                              *000 020
000 020  303                  JMP
000 021  020                  020
000 022  003                  003
                              *000 030
000 030  303                  JMP
000 031  030                  030
000 032  003                  003
                              *000 040
000 040  303                  JMP
000 041  040                  040
000 042  003                  003
                              *000 050
000 050  303                  JMP
000 051  050                  050
000 052  003                  003
                              *000 060
000 060  303                  JMP
000 061  060                  060
000 062  003                  003

                              /BEGINNING OF MAIN PROGRAM
                              *000 070
000 070  061   START,         LXISP    /SET STACK POINTER
                                        TO TOP OF R/W MEM.
000 071  000                  000
000 072  004                  004
000 073  041                  LXIH     /INITIAL VALUE FOR
                                        H & L
000 074  000                  000
000 075  003                  003
000 076  116   POINT A,       MOVCM    /LOAD MEM DATA INTO
                                        TEMP DATA BUFFER
000 077  174                  MOVAH    /OUTPUT HI TO LED'S
000 100  323                  OUT
000 101  001                  001
000 102  175                  MOVAL    /OUTPUT LOW TO
                                        LED'S
000 103  323                  OUT
000 104  000                  000
000 105  171   POINT B,       MOVAC    /OUTPUT TEMP. DATA
                                        BUFFER DATA TO
                                        LED'S
000 106  323                  OUT
000 107  002                  002
000 110  315   POINT C,       CALL    /WAIT & INPUT NEXT
                                       KEY CLOSURE
000 111  315                  KBRD
000 112  000                  0
000 113  376                  CPI
000 114  010                  010
000 115  322                  JNC      /JUMP IF KEY WAS <
                                        010
000 116  134                  POINT D /(0-7, OCTAL
                                        DIGIT)
000 117  000                  0
000 120  107                  MOVBA    /SAVE KEY CODE
000 121  171                  MOVAC    /GET OLD VALUE
000 122  027                  RAL      /ROTATE 3 TIMES
```

```
000 123  027              RAL
000 124  027              RAL
000 125  346              ANI      /MASK OUT LEAST
                                    SIG. OCTAL DIGIT
000 126  370              370
000 127  260              ORAB     /OR IN NEW OCTAL
                                    DIGIT
000 130  117              MOVCA    /PUT NEW DATA
                                    BACK INTO BUFFER
000 131  303              JMP
000 132  105              POINT B
000 133  000              0
000 134  376  POINT D,    CPI
000 135  011              011      /"L" KEY
000 136  302              JNZ      /JUMP IF NOT AN "L"
000 137  145              POINT E
000 140  000              0
000 141  151              MOVLC    /PUT BUFFER DATA
                                    IN L
000 142  303              JMP
000 143  076              POINT A
000 144  000              0
000 145  376  POINT E,    CPI
000 146  010              010      /"H" KEY
000 147  302              JNZ      /JUMP IF NOT AN "H"
000 150  156              POINT F
000 151  000              0
000 152  141              MOVHC    /PUT BUFFER DATA
                                    IN H
000 153  303              JMP
000 154  076              POINT A
000 155  000              0
000 156  376  POINT F,    CPI
000 157  013              013      /"S" KEY
000 160  302              JNZ      /JUMP IF NOT "S"
000 161  170              POINT G
000 162  000              0
000 163  161              MOVMC    /PUT TEMP. DATA
                                    INTO MEMORY
000 164  043              INHX     /INCREMENT H & L
000 165  303              JMP
000 166  076              POINT A
000 167  000              0
000 170  376  POINT G,    CPI
000 171  012              012      /"G" KEY
000 172  302              JNZ      /JUMP IF NOT "G"
000 173  110              POINT C
000 174  000              0
000 175  351              PCHL     /GO EXECUTE PGM
                                    POINTED TO BY
                                    H & L

                          /THIS 10 MSEC DELAY
                           DISTURBS NO REGISTERS OR
                           FLAG

                          *000 277
000 277  365  TIMOUT,     PUSHPSW  /SAVE REGISTERS
000 300  325              PUSHD
                          LXID     /LOAD D & E WITH
                                    VALUE TO BE
000 301  021                        DECREMENTED
000 302  046              046
000 303  001              001
000 304  033  MORE,       DCXD     /JUMP IN THIS
                                    LOOP UNTIL
000 305  172              MOVAD    /D & E ARE BOTH
                                    ZERO
000 306  263              ORAE
000 307  302              JNZ
000 310  304              MORE
000 311  000              0
000 312  321              POPD
000 313  361              POPPSW   /RESTORE
                                    REGISTERS
000 314  311              RET

                          /THE KBRD ROUTINE
                           DEBOUNCES KEY CLOSURES
                          /AND TRANSLATES KEY CODES
```

Table II continues on page 89 (text continues on page 90)

VIDEO DISCS

(continued from page 40)

for every dropout there's a new system waiting in the wings. One of the latest, from Hitachi, uses a laser to read out discrete holographic images on a disc that rotates at just 6 RPM.

In any event, if RCA, MCA-Philips, Sony and their supporters stick to their present timetables, it appears that by this time next year we may have an answer to the industry's biggest question—does anybody really care? The consumer electronics industry has been searching for a new mass market product since 1964, when color television finally made the grade. To fill the bill, the videoplayer concept will have to appeal to millions of consumers. If it turns out the average consumer isn't willing to shell out $500 to $1,000, plus programming costs, for a substitute to the regular free TV fare, then the industry will have to look elsewhere for its future growth. R-E

NEXT MONTH

The July, 1976 issue of **Radio-Electronics** will feature two construction projects. One is a digital clock using a Panaplex display, and the other is a countdown timer. The timer has a built-in relay to control various external devices.

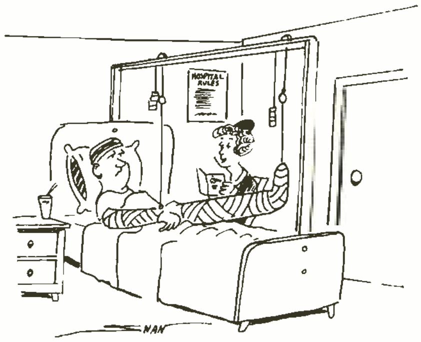
LETTERS

(continued from page 14)

you. You are doing a fine job and I enjoy reading the material in your magazine.

The first letter in the "Letters" column, April, 1976 issue, prompted me to write. Perhaps you have not recalled that Supreme Publications can and does supply diagrams and service material on practically all radio, TV, and stereo material of all makes. We certainly can supply (for a nominal charge) the Stewart-Warner material needed by your reader.

M. N. BEITMAN
Supreme Publications
1760 Balsam Rd.
Highland Park, IL 60035 R-E



"Here's a get well card from the TV store, and they've enclosed their new antenna catalog."

Table II continued from page 87
Text continues on page 90

```
                             /FLAGS AND REG A ARE
                              CHANGED
                             /A0-A3 = CODE; A4-A7 =
                              0000
000 315  333  KBRD,    IN      /INPUT FROM
                                KEYBOARD
                                ENCODERS
000 316  000           000
000 317  267           ORAA    /SET FLAGS
000 320  372           JM      /JUMP BACK IF LAST
                                KEY NOT RELEASED
000 321  315           KBRD
000 322  000           0
000 323  315           CALL    WAIT 10 MSEC
000 324  277           TIMOUT
000 325  000           0
000 326  333  FLAGCK,  IN
000 327  000           000
000 330  267           ORAA
000 331  362           JP      /JUMP BACK TO WAIT
                                FOR A NEW
000 332  326           FLAGCK  /KEY TO BE PRESSED
000 333  000           0
000 334  315           CALL    /WAIT 10 MSEC FOR
                                BOUNCING
000 335  277           TIMOUT
000 336  000           0
000 337  333           IN
000 340  000           000
000 341  267           ORAA
000 342  362           JP      /JUMP BACK IF NEW
                                KEY NOT STILL
000 343  326           FLAGCK  /PRESSED (FALSE
                                ALARM)
000 344  000           0
000 345  346           ANI     /MASK OUT ALL BUT
                                KEY CODE
000 346  017           017
000 347  345           PUSHH   /SAVE H & L
000 350  046           MVIH    /ZERO H REG
000 351  000           000
000 352  306           ADI     /ADD THE ADDRESS
                                OF THE BEGINNING
000 353  360           360     /OF THE TABLE TO
                                THE KEY CODE
000 354  157           MOVLA   /
000 355  176           MOVAM   /FETCH NEW VALUE
                                FROM TABLE
000 356  341           POPH    /RESTORE H & L
000 357  311           RET
                       /THIS TRANSLATION TABLE
                        CONVERTS THE CODE
                       /GENERATED BY KEY CLOSURES
                        TO THE CODE
                       /USED BY THE MAIN KEX
                        PROGRAM
000 360  000  TABLE,   000
000 361  001           001
000 362  002           002
000 363  003           003
000 364  004           004
000 365  005           005
000 366  006           006
000 367  007           007
000 370  013           013     /S
000 371  000           000     /THIS CODE CAN'T
                                BE GENERATED
000 372  017           017     /C
000 373  012           012     /G
000 374  010           010     /H
000 375  011           011     /L
000 376  015           015     /A
000 377  016           016     /B
```

end of Table II (text continues on page 90)

BUILD A COMPUTER
(continued from page 87)

segments have been set up as subroutines and can be used in your software and in the experiments. Each of these subroutines may be started with a CALL instruction, 315. The TIMOUT subroutine does not affect any of the registers or flags and it only serves to delay the software flow by 10 ms.

An important distinction between the 8008 and the 8080 processors is in the use of subroutines. In the 8008, return-pointer addresses were stored in the 8008 IC itself. In the 8080, these return-pointer addresses are stored in a portion of the R/W memory. This is called a "stack" area. Whenever a subroutine is used, we want to execute the subroutine and then return back to the normal program flow. These return addresses are very important to the computer since they provide the only link between the subroutine and the main program. If we are to store them in a portion of R/W memory, the computer must know where this storage area is if it is to be able to use the addresses properly. In the KEX software, this is preset to be the top of the R/W memory with instructions at locations 070, 071 and 072. The LXISP instruction loads an internal 8080 stack-pointer register to HI=004, LO=000. Since the stack-pointer register is *decremented* to point to a new location before anything is stored, the first stack location will be HI=003, LO=377. Check your 16" bit binary numbers if this looks a little confusing.

You can use the stack as set up by the KEX (generally a good idea) or you can put your own stack anywhere you want, just by using the LXISP instruction. Remember to avoid the stack area when writing your programs. Remember, too, that you can't put the stack in an area of non-existent memory or in PROM.

You will use the stack area and you'll see how it can also be used to temporarily store data. This will be covered in the software modules. Let's see how the TIMOUT and KBRD subroutines can be used in our own software. We will use the software stack already set up in KEX.

Let's input a keyboard character, add a constant to the binary code for that character and display the result. We would first CALL the KRBD subroutine to input a binary key-code, then add the constant and display the result. The software listed in Table III will do this:

You can enter this with the KEX program. Depress the R key and start entering data. Enter 000 at location 003 004 so we'll first add zero to the codes. This will let us check what values are assigned to each key. Write down the codes. Go back and restart

TABLE III

HI	LO	INSTR	MNEMONIC	
003	000	315	CALL	/Input keyboard character
003	001	315	KBRD	/Subroutine's LO address
003	002	000	0	/Subroutine's HI address
003	003	306	ADI	/Add the following DATA to
003	004	???	DATA	/the contents of register A
003	005	323	OUT	/Output data from register A to
003	006	000	000	/device 000 (LEDs)
003	007	303	JMP	/Jump back to program at
003	010	000	000	/LO address = 000
003	011	003	003	/HI address = 003

TABLE IV

Assume HI = 003 throughout this program

LO	INSTR	MNEMONIC	
000	006	MVIB	/Load register B with the following data
001	370	370	/Data; time constant
002	315	CALL	/Call TIMOUT subroutine at
003	277	277	/LO address = 277
004	000	000	/HI address = 000
005	005	DECB	/Decrement B by 1
006	302	JNZ	/Jump if result is not zero to
007	002	002	/LO address = 002
010	003	003	/HI address = 003
011	076	MVIA	/Load register A with the following data
012	377	377	/Data; all 1's
013	323	OUT	/Output to device,
014	000	000	/device 000 (LED's)
015	166	HLT	/Stop once you reach here

KEX and change the value in 003 004 to, say, 005. This will add 5 to each code. Restart your software and see if this is the case. Congratulations, you have just done your first software experiment! The instructions at 003 003 and 003 004 could be changed to do other things to the data. Can you suggest one?

The 10 ms delay routine, TIMOUT, can be useful when we want a software delay that is in multiples of 10 ms. The software routine listed in Table IV will delay an output of all 1's on OUTPUT PORT 0 by about 2.5 seconds after the program is started. Try it. Can you see how the time delay might be shortened? Can you see any use for programs like this?

The keyboard input subroutine, KBRD, is called at address 000 315 and the time delay subroutine, TIMOUT, is called at address 000 277.

Next month, this construction article concludes with a description of the 8080A microprocessor and how the Dyna-Micro works. This will include an explanation of how the memory is accessed and how the Dyna-Micro selects input/output devices via software. R-E

Circle 90 on reader service card

market center

CLASSIFIED COMMERCIAL RATE (for firms or individuals offering commercial products or services). **$1.40 per word . . .** minimum 15 words.

NONCOMMERCIAL RATE (for individuals who want to buy or sell personal items) **85¢ per word . . .** no minimum.

ONLY FIRST WORD AND NAME set in bold caps. Additional bold face (not available as all caps) at 10¢ per word. Payment must accompany all ads except those placed by accredited advertising agencies. 10% discount on 12 consecutive insertions, if paid in advance. All copy subject to publisher's approval. Advertisements using P.O. Box address will not be accepted until advertiser supplies publisher with permanent address and phone number. Copy to be in our hands on the 26th of the third month preceding the date of the issue (i.e. August issue closes May 26). When normal closing date falls on Saturday, Sunday or a holiday, issue closes on preceding working day.

NOTICE TO MAIL ORDER BUYERS

Under a new Trade Regulation Rule of the FTC that became effective February 2, 1976, mail-order merchants are required to make deliveries within a reasonable time, notify the customer if his order has to be delayed, and return his money if requested.

The rule provides that if a mail-order seller is unable to ship merchandise within the time specified in his ad (or if no time is specified, within 30 days) he must notify the buyer of the delay and give him the option of cancelling the order and having his purchase money refunded.

The buyer must be provided with a cost-free device for this purpose such as a postpaid postcard or return envelope. If the buyer does not respond, it will be assumed that he has consented to an additional 30-day delay. For any longer delay, the customer's express consent must be gained; otherwise the money is to be refunded.

The rule also makes provision for indefinite delays if agreed to by the customer; though a refund must be made, if requested any time during the delay. It also requires sellers of mail-order merchandise to have a reasonable basis for any claims they make about shipping time.

Penalties are severe. The FTC can go to court to get an order for compliance by a company or they could have a company fined up to $10,000 for each day of non-compliance.

The rule *does not apply* to COD orders.

If you have a documented complaint send it to: Federal Trade Commission, Bureau of Consumer Protection, Washington, DC 20580.

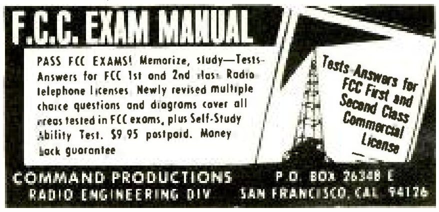
EDUCATION & INSTRUCTION

TELEPHONE bugged? Don't be Watergated! Countermeasures brochure $1.00. **NEGEYE LABORATORIES,** Box 547-RE, Pennsboro, WV 26415

FCC License Study Guide. New, 377 pages. Includes 1465 FCC-type questions, with answers and discussions, covering third, second, and first class radiotelephone exams. $8.95 postpaid. **GSE PUBLICATIONS,** 2000 Stoner Ave., Los Angeles, CA 90025

ELECTRONICS DESIGN NEWSLETTER
Learn Design Techniques!
★ Logic Design Techniques
★ Digital & Linear Design Theory & Procedures
★ Construction Projects
Write for FREE CATALOG of parts & kits
Subscription $6 Sample Copy $1
VALLEY WEST Box 2119-L Sunnyvale, CA 94087

FREE educational electronics catalog. Home study courses. Write to: **EDUKITS WORKSHOP,** Dept. 280G, Hewlett, NY 11557



MICROPROCESSOR, M6800 Instructional Lab—Preprogrammed, includes **CPU, DEBUG ROM, RAM, ACIA, PC BOARD,** Teletype provision; expandable; with Programming/Application Manuals; $199.00 kit; money order, B/Acard, Master Charge. **COMPUTER SYSTEMS,** 18430 Morang, Detroit, MI 48205 (313) 779-8700

Poly Pak's

BUY 'EM FROM THE "BARREL" AND SAVE!
100'S OF BARRELS PURCHASED!

$1,000,000 SALE

EXCLUSIVE 'BARREL'

Your choice of any kit **$1.98**

Every kit carries money back guarantee.

THE BIGGEST INFLATION-FIGHTING VALUE EVER! TEST 'EM YOURSELF 'N SAVE!

For the first time anywhere, Poly Pak merchandisers introduce a new way in buying the economical way. Raw stock from the "barrel". Remember the "good ole days"? They're back again. The same way merchandisers throughout the United States buy from various factories . . . their over-runs in barrels. Poly Pak has done the same. Therefore you are getting the same type of material as the RE-TESTERS DO!

NEVER BEFORE! U-TEST EM-N-CHOOSE EM IC'S

Order by Cat. No. and Type No.

NEW FACTORY ARRANGEMENTS! Why mix 'em? They decided to "bag" same types, then throw bags into barrels. WE DON'T TEST! You test 'em yourself. Buy types of your choice at BARREL PRICES!

7400 SERIES

Cat. No. 6R3170

Type	Sale
☐ SN7400	50 for $1.98
☐ SN7402	50 for 1.98
☐ SN7404	40 for 1.98
☐ SN7410	50 for 1.98
☐ SN7413	25 for 1.98
☐ SN7420	50 for 1.98
☐ SN7440	50 for 1.98
☐ SN7442	25 for 1.98
☐ SN7452	50 for 1.98
☐ SN7474	40 for 1.98
☐ SN7475	30 for 1.98
☐ SN7476	30 for 1.98
☐ SN7483	40 for 1.98
☐ SN7486	40 for 1.98
☐ SN7490	25 for 1.98
☐ SN7493	30 for 1.98
☐ SN7495	30 for 1.98
☐ SN74107	40 for 1.98
☐ SN74112	40 for 1.98
☐ SN74123	30 for 1.98
☐ SN74125	40 for 1.98
☐ SN74150	30 for 1.98
☐ SN74157	30 for 1.98
☐ SN74164	30 for 1.98
☐ SN74173	30 for 1.98
☐ SN74192	30 for 1.98
☐ SN74193	30 for 1.98
☐ SN74198	30 for 1.98

MONEY BACK GUARANTEE PER PAK!

LINEARS

Cat. No. 6R3171

☐ LM300H	30 for $1.98
☐ LM301V	50 for 1.98
☐ LM307V	40 for 1.98
☐ LM308V	30 for 1.98
☐ LM311V	50 for 1.98
☐ LM318V*	30 for 1.98
☐ LM319V	30 for 1.98
☐ LM324N	30 for 1.98
☐ LM339N	30 for 1.98
☐ LM351V	30 for 1.98
☐ LM358V	30 for 1.98
☐ LM377N	40 for 1.98
☐ LM380N	30 for 1.98
☐ LM380V*	30 for 1.98
☐ LM381N	30 for 1.98
☐ LM382N	30 for 1.98
☐ LM555V	30 for 1.98
☐ LM709H	50 for 1.98
☐ LM733N	30 for 1.98
☐ LM741†	30 for 1.98
☐ LM747N	30 for 1.98
☐ LM1303N	30 for 1.98
☐ LM1304N	30 for 1.98
☐ LM1310N	30 for 1.98
☐ LM1458V	30 for 1.98
☐ LM1810N	30 for 1.98
☐ LM1902N	30 for 1.98
☐ LM2111N	50 for 1.98
☐ LM2901N	30 for 1.98
☐ LM2902N	30 for 1.98
☐ LM3065N	30 for 1.98
☐ LM3302N	30 for 1.98
☐ LM3612V*	30 for 1.98
☐ LM3900	30 for 1.98
☐ LM7512N	40 for 1.98
☐ LM7534N	40 for 1.98
☐ LM7535N	40 for 1.98
☐ LM7538N	40 for 1.98
☐ LM75451V*	40 for 1.98
☐ LM75491N	30 for 1.98
☐ LM75492N	30 for 1.98

*Mini †TO-5

BARREL KIT #1 SN7400 DIP IC'S 75 for $1.98. Marked 14 and/or with 16 pin dips, may include gates, registers, flip flops, counters. Who knows! GUARANTEED SATISFACTION! Cat.No.6R2415 Untested.

BARREL KIT #2 LINEAR OP AMPS, DIPS Untested 75 for $1.98. May include 709's, 741's, 703's, 560 series, 555 includes marked and unmarked. Cat.No.6R2416

BARREL KIT #3 1N4148/914 SWITCHING DIODES 100 for $1.98. You never saw this before. Imagine famous switching diodes at these prices! Cat.No.6R2418 Untested.

BARREL KIT #4 "4000" RECTIFIERS 100 for $1.98 Untested. These are the famous micro miniature rectifiers of the 1N4000 series. May include 25, 50, 100, 200, 400, 600, 800 and 1000 volters. Cat.No.6R2417

BARREL KIT #5 SCRS, TRIACS, QUADRACS 40 for $1.98. All the famous plastic power tab type. Raw factory stock! All the 10 amp types. Cat.No.6R2419 Untested.

BARREL KIT #7 VOLUME CONTROL BONANZA! 40 for $1.98 100% good. Singles, duals, variety of values, styles, big ones — small ones. Cat.No.6R2421

BARREL KIT #8 SUBMINIATURE IF TRANSFORMERS 100% good. 100 for $1.98. Amazing, includes 455kcs, osc, antenna, who knows? From transistor radio manufacturers. Cat.No.6R2422

BARREL KIT #10 ROMS-REGISTERS 50 for $1.98 Untested. 28 to 40 pin devices, marked, internal factory numbers, etc. Cat.No.6R2424

BARREL KIT #12 POWER TAB TRANSISTORS 40 for $1.98. PNP, plastic 10220 type. Assorted 2N numbers. Cat.No.6R2426 Untested.

BARREL KIT #13 RESISTOR NETWORKS 60 for $1.98 Untested. By Corning Glass, in 14-pin dip paks. Cat.No.6R2427

BARREL KIT #15 MOSFET TRANSISTORS 60 for $1.98. All 4 leaders TO-18 case, includes UHF transistors too! Cat.No.6R2429

BARREL KIT #17 LINEAR & 7400 DIPS Untested 100 for $1.98. Marked and unmarked, internal numbers of raw factory stock. Cat.No.6R2431

BARREL KIT #19 DIPPED MYLARS 60 for $1.98. Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. Cat.No.6R2597 100% good.

BARREL KIT #20 LONG LEAD DISCS 150 for $1.98. Factory distributor stock "auction sale". Prime, marked only. Long leads. Cat.No.6R2598 100% good.

BARREL KIT #25 METAL CAN TRANSISTORS 100 for $1.98 Untested. Includes TO-5, TO-1, TO-18, etc., assorted 2N numbers, unmarked etc. Cat.No.6R2603

BARREL KIT #26 PLASTIC TRANSISTORS 100 for $1.98 Untested. Type TO-92 (TO-18), all manufacturers, variety of 2N's. Cat.No.6R2604

BARREL KIT #30 PREFORMED RESISTORS 250 for $1.98. We got barrels of 1/4 and 1/2" watters for pc use. You'll get even amount, 100: 1/4, 100 1/2" watters. Cat.No.6R2608 100% good.

BARREL KIT #31 METALLIC RESISTORS 100 for $1.98 100% good. Made mostly by Corning, the finest resistor made. Mostly 1/2 watters, 1% to 5% tol. & a barrel of values. Cat.No.6R2609

BARREL KIT #32 TRANSISTORS WITH A HOLE IN IT 50 for $1.98. Cat.No.6R2610 Untested. Can't name factory but we bought barrels of 25 watters with mtg. hole in middle, PNP'S and NPN'S.

BARREL KIT #35 NEON LAMPS 40 for $1.98 100% good. Famous NE-2's. All prime, but factory made millions and barrel'ed 'em. Your advantage. Cat.No.6R2613

BARREL KIT #36 GERMANIUM DIODES 200 for $1.98 Untested. Famous maker, popular item. Never grows old. But this is the way the RE-TESTERS buy 'em from the factories. Cat.No.6R2614

BARREL KIT #37 1 AMP "BULLETT" RECTIFIERS Untested. 100 for $1.98. Famous style, asstd. voltages, silicon, axial includes all types of voltages to 1KV. Cat.No.6R2615

BARREL KIT #39 2N3055 HOBBY TRANSISTORS 15 for $1.98 100% good. From factory to you, these failouts of the famous 2N3055. We have 10 barrels. Cat.No.6R2617

BARREL KIT #40 PNP HIGH-POWER TRANSISTORS 20 for $1.98. Popular germanium TO-3 case units, now available at "good ole barrel" prices. Cat.No.6R2618 100% good.

BARREL KIT #46 G.E. 3.5 WATT AMPLIFIERS 25 for $1.98 Untested. Hobby type, factory fallouts, we purchased them in barrels. These are unknowns. Cat.No.6R2624

BARREL KIT #50 SIGNAL SILICON DIODES 200 for $1.98. Includes many, many types of switching, signal silicon types, all axial leads. Some may be zeners. Cat.No 6R2628 Untested.

BARREL KIT #51 HOBBY OPTO COUPLERS Untested. 40 for $1.98. We bot 1,000's unknown both the sensor or transmitter may be good, or both. WE DON'T KNOW! We don't know the types. 1500V isolation. Cat.No.6R2629

BARREL KIT #52 DISCS! 500 for $1.98. Cat.No.6R2630 100% good. The bargain of a lifetime: First time ever offered by Poly Paks for the economy-minded bargain hunters.

BARREL KIT #53 JUMBO RESISTOR PAK 100-pc. $1.98. Cat.No.6R2721. Assortm metal films, precisions, carbons, metal oxide powers, from 1/8 watt to 7 watts. Color coded & 100% good. Worth $10.

BARREL KIT #58 SLIDE SWITCHES 30 for $1.98. All shapes, sizes, spst, dpdt, momentaries, etc. Tremendous shop pak for 100's of switching projects. Cat.No.6R2726 100% good.

BARREL KIT #59 POWER TRANSISTORS 40 for $1.98. 15 watt Bendix B-5000 pellet transistors, npn, all good, purchased from a pretester, have millions of. 100% good Cat.No.6R2727

BARREL KIT #60 DTL'S IC'S 75 for $1.98 Untested. This is prime barrel material. Who wants DTL's? 930, 936, 946's. Your gain is our loss. They're marked too. Cat.No.6R2728

BARREL KIT #61 POLYSTYRENE CAPS 100% good 100 for $1.98. Finest caps made. As a gamble we bought 10 barrels from factory, mixed values; all good. Cat.No.6R2729

BARREL KIT #65 MIXED READOUTS 15 for $1.98. Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate. Cat.No.6R2733 Untested.

BARREL KIT #68 2 WATTERS 100 for $1.98 100% good. Nobody seems to want 'em! So many suppliers don't count, but throw 'em in the barrel. It's a li'l gold mine All marked. Cat.No.6R2735

BARREL KIT #71 CAPACITOR SPECIAL 100 pcs. $1.98. Emptied stockrooms into barrels of mylars, poly's, micas, moldeds, plastics, ceramics, discs, etc. Nifty 100% good Cat.No.6R2738

BARREL KIT #73 TRANSISTOR ELECTROS 50 for $1.98. It "bugs" us why the factories dump 'em in barrels. We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 6R2747

BARREL KIT #75 400MW ZENERS 150 for $1.98. Factory out of biz! Amazing offer: 6, 8, 10, 12 to 15V You test. Hermetically sealed glass pak. Double plug. Cat.No.6R2740

BARREL KIT #76 1-WATT ZENERS 100 for $1.98 Untested. Factory same as 400-mw's. Never-to-see-again offer. 6, 8, 10, 12, 15V, under glass. Double plug. Cat.No.6R2741

BARREL KIT #77 "BROWN" BODY TRANSISTORS 40 for $1.98. G-E D-40 series: has hi-voltage, Darlingtons, hi-current, npn's. Factory line discontinued. Power tabs. Cat.No 6R2742 Untested.

BARREL KIT #78 "RED" BODY TRANSISTORS 40 for $1.98. D-42 series. You test—go into your own biz! High current, hi-V, NPN. Cat.No.6R2743 Untested

BARREL KIT #81 SUBMINI RESISTORS 200 for $1.98 100% good. PC, upright type, color coded, 1/8 watt. Asst values. Came to us in a barrel. Cat.No.6R2746

BARREL KIT #83 15 for $1.98 **LM-340T VOLTAGE REGULATORS** Untested. Factory rejected them for length of leads. May include 5, 6, 8, 12, 15, 18, 24 volts. Power tab Cat.No.6R2635

BARREL KIT #87 NATIONAL IC BONANZA 100 for $1.98. Factory dumps into barrels. Types 8000, 7400 series, DTLs, ROMs, registers, clock & calc. chips, linears, etc. Cat.No.6R2860 Untested.

BARREL #91 SILVER MICAS 100 for $1.98 Cat.No.6R3018. For the first time silver micas so low in price! Axial, red case, variety of physical sizes & values. Big savings from distributor prices. Wt. 1 lb.

BARREL KIT #94 "BUBBLE" READOUTS 12 for $1.98. DL-33B bubble magnifiers. Segs missing. Truthfully so many of 'em we don't care. Untested. 3 oz. No.6R3046

BARREL KIT #99 PHOTO ELECTRIC CELLS 10 for $1.98. Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat.No.6R3052

BARREL KIT #102 CLOCK CHIPS 5 for $1.98 No.6R3055. National is dumping! MM-5316 — what's wrong with 'em, we don't know, but we got barrels. Hobby special. Wt. 2 oz.

BARREL KIT #104 SLIDE VOLUME CONTROLS 10 for $1.98 Cat.No.6R3057. Used in hi-fi, volume control maker unloads. Asst. values, what a buy. Worth $1 ea. We've got barrels of 100% material.

BARREL KIT #107 SQUARE OHMS 60 for $1.98 Cat.No.6R3096. Factory people are sometimes "squares" when they topple prime square ohms mix 'em up in barrels. Asst. values watts. Wt. 1 lb.

BARREL KIT #108 TO-5 PLASTIC TRANSISTORS Cat.No.6R3101. 40 for $1.98. Includes PNP, NPN, 2N-3638, 2N3641, 2N5000 series, etc. Untested, but guaranteed to a 60% yield.

BARREL KIT #109 TERMINAL STRIPS 150 for $1.98. Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat.No 6R3136

BARREL KIT #110 SUPPRESSOR DIODES 50 for $1.98 Cat.No.6R3137. Keeps ignition noises out axial. Untested, but the of your eqpt., car, industrial, etc. Double plug.

BARREL KIT #111 MULTI DIGIT READOUTS 8 for $1.98. barrels of blemished 3, 4 and/or 5 digit readouts to USA for "dump". Untested. Cat.No.6R3138

BARREL KIT #112 MICRO MINI LEDS 40 for $1.98. All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50% or better. Cat.No.6R3139

BARREL KIT #113 STABISTORS 50 for $1.98 Cat.No.6R3140. Regulator, sensing and computer circuitry. Axial double plug type. Discontinued factory line. PIV 20 volts. 80% yield. U test 'n save!

BARREL KIT #115 MOLEX SOCKETS 300 for $1.98 100% good. Calculator maker dump! We got a zillion of 'em. Used for IC sockets, etc. Cat.No.6R3144

BARREL KIT #116 BUTTONS 'N FEEDTHRU'S 100 for $1.98 100% good. Truthfully worth a small fortune. Wide asst. of button-feedthru caps! HAMS TAKE NOTE! RF, UHF, etc. Wt. 1 lb. Cat.No.6R3141

BARREL KIT #117 20-MIL OPTICAL FIBERS 200-FT. $1.98. Fiber optics factory bankruptcy purchase! High quality, most-commonly used size (20-mil), CLEAR. Lowest price. 6R3206

BARREL KIT #118 MINI SCRS 50 for $1.98. UNBELIEVABLE! TO-92 plastic SCRS in barrels . . . rite from factory. Includes all voltages up thru 200 prv. 6R3135

BARREL KIT #119 MODULAR SWITCHES 25 for $1.98. Centralab "push-ON" switches. TV-makers excess. Dpdt, 6pdt, etc. Brand new. Cat. No. 6R3150

BARREL KIT #120 TRIGGER DIODES 25 for $1.98. Type ER-900, same type used to trigger scrs, triacs. Sometimes called "diacs". Untested. No. 6R3160

BARREL KIT #121 "MINI" MAGNETS 100 for $1.98. Magnet circular and rectangular cuttings from a major maker — For reed switches & micro-circuitry. Cat. No. 6R3168

BARREL KIT #122 PLASTIC OPTICAL FIBERS 500-Ft. $1.98. Pop'lr 10-mil size. Excellent for making lite pipes, experiments, lamp sprays. Cat. No. 6R3159

BARREL KIT #123 CD-4002 C-MOS IC 15 for $1.98. mostly good. But we have 250,000. Can never sell 'em out. YOUR GAIN! Their number is CD-5602. Cat. No. 6R3217

BARREL KIT #126 UPRIGHT ELECTROS 40 for $1.98. Wide asst. of values from 1mf to 300mf in mixture of voltages. 100% marked 'n good. Why barreled? U-got-a-buy! Cat. No. 6R3226

BARREL KIT #127 AXIAL ELECTROS 40 for $1.98. Truthfully the factories (by mixing 'em in barrels) do all of us a favor. WUT A BUY! Asst. capacities and voltages. Cat. No. 6R3227

BARREL KIT #128 MINI DIP ICS 75 for $1.98. Large mfgr dumped 100's of lbs into barrels. Includes 741s, LM-380-8, 703, 567, 555, 558—but who knows? Factory to you. All mixed, you test. Wt. 1 lb. Cat. No.6R3245

BARREL KIT #131 TANTALUM ELECTROS 30 for $1.98. Mixed, marked prime, top grade asst. values, voltages. GE, Centralab, etc. Cat. No. 6R3255

BARREL KIT #133 C-MOS IC'S 60 for $1.98. Deliberately thrown in barrels, so we can't test 'em! The famous CD4000 series. How good? Who knows? Who cares? It's only 3¢ ea. Cat. No. 6R3257

Terms: Add postage Rated: net 30
Phone: Wakefield, Mass. (617) 245-3829
Retail: 16-18 Del Carmine St., Wakefield.
MINIMUM ORDER — $6.00

C.O.D.'s MAY BE PHONED

POLY PAKS

P.O. BOX 942 R-6 LYNNFIELD, MASS. 01940

☐ *Send for FREE Spring-Summer* **CATALOG**

Circle 91 on reader service card

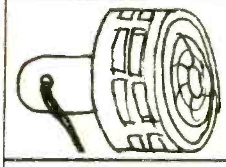
DELTA ELECTRONICS CO.

P.O. BOX 2, AMESBURY, MASS. 01913

BURGLAR ALARM PARTS

This month we are featuring a variety of parts useful in burglar alarms. Use in your home, car, shop, or business.

INFRARED PHOTOTRANSISTOR. TO-18 case, red coating over lens increases IR sensitivity. Very good for fire detection.
STOCK NO. R4538 .75 each, 3/2.00



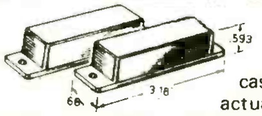
12 VOLT DC SIREN. A very powerful 12v siren, makes an ear splitting sound when energized. 4½" diameter x 5½" long. Shipping weight 3 lbs. Brand new.
STOCK NO. R5219 $11.95 ea, 2/21.00

R9272

ULTRASONIC TRANSDUCERS, used in alarm circuits and remote controls. We have 2 types, operating at 23 Khz & 41.5 Khz. Both can operate as either a receiver or transmitter. We supply some basic alarm circuits and data.

R6000

STOCK NO. R9272	23 Khz	$2.00 each, 4/7.00
STOCK NO. R6000	41.5 Khz	$3.00 each, 2/5.00



PROXIMITY REED SWITCHES. One case contains an Alnico magnet, which actuates a normally open reed switch in the other case within a distance of 1". Mount on windows, doors, or on the back of valuable equipment.
STOCK NO. R5351 $1.75/set, 4 sets/6.00, 10 sets/12.50

Send for our free catalog. Phone orders welcome, MASTERCHARGE & BANKAMERICARD accepted. ALL numbers must be included to process order. Minimum order $5. Include sufficient postage excess will be refunded.

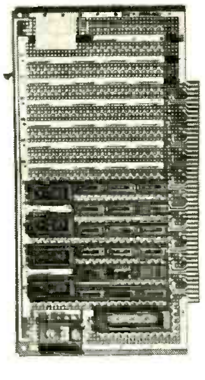
Phone (617) 388–4705

Circle 92 on reader service card

GODBOUT

★ ★ ★

UNIVERSAL PROTOTYPE BOARD: Use with Altair 8800 or homebrew computers. Accepts any DIP package; power & ground planes on opposite sides of board; onboard room for 2 regulators (1 heat sink also provided). **UNIVERSALLY USEFUL FOR PERIPHERALS.** Add 1 lb shipng.



new from VECTOR $19.95

Other VECTOR products:

WIRE PENCIL: $9.50 + 1 lb shp. Reviewed in RE, PE. Eliminates cutting, stripping; makes interconnections between parts FAST. With tool, 250' wire, extra 250' bobbin, and instructions.

PRE-PUNCHED VECTORBOARD: $8.95. Holes on .1" centers. 8½" X 17". 1/16" thick epoxy glass base. Add 1 lb shipping.

HOBBYWRAP TOOL.......$41.95
Wire wrapping equipment at the right price. Comes with tool (rechargeable: no cords in tight places), bit, charger, nicads, & instructions.

WIRE WRAP SOCKETS...Perfect mate for the HOBBYWRAP tool. 3 level, gold-plated leads.

14 pin..............10/$3.70
16 pin..............10/$3.85
18 pin...............1/$0.75
24 pin...............1/$1.00
28 pin...............1/$1.25
36 pin...............1/$1.35
40 pin...............1/$1.75

FOR SALE: RESISTORS, MUSIC KITS, LINEAR-TTL-CMOS ICS, COMPUTER PERIPHERALS, MICRO PROCESSORS, CLOCKS, POWER SUPPLY KITS, SPECIALS, AND A WHOLE LOT MORE FOR HOBBYISTS. **SEND FOR OUR FLYER!!**

We added more capacity to our warehouse---

TANTALUM CAPACITORS

2.2 uF @ 20V........4/$1.00
2.7 uF @ 20V........4/$1.00
3.3 uF @ 15V........4/$1.00
4.7 uF @ 10V........4/$1.00
22 uF @ 10V.........3/$1.00
33 uF @ 10V.........3/$1.00
39 uF @ 10V.........3/$1.00
47 uF @ 6V..........3/$1.00

ELECTROLYTIC CAPACITORS

10 uF, 250V, axial..3/$1.00
12 uF, 250V, axial..3/$1.00
100 uF, 10V, axial..5/$1.00
100 uF, 35V, PC mount.4/$1.00
100 uF, 50V, PC mount.4/$1.00
220 uF, 25V, PC mount.4/$1.00
250 uF, 25V, axial...4/$1.00
500 uF, 15V, axial...3/$1.00
2000 uF, 30V, PC mnt..1/$0.95
4000 uF, 20V, PFP....1/$0.95
10000 uF, 10V, axial .1/$1.25

BILL GODBOUT ELECTRONICS***BOX 2355***OAKLAND AIRPORT, CA 94614.
Terms: Add 50¢ to orders under $10. Add shipping where shown. Cal res add tax. Mastercharge®/Bankamericard®: (415) 357-7007, 24 hrs.

Circle 93 on reader service card

CB SPECIALS–R.F. DRIVERS–R.F. POWER OUTPUTS–FETS

2SC481	1.85	2SC767	15.75	2SC866	5.85	2SC1449-1	1.60	40081	1.50
2SC482	1.75	2SC773	.85	2SC1013	1.50	2SC1475	1.50	40082	3.00
2SC495	1.10	2SC774	1.75	2SC1014	1.50	2SC1678	5.50	2SC608	4.85
2SC502	3.75	2SC775	2.75	2SC1017	1.50	2SC1679	4.75	SK3046	2.15
2SC517	4.75	2SC776	3.00	2SC1018	1.50	2SC1728	2.15	SK3047	3.75
2SC614	3.80	2SC777	4.75	2SC1173	1.25	2SC1760	2.15	SJ2095	3.50
2SC615	3.90	2SC778	3.25	2SC1226A	1.25	2SC1816	5.50	SK3048	3.25
2SC616	4.15	2SC797	2.50	2SC1237	4.50	2SC1908	.70	SK3054	1.25
2SC617	4.25	2SC798	3.10	2SC1239	3.50	2SC1957	1.50		
2SC699	4.75	2SC781	3.00	2SC1243	1.50	2SF8	3.00	2SK19	1.75
2SC710	.70	2SC789	1.00	2SC1306	4.75	HEP-S 3001	3.25	2SK30	1.00
2SC711	.70	2SC796	3.15	2SC1306-1	4.90	2SD235	1.00	2SK33	1.20
2SC735	.70	2SC799	4.25	2SC1307	5.75	MRF8004	3.00		
2SC756	3.00	2SC802	3.75	2SC1307-1	6.00	4004	3.00	3SK40	2.75
2SC765	9.50	2SC803	4.00	2SC1377	5.50	4005	3.00	3SK45	2.75
2SC766	10.15	2SC839	.85	2SC1449	1.30	40080	1.25	3SK49	2.75

JAPANESE TRANSISTORS

2SA52	.60	2SB187	.60	2SC458	.70	2SC815	.75	2SC1569	1.25
2SA316	.75	2SB235	1.75	2SC460	.70	2SC828	.75	2SC1756	1.25
2SA473	.75	2SB303	.65	2SC478	.80	2SC829	.75		
2SA483	1.95	2SB324	1.00	2SC491	2.50	2SC830	1.60	2SD30	.95
2SA489	.80	2SB337	2.10	2SC497	1.60	2SC839	.85	2SD45	2.00
2SA490	.70	2SB367	1.60	2SC515	.80	2SC945	.65	2SD65	.75
2SA505	.70	2SB370	.65	2SC535	.75	2SC1010	.80	2SD68	.90
2SA564	.50	2SB405	.85	2SC536	.65	2SC1012	.80	2SD72	1.00
2SA628	.65	2SB407	1.65	2SC537	.70	2SC1051	2.50	2SD88	1.50
2SA643	.85	2SB415	.85	2SC563	2.50	2SC1061	1.65	2SD151	2.25
2SA647	2.75	2SB461	1.25	2SC605	1.00	2SC1079	3.75	2SD170	2.00
2SA673	.85	2SB463	1.65	2SC620	.80	2SC1096	1.20	2SD180	2.75
2SA679	3.75	2SB471	1.75	2SC627	1.75	2SC1098	1.15	2SD201	1.95
2SA682	.85	2SB474	1.50	2SC642	3.50	2SC1115	2.75	2SD218	4.75
2SA699	1.30	2SB476	1.25	2SC643	3.75	2SC1166	.70	2SD300	2.50
2SA699A	1.75	2SB481	2.10	2SC644	.70	2SC1170	4.00	2SD313	1.10
2SA705	.55	2SB492	1.25	2SC681	2.50	2SC1172B	4.25	2SD315	.75
2SA815	.85	2SB495	.95	2SC684	2.10	2SC1209	.55	2SD318	.95
2SA816	.85	2SB507	.90	2SC687	2.50	2SC1213	.75	2SD341	.95
		2SB511	.70	2SC696	2.35	2SC1226	1.25	2SD350	3.25
2SB22	.65			2SC712	.70	2SC1243	1.50	2SD352	.80
2SB54	.70	2SC206	1.00	2SC713	.70	2SC1293	.85	2SD380	5.70
2SB56	.70	2SC240	1.10	2SC732	.70	2SC1308	4.75	2SD389	.90
2SB77	.70	2SC261	.65	2SC733	.70	2SC1347	.80	2SD-390	.75
2SB128	2.25	2SC291	.65	2SC739	.70	2SC1383	.75	2SD437	5.50
2SB135	.95	2SC320	2.00	2SC715	1.75	2SC1409	1.25		
2SB152	4.50	2SC352	.75	2SC762	1.90	2SC1410	1.25	MPS-U31	4.00
2SB173	.55	2SC353	.75	2SC783	1.00	2SC1447	1.25		
2SB175	.55	2SC371	.70	2SC784	.70	2SC1448	1.25		
2SB178	1.00	2SC372	.70	2SC785	1.00	2SC1507	1.25		
2SB186	.60	2SC394	.70	2SC793	2.50	2SC1509	1.25		

POWER-TRANSISTORS HIGH-VOLT. TV. TYPE

BU204	1300V	3.90	BU207	1300V	5.40	2SC1172B	1100V	4.25
BU205	1500V	4.70	BU208	1500V	6.25	2SC1308	1100V	4.95
BU206	1700V	5.90	2SC1170	1100V	4.00	2SC1325	1100V	4.95

OEM SPECIALS

1N270	.10	2N960	.55	2N2219A	.30	2N2913	.75	2N3740	1.00	2N4401	.20
1N914	.10	2N962	.40	2N2221	.25	2N2914	1.20	2N3771	1.75	2N4402	.20
		2N967	.50	2N2221A	.30	2N2916A	3.65	2N3772	1.90	2N4403	.20
2N173	1.75	2N1136	1.35	2N2222	.25	2N3019	.50	2N3773	3.00	2N4409	.20
2N178	.90	2N1142	2.25	2N2222A	.30	2N3053	.30	2N3819	.32	2N4410	.25
2N327A	1.15	2N1302	.25	2N2270	.40	2N3054	.70	2N3823	.70	2N4416	.75
2N334	1.20	2N1305	.30	2N2322	1.00	2N3055	.75	2N3856	.20	2N4441	.85
2N336	.90	2N1377	.75	2N2323	1.00	2N3227	1.00	2N3866	.85	2N4442	.90
2N338A	1.05	2N1420	.20	2N2324	1.35	2N3247	3.40	2N3903	.20	2N4443	1.20
2N398B	.90	2N1483	.95	2N2325	2.00	2N3250	.50	2N3904	.20	2N4852	.55
2N404	.30	2N1540	.90	2N2326	2.85	2N3375	6.50	2N3905	.20	2N5061	.30
2N443	1.75	2N1543	2.70	2N2327	3.80	2N3393	.20	2N3906	.25	2N5064	.50
2N456	1.10	2N1544	.80	2N2328	4.20	2N3394	.17	2N3925	3.75	2N5130	.20
2N501A	3.00	2N1549	1.25	2N2329	4.75	2N3414	.17	2N3954	3.50	2N5133	.15
2N508A	.45	2N1551	2.50	2N2368	.25	2N3415	.18	2N3954A	3.75	2N5138	.15
2N555	.45	2N1552	3.25	2N2369	.25	2N3416	.19	2N3955	2.45	2N5198	3.75
2N652A	.85	2N1554	1.25	2N2484	.32	2N3417	.20	2N3957	1.25	2N5294	.50
2N677C	6.00	2N1557	1.15	2N2712	.18	2N3442	1.85	2N3958	1.20	2N5296	.50
2N706	.25	2N1560	2.80	2N2894	.40	2N3553	1.50	2N4037	.60	2N5306	.20
2N706B	.40	2N1605	.35	2N2903	3.30	2N3563	.20	2N4093	.85	2N5354	.20
2N711	.50	2N1613	.30	2N2904	.25	2N3565	.20	2N4124	.20	2N5369	.20
2N711B	.60	2N1711	.30	2N2904A	.30	2N3638	.20	2N4126	.20	2N5400	.40
2N718	.25	2N1907	4.10	2N2905	.25	2N3642	.20	2N4141	.20	2N5401	.50
2N718A	.30	2N2060	1.85	2N2905A	.30	2N3643	.15	2N4142	.20	2N5457	.35
2N720A	.50	2N2102	.40	2N2906	.25	2N3645	.15	2N4143	.20	2N5458	.30
2N918	.35	2N2218	.25	2N2906A	.30	2N3646	.14	2N4220A	.45	C103y	.25
2N930	.25	2N2218A	.30	2N2907	.25	2N3730	1.50	2N4234	.95	C103d	.40
2N956	.30	2N2219	.25	2N2907A	.30	2N3731	2.75	2N4400	.20	C106b1	.50
										C106di	.75

SILICON UNIJUNCTIONS

2N2646	.50	2N4871	.50
2N2647	.60	2N4891	.50
2N6027	.55	2N4892	.50
2N6028	.70	2N4893	.50
D5E37	.25	2N4894	.50
2N2160	.65	MU10	.40
2N4870	.50		

INTEGRATED CIRC.

UA703C	.40
709C OP. AMP.	.25
741C OP. AMP.	.25
7400	.15
7404n	.18
7430n	.19
9700/74LS00	.35
74h55n	.35

RECTIFIERS

	10	100
IN4001	.60	5.00
IN4002	.70	6.00
IN4003	.80	7.00
IN4004	.90	8.00
IN4005	1.00	9.00
IN4006	1.10	10.00
IN4007	1.20	11.00

New-Tone Electronics
P.O. Box 1738 A
Bloomfield, N.J. 07003
Phone: (201) 762-9020

ALL PARTS GUARANTEED AND TESTED ON PREMISES.

N.J. residents add 5% sales tax. Minimum order $5.00. All orders add $1.00 postage. Dealers write or phone for discount prices.

Circle 94 on reader service card

TTL PLASTIC DUAL-IN-LINE I.C.

SN7400N	.15	SN74126N	.49
SN7401N	.15	SN74128N	.84
SN7402N	.15	SN74132N	.99
SN7403N	.15	SN74136N	.64
SN7404N	.18	SN74141N	.93
SN7405N	.18	SN74142N	3.70
SN7406N	.34	SN74143N	3.98
SN7407N	.34	SN74144N	3.98
SN7408N	.18	SN74145N	.98
SN7409N	.18	SN74147N	2.30
SN7410N	.15	SN74148N	1.90
SN7412N	.30	SN74150N	1.94
SN7413N	.45	SN74151N	.64
SN7414N	.99	SN74153N	.69
SN7416N	.27	SN74154N	1.04
SN7417N	.32	SN74155N	.79
SN7420N	.15	SN74156N	.74
SN7422N	.15	SN74157N	.65
SN7423N	.27	SN74159N	3.50
SN7425N	.27	SN74160N	.99
SN7426N	.24	SN74161N	.99
SN7427N	.27	SN74162N	.99
SN7428N	.39	SN74163N	.99
SN7430N	.15	SN74164N	1.10
SN7432N	.24	SN74165N	1.10
SN7433N	.37	SN74166N	1.28
SN7437N	.25	SN74167N	2.98
SN7438N	.25	SN74170N	2.15
SN7440N	.15	SN74172N	8.75
SN7442N	.48	SN74173N	1.30
SN7443N	.85	SN74174N	1.05
SN7444N	.85	SN74175N	.90
SN7445N	.79	SN74176N	.79
SN7446AN	.79	SN74177N	.79
SN7447AN	.79	SN74178N	1.95
SN7448N	.75	SN74179N	1.95
SN7450N	.15	SN74180N	.72
SN7451N	.15	SN74181N	2.25
SN7453N	.15	SN74182N	.69
SN7454N	.15	SN74184N	1.95
SN7460N	.15	SN74185AN	1.85
SN7470N	.28	SN74186N	13.95
SN7472N	.28	SN74188N	4.75
SN7473N	.32	SN74190N	1.15
SN7474N	.32	SN74191N	1.15
SN7475N	.48	SN74192N	1.05
SN7476N	.34	SN74193N	1.05
SN7480N	.44	SN74194N	.99
SN7481AN	.99	SN74195N	.72
SN7482N	.59	SN74196N	.94
SN7483AN	.74	SN74197N	.87
SN7484AN	1.95	SN74198N	1.69
SN7485N	.99	SN74199N	1.69
SN7486N	.33	SN74221N	1.50
SN7489N	2.24	SN74246N	1.95
SN7490AN	.47	SN74247N	1.85
SN7491AN	.69	SN74248N	1.75
SN7492AN	.48	SN74249N	1.75
SN7493AN	.47	SN74251N	1.40
SN7494N	.76	SN74265N	.85
SN7495AN	.72	SN74278N	2.45
SN7496N	.75	SN74279N	.85
SN7497N	2.85	SN74283N	1.75
SN74100N	1.20	SN74284N	4.50
SN74104N	.43	SN74285N	4.50
SN74105N	.43	SN74290N	.85
SN74107N	.30	SN74293N	.85
SN74109N	.74	SN74298N	1.98
SN74110N	.54	SN74351N	1.92
SN74111N	.74	SN74365N	.69
SN74116N	1.98	SN74366N	.69
SN74120N	1.40	SN74367N	.95
SN74121N	.37	SN74368N	.69
SN74122N	.42	SN74390N	1.40
SN74123N	.68	SN74393N	1.40
SN74125N	.49	SN74490N	1.90

C/MOS

CD4000AE	.15
CD4001AE	.19
CD4002AE	.19
CD4006AE	1.30
CD4007AE	.19
CD4008AE	.99
CD4009AE	.48
CD4010AE	.48
CD4011AE	.19
CD4012AE	.19
CD4013AE	.42
CD4014AE	1.19
CD4015AE	1.15
CD4016AE	.42
CD4017AE	1.19
CD4018AE	1.15
CD4019AE	.45
CD4020AE	1.15
CD4021AE	1.20
CD4022AE	1.05
CD4023AE	.19
CD4024AE	.85
CD4025AE	.19
CD4026AE	1.75
CD4027AE	.49
CD4028AE	.85
CD4029AE	.99
CD4030AE	.42
CD4033AE	1.80
CD4035AE	1.20
CD4040AE	1.20
CD4042AE	.70
CD4043AE	.50
CD4044AE	.50
CD4049AE	.45
CD4050AE	.45
CD4051AE	1.25
CD4052AE	1.25
CD4053AE	1.25
CD4055AE	1.50
CD4056AE	1.50
CD4060AE	1.75
CD4066AE	.70
CD4069AE	.29
CD4071AE	.25
CD4072AE	.35
CD4073AE	.35
CD4075AE	.35
CD4076AE	1.24
CD4081AE	.25
CD4082AE	.35
CD4502AE	1.25
CD4507AE	.60
CD4508AE	3.00
CD4510AE	1.24
CD4511AE	1.75
CD4512AE	1.95
CD4514AE	2.25
CD4515AE	2.25
CD4516AE	1.25
CD4518AE	.95
CD4519AE	.99
CD4520AE	.95
CD4528AE	1.25
CD4585AE	1.95

LED'S

LITRONIX	
DL16	6.70
DL34M	7.25
DL44M	5.25
DL57	6.98
DL701	1.95
DL702	1.95
DL704	2.30
DL707	1.70
DL707R	1.70
DL727	4.75
DL746	2.75
DL747	2.45
DL749	2.75
DL750	2.75
IL-1	1.05
IL-5	1.15
IL-12	.69
IL-15	1.25
IL-16	1.40
IL-74	.82
IL-100	5.45
ILD-74	1.61
ILQ-74	3.10
ILA-30	1.29
ILA-55	1.42
ILCA-2-30	1.60
ILCA-2-55	1.75
ILCT-6	2.20
RL2	.23
RL2-02	.48
RL2-03	.48
RL2-04	.48
RL20	.48
RL20-02	.48
RL20-03	.48
RL20-04	.48
RL21	.42
RL21-02	.42
RL21-04	.42
RL50	.28
RL50-01	.28
RL50-02	.28
RL50-03	.28
RL54	.21
RL55	.29
RL55-5	.21
RL209	.29
RL-2000	.39
RL-4403	.32
RL-4415	.55
RL-4484	.19
RL-4850	.19
RL-5054-1	.27
RL-5054-2	.52
RL-5054-5	.19
GL-56	.60
GL-4484	.75
GL-4850	.75
OL-30	.33
OL-31	.30
RLC-200	.54
RLC-201	.54
RLC-210	.59
RLC-400	.53
RLC-410	.59
1RL-40	1.30
IRL-60	.53
ARL-18	3.75
LPT-100	.59
LPT-100A	.69
LPT-100B	.84
LPT-110	.74
LPT-110A	.94
LPT-110B	1.09
OPCOA	
LLL7	.19
LSL16L	.35
LSL26L	.35
LSL13L	.30
LSL3L	.45
LSL4L	.75
LSL8L-1	.65
LSM6	.45
OPL211	.25
OPL212	.25
OSL1	.55
OSL16L	.35
SLA7	2.95
TEXAS INSTRUMENTS	
TIL103	7.00
TIL111	1.20
TIL112	.99
TIL208	.65
TIL209A	.19
TIL211	.45
TIL220	.24
TIL221	.22
TIL222	.49
TIL223	.49
TIL302	4.95
TIL303	4.95
TIL304	4.95
TIL305	7.95
TIL306	8.95
TIL308	8.95
TIL309	8.95
TIL311	11.95
TIL312	1.70
TIL313	1.70
TIL32	.90
TIL63	.75
TIL78	.60
FAIRCHILD	
FCD802	.65
FCD806	.70
FCD820A	.80
FLV117	.18
FLV310	.55
FLV410	.55
FND357	1.75
FND500	1.75
FND507	1.75
FND807	3.00
FNS700	.60
FPT100	.70

MOS & BI-POLAR MEMORIES

AY5-1013P	7.75		8 Bit UART
AY5-2376	19.95		88 x 3 x 9 Keyboard Encoder
MF1101AP	3.50		MOS RAM 256 Bit
MF1103-P	3.95		MOS RAM 1024 Bit
MF1403AT	3.25		Dual 512 Dynamic Shift Register
MF1404AT	3.00		1024 x 1 Dynamic Shift Register
MF1702AR	15.50		Static 256 x 8 PROM
MF2102P	3.50		1024 x 1 Static RAM 500 NS
MF8008R	17.95		MOS 8 Bit CPU 500 KHZ
MM6300J-1	5.95		256 x 4 PROM (open collector)
MM6301J-1	5.95		256 x 4 PROM Tristate
MM6305J-1	11.95		512 x 4 PROM (open collector)
MM6306J-1	11.95		512 x 4 PROM Tristate
MM6701D	34.95		4 Bit Expandable Bipolar C.P.U.
CDM2017	8.95		8 Bit UART
COM2502	8.50		8 Bit UART
COM2601	23.50		Universal Synchronous Receiver Transmitter
TMS3112NC	6.00		Hex 32 Bit Static Shift Register
TMS3113NC	6.00		Dual 133 Bit Static Shift Register
TMS3133NC	7.50		1024 Bit Static Shift Register
TMS3409NC	4.95		Quad 8 Bit Dynamic Shift Register
TMS4024NC	10.95		64 x 9 Fifo
TMS4030NL	14.95	(22 PIN)	4K Dynamic RAM Plastic 300 NS
TMS4030JL	16.95	(22 PIN)	4K Dynamic RAM Ceramic 300 NS
TMS4033NL	4.50	(2102-1)	1024 Bit Static RAM 450 NS
TMS4035NL	3.75	(2102)	1024 Bit Static RAM 1000 NS
TMS4050NL	15.00	(18 PIN)	4K Dynamic RAM 18 Pin 300 NS
TMS4060NL	16.00	(22 PIN)	4K Dynamic RAM 22 Pin 300 NS
TMS4103NC	12.00		64 x 5 x 7 ASCII Character Generator
TMS8080NC	29.95		8 Bit MOS CPU 2 Microseconds
TMS5501JL	29.95		Input/Output Interface for 8080
4096DC	17.50	(16 PIN)	Isoplanar 4K Dynamic RAM 350 NS
F8 KIT	295.00		8 Bit MPU Evaluation Kit
3347PC	4.95		Quad 80 Bit Static Shift Register
3342PC	5.50		Quad 64 Bit Static Shift Register
38140C	17.95		Digital Voltmeter Chip
2533PC	7.95		1024 Bit Static Shift Register 1.5 MHZ
93415PC	16.95		Bipolar 1K RAM 40 NS Open Collector
93425PC	16.95		Bipolar 1K RAM 40 NS Tri-State
93427PC	4.95		Tri-State 256 x 4 PROM
93446DC	15.75		Tri-State 512 x 4 PROM
93436DC	15.75		Open Collector 512 x 4 PROM
LCM1001	149.95		Texas Instruments Microprocessor Learning Module

LINEARS

LM300H	.69	Voltage Regulator
LM301AH	.35	General Purpose Operational Amplifier
LM301AN-8 (Mini Dip)	.39	General Purpose Operational Amplifier
LM304H	.75	Precision Voltage Negative Regulator
LM305H	.78	Positive Voltage Regulator
LM307H	.28	Operational Amplifier
LM307 N-8 (Mini Dip)	.28	Operational Amplifier
LM308H	1.25	Precision Operational Amplifier
LM308AN	2.75	Precision Operational Amplifier
LM309H	.75	Five Volt Regulator
LM309K (TO3)	1.34	Five Volt Regulator
LM310H	1.09	Voltage Follower
LM311H	1.40	Voltage Comparator
LM318H	1.50	Precision High Speed Operational Amplifier
LM323K	7.50	3 Amp 5 volt Regulator
LM324N	1.10	Quad op amp
LM339N	1.20	Quad Comparator
LM555N-8 (Mini Dip)	.48	Timer
LM556N-14	.99	Dual Timer
LM709CN-14	.29	Operational Amplifier
LM709CH	.29	Operational Amplifier
LM710CH	.95	Differential Comparator
LM711CH	.50	Dual Channel Differential Comparator with strobes
LM720CN-14	1.50	Dual Differential Comparator
LM723CH	.52	Voltage Regulator
LM723CN-14	.52	Voltage Regulator
LM733CN-14	1.40	Differential Video Amp
LM739CN-14	1.25	Dual Stereo Pre-amp
LM741CH	.29	Operational Amplifier
LM741CN-14	.29	Operational Amplifier
LM741CN-8 (Mini Dip)	.28	Operational Amplifier
LM747CN-14	.75	Dual Operational Amplifier
LM747CH	.65	Dual Operational Amplifier
LM748CN-14	.45	Operational Amplifier
LM748CN-8 (Mini Dip)	.29	Operational Amplifier
LM748CH	.45	Operational Amplifier
LM1436CH	1.95	High voltage op amp
LM1458H	.65	Dual Operational Amplifier
LM1458N-8 (Mini Dip)	.79	Dual Operational Amplifier
LM1458N-14	.89	Dual Operational Amplifier
LM1488D	1.98	Quad Line Driver
LM1489D	1.98	Quad Line Receiver VT plus equals 1 volt
LM1489AD	2.45	Quad Line Receiver VT plus equals 1.75V
LM3045D	1.25	Transistor Array
LM3046N-14	.85	Transistor Array
LM3086	.63	Transistor Array
LM3089	2.39	FM IF System
LM3900N	.60	Quad op Amplifier
LM4136N	2.25	Quad op Amplifier
LM7800 Series TO-3	2.25	Positive Voltage Regulators 5, 6, 8, 12, 15, 18, 24 volts
LM7800 Series TO-5	1.95	Positive Voltage Regulators 5, 6, 8, 12, 15, 18, 24 volts
LM7800 Series (Plastic) TO-220	1.75	Positive Voltage Regulators 5, 6, 8, 12, 15, 18, 24 volts
LM78M00 Series TO-220	1.47	Positive Voltage Regulators ½ Amp 5, 6, 8, 12, 15, 20, 24 volts
LM78L00 AWC Series TO-92	.45	Positive Voltage Regulators 70 MA 2, 5, 6, 12, 15, 26, 62, 82 Volts
LM7900 Series TO-3	2.50	Negative Voltage Regulators, 1 amp 5, 6, 8, 12, 15, 18, 24 Volts
LM7900 Series TO-220	1.87	Negative Voltage Regulators, 1 amp 5, 6, 8, 12, 15, 18, 24 Volts
LM79M00 Series TO-5	1.80	Negative Voltage Regulators, ½ amp 5, 6, 8, 12, 15, 20, 24 Volts
LM79M00 Series TO-220	1.60	Negative Voltage Regulators, ½ amp 5, 6, 8, 12, 15, 20, 24 Volts
78MGT2C	1.35	Dual In Line Adjustable 4 Terminal Positive Voltage Regulator
79MGT2C	1.35	Dual In Line Adjustable 4 Terminal Negative Voltage Regulator
78GU1 TO-220	1.50	1 Amp Adjustable Positive Voltage Regulator
79GU1 TO-220	1.75	1 Amp Adjustable Negative Voltage Regulator
78GKC TO-3	1.95	1 Amp Adjustable Positive Voltage Regulator
79GKC TO-3	2.25	1 Amp Adjustable Negative Voltage Regulator

TTL LOW POWER SCHOTTKY PLASTIC DUAL-IN-LINE I.C.

SN74LS00N	.29	SN74LS83AN	1.49	SN74LS175N	1.45
SN74LS01N	.29	SN74LS85N	1.75	SN74LS181N	3.50
SN74LS02N	.29	SN74LS86N	.59	SN74LS190N	2.50
SN74LS03N	.29	SN74LS90N	1.15	SN74LS191N	2.50
SN74LS04N	.35	SN74LS91N	1.25	SN74LS192N	2.50
SN74LS05N	.35	SN74LS92N	1.15	SN74LS193N	2.50
SN74LS08N	.29	SN74LS93BN	1.15	SN74LS194AN	1.45
SN74LS09N	.29	SN74LS95AN	1.60	SN74LS195AN	1.45
SN74LS10N	.29	SN74LS96N	1.75	SN74LS196N	1.45
SN74LS11N	.29	SN74LS107N	.59	SN74LS197N	1.45
SN74LS12N	.29	SN74LS109N	.59	SN74LS221N	1.35
SN74LS13N	.75	SN74LS112N	.59	SN74LS247N	1.30
SN74LS14N	1.48	SN74LS113N	.59	SN74LS248N	1.30
SN74LS15N	.29	SN74LS114N	.59	SN74LS249N	1.30
SN74LS20N	.29	SN74LS122N	.90	SN74LS251N	1.60
SN74LS21N	.29	SN74LS123N	1.10	SN74LS253N	1.60
SN74LS22N	.29	SN74LS124N	3.00	SN74LS257N	1.70
SN74LS26N	.40	SN74LS125N	.75	SN74LS258N	1.50
SN74LS27N	.35	SN74LS126N	.75	SN74LS261N	2.95
SN74LS28N	.35	SN74LS132N	1.25	SN74LS266N	.59
SN74LS30N	.29	SN74LS136N	.59	SN74LS279N	.80
SN74LS32N	.40	SN74LS138N	1.68	SN74LS283N	1.40
SN74LS33N	.40	SN74LS139N	1.68	SN74LS290N	1.35
SN74LS37N	.40	SN74LS145N	1.35	SN74LS293N	1.35
SN74LS38N	.40	SN74LS151N	1.30	SN74LS295AN	1.75
SN74LS40N	.35	SN74LS153N	1.30	SN74LS298N	1.75
SN74LS42N	1.20	SN74LS155N	1.45	SN74LS324N	2.25
SN74LS47A	1.20	SN74LS156N	1.45	SN74LS352N	1.45
SU74LS48N	1.20	SN74LS157N	1.35	SN74LS353N	1.70
SN74LS49N	1.20	SN74LS158N	1.25	SN74LS365N	.75
SN74LS51N	.29	SN74LS160N	2.25	SN74LS366N	.75
SN74LS54N	.29	SN74LS161N	2.25	SN74LS367N	.75
SN74LS55N	.29	SN74LS162N	2.25	SN74LS368N	.75
SN74LS63N	1.75	SN74LS163N	2.25	SN74LS375N	.80
SN74LS73N	.49	SN74LS164N	1.98	SN74LS386N	.59
SN74LS74N	.55	SN74LS168N	2.75	SN74LS395N	1.95
SN74LS75N	.75	SN74LS169N	2.75	SN74LS670N	3.95
SN74LS76N	.49	SN74LS170N	2.95		
SN74LS78N	.49	SN74LS174N	1.45		

Active Electronic Sales Corp.

P.O. BOX 1035 FRAMINGHAM, MASSACHUSETTS 01701

Telephone Orders (617) 879-0077 New Catalogue available on request

MINIMUM ORDER $10.00 ADD $1.00 TO COVER POSTAGE & HANDLING

"Our new comprehensive catalogue is now available with many more items advertised. Please write for your copy"

Circle 95 on reader service card

CRYSTALS

THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33/U	$4.95
CY2A	2.000 MHz	HC33/U	$4.95
CY3A	4.000 MHz	HC18/U	$4.95
CY7A	5.000 MHz	HC18/U	$4.95
CY12A	10.000 MHz	HC18/U	$4.95
CY14A	14.31818 MHz	HC18U	$4.95
CY19A	18.000 MHz	HC18/U	$4.95
CY22A	20.000 MHz	HC18/U	$4.95
CY30B	32.000 MHz	HC18/U	$4.95

CLOCK CHIPS — CALCULATOR CHIPS

MM5309	6 Digit, BCD Outputs, Reset PIN	$5.95
MM5311	6 Digit, BCD Outputs, 12 or 24 Hour	4.95
MM5312	4 Digit, BCD Outputs, 1 PPS Output	4.95
MM5313	6 Digit, BCD Outputs, 1PPS Output	4.95
MM5314	6 Digit, 12 or 24 Hour, 50 or 60 Hz	4.95
MM5316	4 Digit, Alarm, 1PPS Output	6.95
MM5318	Video Clock Chip For Use With MM5841	9.95
CT7001	6 Digit, Calander, Alarm, 12 or 24 Hour	6.95

CALCULATOR CHIPS

MM5725	6 Digit, Four Function, Less Decimal	$2.95
MM5738	8 Digit, 5 Function, +, =, ×, -, %	2.95
MM5739	8 Digit, 4 Function Floating Decimal	2.95
CT5001	12 Digit, 4 Function	3.95
CT5005	12 Digit, 4 Function with Memory	5.95
CT5030	12 Digit, 4 Function and %	7.95

MISC. MOS

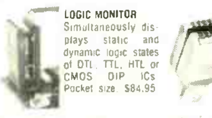
MM5320	TV Camera Sync Generator	$19.95
MM5330	4½ Digit DVM Chip	9.95
MM5369	60 Hz Timebase Circuit From 3.58 MHz	5.00
MM5841	Video Generator For MM5318	18.00
MC1408-L7	7 Bit Digital to Analog Converter	9.95
MK5007	4 Decade Counter with Latches	10.95
LD110/LD111	3½ Digit DVM Chip Set	25.00
95H90	100 MHz ÷ 10 Counter For Prescalers	13.95

Continental Specialties

PROTO BOARDS

Build & test circuits as fast as you think!

PB100	10 IC cap breadboard kit, 4.5 x 6.0 x 1.35"	$19.95
PB101	10 14-DIP cap. 5-way post, 940 solderless tie points, 5.8 x 4.5"	$29.95
PB102	12 14-DIP cap. like PB101 with 1,240 tie points, 7.0 x 4.5"	$39.95
PB103	24 14-DIP cap. 4 5-way posts, 2,250 tie points, 6.0 x 9.0"	$59.95
PB104	32 14-DIP cap. 3060 solderless tie points, 8.0 x 9.76"	$79.95



PROTO-CLIP

For power-on/hands-off signal tracing. Bring IC leads up from PC board surface for fast troubleshooting. PC14 14-pin $4.50 PC16 16-pin 4.75

LOGIC MONITOR

Simultaneously displays static and dynamic logic states of DTL, TTL, HTL or CMOS DIP ICs. Pocket size. $84.95

SOCKETS & BUS STRIPS

Plug in wire, test, modify or expand without patch cords or solder. Snap together to form breadboard needed.

PN/Description	L.	Hole to Hole	Term'ls	Price
QT59S Socket	6.5"	6.2"	118	$12.50
QT59B Bus	6.5"	6.2"	20	2.50
QT47S Socket	5.3"	5.0"	94	10.00
QT47B Bus	5.3"	5.0"	16	2.25
QT35S Socket	4.1"	3.8"	70	8.50
QT35B Bus	4.1"	3.8"	12	2.00
QT18S Socket	2.4"	2.1"	36	4.75
QT12S Socket	1.8"	1.5"	24	3.75
QT8S Socket	1.4"	1.1"	16	3.25
QT7S Socket	1.3"	1.0"	14	3.00

1/16 VECTOR BOARD

0.1" Hole Spacing, P-Pattern

	Part No.	L	W	Price 1-19	20-49
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062	4.50	6.50	2.07	1.86
	84P44 062	4.50	8.50	2.56	2.31
	169P44 062	4.50	17.00	5.04	4.53
	169P84 062	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062C1	4.50	17.00	6.80	6.12

VECTOR TERMINALS

Series	Part No. Finish Gold	Tinned	Post Size	25 pcs Gold	25 pcs Tin	50 pcs Gold	50 pcs Tin
T44	T44-1	T44	.025" sq.	1.50 lot	1.00 lot	2.75 lot	1.75 lot
T46	T46-1	T46	.028" sq.	1.75 lot	1.25 lot	3.00 lot	2.25 lot
T49	T49A	T49	.025" sq.	1.75 lot	1.25 lot	3.10 lot	2.25 lot

VECTOR WIRING PENCIL

Vector Wiring Pencil P173 consists of a hand held leatherweight (under one ounce) tool which is used to guide and wrap insulated wire, fed off a self-contained replaceable bobbin, onto component leads or terminals installed on pre-punched "P" Pattern Vectorbord. Connections between the wrapped wire and component leads, pads or terminals are made by soldering. Complete with 250 FT of red wire. **$9.50**

REPLACEMENT WIRE — BOBBINS FOR WIRING PENCIL

W36-3-A-Pkg. 3	250 ft. 36 AWG GREEN	$2.40
W36-3-B-Pkg. 3	250 ft. 36 AWG RED	$2.40
W36-3-C-Pkg. 3	250 ft. 36 AWG CLEAR	$2.40
W36-3-D-Pkg. 3	250 ft. 36 AWG BLUE	$2.40

MOLEX PINS

100 PER STRIP

Intended for use as an inexpensive substitute for IC sockets. Also perfect for use as board connectors and in subassemblies

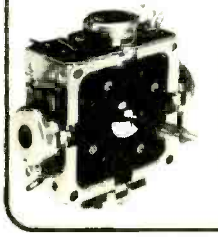
SPECIAL — 100/1.49 — 1000/12.00

64 KEY KEYBOARD

The ideal item for the real homebrew computer hobbyist. This keyboard features 64 unencoded SPST keys, unattached to any kind of P.C.B. A very solid molded plastic 13" x 4" base suits most applications.

$24.95 ea.

JOYSTICK



These joysticks feature four 100K potentiometers, that vary resistance proportional to the angle of the stick. Sturdy metal construction with plastics components only at the movable joint. Perfect for electronic games and instrumentation.

$9.95 ea.

MICROPROCESSOR COMPONENTS

8080 SUPPORT DEVICES

8080A $37.95

8212	8 BIT INPUT/OUTPUT PORT FOR 8080	$ 5.95
8224	CLOCK GENERATOR AND DRIVER FOR 8080	12.95
8228	SYSTEM CONTROLLER AND BUS DRIVER FOR 8080	12.95

8080 $24.95

	CPU'S	
8008	8 BIT CPU	$19.95
8080	Super 8008	24.95
8080A	Super 8008	37.95
	SR'S	
2504	1024 Dynamic	$ 9.00
2518	Hex 32 BIT	7.00
2519	Hex 40 BIT	4.00
2524	512 Dynamic	2.95
2525	1024 Dynamic	6.00
2527	Dual 256 BIT	3.95
2529	Dual 512 BIT	4.00
2532	Quad 80 BIT	3.95
2533	1024 Static	7.95
3341	Fifo	6.95
74LS670	16 x 4 Reg.	3.95
	UART'S	
AY-5-1013	20K Baud	$ 6.95
	ROM'S	
2513	Char. Gen.	$11.00
7488	Random Bits	3.50

		RAM'S	
3601	256 x 1	FAST	5.00
1101	256 x 1	Static	$ 2.25
1103	102 x 1	Dynamic	2.95
2101	256 x 1	Static	6.95
2102	1024 x 1	Static	1.95
2107	4096 x 1	Dynamic	19.95
2111	256 x 4	Static	7.95
7010	1024 x 1	MNOS	29.95
7489	16 x 4	Static	2.49
8101	256 x 4	Static	7.95
8111	256 x 4	Static	7.95
8599	16 x 4	Static	3.49
91L02	1024 x 1	Static	2.49
74200	256 x 1	Static	6.95
93410	256 x 1	Static	1.75
5262	2048 x 1	Dynamic	2.95
		PROMS	
1024	1024 x 1	HPROM	5.00
1702A	2048	Famos	$15.95
5203	2048	Famos	14.95
82S23	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	5.00

BUILD YOUR OWN JOLT MICROCOMPUTER IN JUST 3 HOURS OR LESS FOR $159.95

A COMPLETE MICROCOMPUTER IN A SINGLE CPU KIT INCLUDES: • An MOS Technology MCS6502 NMOS microprocessor • 512 bytes of program RAM, and 64 bytes of interrupt vector RAM • 1K bytes of mask programmed ROM containing DEMON, a powerful debug monitor • 26 programmable I/O lines • Internal RC clock, or crystal controlled clock with user supplied crystal • Serial I/O ports for use with a teleprinter current loop drive/receiver, or an EIA standard driver/receiver • Expandable address and data buses • Hardware interrupt • Control panel interface lines available on card connector • Complete assembly manuals and sample programs

JOLT ACCESSORY KITS

JOLT RAM CARD — Fully static 4,096 bytes of RAM with 1 microsecond access time and on-board decoding. **$199.95**

JOLT I/O Card (Peripheral Interface Adapter) — 2 PIA LSI chips, 32 I/O lines, four interrupt lines, on-board decoding and standard TIL drive. Fully programmable. **$95.50**

JOLT Power Supply — Operates at +5, +12 and −10 voltages. Supports JOLT CPU, 4K bytes of RAM and JOLT I/O card — or, CPU and 8 I/O cards. **$99.95**

JOLT +5V Booster Option — Fits onto JOLT Power Supply card. Supports CPU, 8K bytes RAM and 8 I/O CPU and cards. **$24.95**

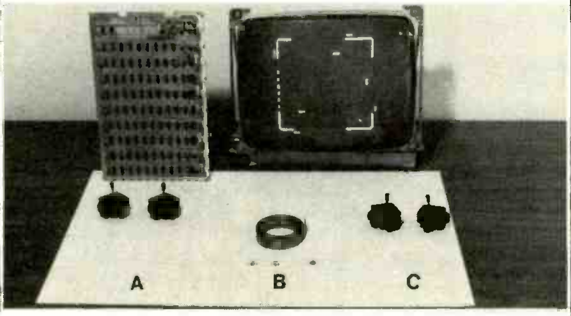
JOLT Universal Card — Sames size (4¼" x 7"), same form factor as other JOLT cards. Completely blank, drilled to accept 14, 16, 24 or 40 pin sockets. **24.95**

JOLT Accessory Bag — Contains enough hardware to connect one JOLT card to another, flat cable, connectors, card spacers, hardware, etc. **$39.95**

JOLT Resident Assembler — Fully symbolic, single pass resident assembler, all memonics compatible with timesharing assemblers. Delivered on four 1702A PROMs, ready for plugging into JOLT PROM card. **$149.95**

JOLT 1702A PROM Card — Sockets for 2,048 bytes of PROM memory. Place anywhere in memory with jumper selectable addresses. **$99.95**

NOW: YOUR OWN VIDEO GAME FOR THE ENTIRE FAMILY



This game comes pre-tested with two **PROFESSIONAL** Kraft joysticks. Joysticks allow 2 dimensional player control (rather than only one dimension, such as up and down.) If you require more than two players, order extra joysicks. All that's required is a 5V/2A power supply, a harness, and speaker. Comes with schematics, wiring information, and all necessary documentation. Game gives 1V composite video output, perfect for any TV monitor. Game designed so one, two, three, or four players can play at the same time. You can even play against the HOUSE. Score for each person is shown on TV set. These boards are production over runs of a well known video game manufacturer, and are **not** rejects, or in any way inferior to one presently being sold in games for over $1,000.00.

KIT A — $179.95 **PROFESSIONAL** game P.C. board, and 2 **PROFESSIONAL** joysticks. P.C. board size is 10½" x 17". This is the same **PROFESSIONAL** game as seen in commercial establishments. Dont't confuse it with the simple games sold in stores, or with analog kits.

ACCESSORY B — $3.95 Six feet of ribbon cable, three SPST switches (coin simulator, house/player, and start switch), for those of you who don't have extra wire or switches to build the harness.

ACCESSORY-C — $39.95 Two additional **PROFESSIONAL** Kraft joysticks, for third and fourth player.

DIGITAL CLOCK KIT — 3½ INCH DIGITS

This clock features big 3½" high digits for viewing in offices, auditoriums, etc. Each digit is formed by 31 bright 0.2" LED's. The clock operates from 117 VAC, has either 12 or 24 hr. operation. The 6 digit version is 27" x 3½" x 1½", and the 4 digit is 18" x 3½" x 1½". Kits come complete with all components, case and transformer.

4 DIGIT KIT $49.95	4 DIGIT ASSEMBLED $59.95
6 DIGIT KIT $69.95	6 DIGIT ASSEMBLED $79.95

Specify 12 Or 24 Hr. When Ordering

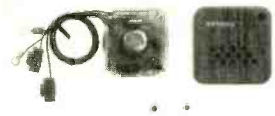
Satisfaction Guaranteed. $5.00 Min. Order. U.S. Funds.
California Residents — Add 6% Sales Tax — Data Sheels 25c each
Send a 13c Stamp (postage) for a FREE 1976 Catalog

JAMES

1021 HOWARD ST., SAN CARLOS, CA. 94070
PHONE ORDERS — (415) 592-8097

AUTOTEL ™

WARNING LIGHTS ARE NOT ENOUGH



AN AUDIBLE ALARM INDICATING POTENTIAL ENGINE DAMAGE

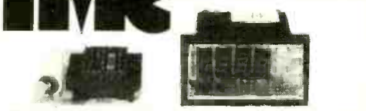
AUTOTEL is an effecient (15 ma current standby) device by which every owner of an automobile, truck or vehicle equipped with indicator lights for temperature and oil pressure can be assured of a reliable warning **before** an impending failure.

AUTOTEL, by means of an audible signal 70 db pulsing) immediately forewarns the vehicle operator of a malfunction or failure, allowing time to correct and prevent major engine failures. It is programmed so there is no sound during normal operating conditions.

AUTOTEL features CMOS circuitry, packaged in a 2½" sq. x ⅞" case. The kit comes complete with all components, hardware and case to hook directly into your car's warning light system.

$14.95 Assembled $9.95 Per Kit

IMC 3½ DIGIT DVM KIT



This 0-2 VDC .05 per cent digital voltmeter features the Motorola 3½ digit DVM chip set. It has a .4" LED display and operates from a single +5V power supply. The unit is provided complete with an injection molded black plastic case complete with Bezel. An optional power supply is available which fits into the same case as the 0-2V DVM allowing 117 VAC operation.

A. 0-2V DVM with Case	$49.95
B. 5V Power Supply	$14.95

JE700 CLOCK

12 or 24 Hour

115 VAC

The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout, and the MM5314 clock chip.

$19.95

Liquid Crystal Temperature Display

Six Digit Light Emitting Diode Display

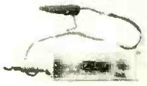
DL 33 Display

This clock makes an attractive addition to any desk. It has an extruded, black anodized aluminum case. It displays hours, minutes, and seconds with .11 inch displays, and comes complete with a liquid crystal thermometer. It operates off 115 VAC at 50 or 60 Hz. **$24.95**

This large digit clock (.6" hours & minutes, .3" seconds) features the MM5314 clock chip. It operates from 117 VAC, and will operate in either a 12 or 24 hour mode. The clock is complete with a walnut grain case, and has fast set, slow set, and hold time set features.

KIT - ALL COMPONENTS & CASE $34.95
WIRED & ASSEMBLED $39.95

JE803 PROBE

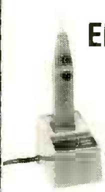


The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols (H) - 1 (LOW) - 0 (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.

$9.95 Per Kit printed circuit board

ELECTRONIC TOOLS

QUICK CHARGE CORDLESS SOLDERING IRON



This versatile tool weighs only six ounces, and can be operated without power anywhere. It gives the performance of a 50 watt iron with a tip temperature of over 700°F. It will solder an average of 160 3 twist 22 guage wire joints on one charge. It has a charge time of 4 hours, and heats in 5 seconds. Complete with recharger.

$29.95 EACH

NIBBLING TOOL

This Nibbling Tool is perfect for cutting, trimming or notching sheet metal up to 18 guage. It operates like a punch and die and also works well on aluminum or plastic up to 1/16" thick. We feel that this tool can be a real time saver for our customers when working on chassis, printed circuit boards and prototype model parts.

Nibbling Tool	$6.95
Replacement Punch	$3.75 Each

DIAGONAL CUTTER

½" Semi-Flush Cut Fine Diagonal

4-in. long. Most popular cutter on assembly line, cuts at extreme tip. Semi-flush cut. For fine wire work only. No 20 soft copper wire and smaller. Width across joint 13/32", thru joint 1/32", tip length 1/2".

Light Blue Handle A97MS $8.50 ea.

SOLDER

Part No	Wire Dia.	Price/1 lb Spool
SN60	.031	6.85/Spool
SN60	.040	6.50/Spool

Solder Wick

STOCK	WIDTH	PRICE
40-1	.025	$2.00 ea
40-2	.050	2.00 ea
40-3	.075	2.00 ea

Circle 96 on reader service card

TV-Stereo techs. Free copy TV Service Newsletter has hard-to-get service tips and case histories. Send name to: **ELECTRONIC PUBLISHING CO.,** Dept. B, 617 E. 13th Ave., Denver, CO 80203

FOR SALE

SURPRISE! Build inexpensively, the most unusual test instruments, futuristic gadgets using numerical readouts. Catalogue free! **GBS,** Box 100B, Greenbank, WV 24944

Circle 105 on reader service card

TV picture tubes—Over 1700 types of B-W and Color at the lowest prices. **ALLIED SALES,** Dept. 32, Pimento, IN 47866. 812-495-6555

FREQUENCY directories! Police, fire, other services! Retail sales & dealer inquiries invited. Send postage stamp for catalog. **CRB RESEARCH,** Box 56-RE, Commack, NY 11725

SEMICONDUCTOR and parts literature, **J. & J. ELECTRONICS,** Box 1437R, Winnipeg, Manitoba, Canada, U.S. Inquiries Invited.

DESCRAMBLERS: Several professional models that work with all scanners. Tone encoders/decoders, Scanmate, AAPP, radar detectors, Big Ears, alarms, books, kits, parts. Catalog 25 cents: **KRYSTAL KITS,** Box 445, Bentonville, AR 72712

JAPANESE transistors. All transistors original factory made. Free catalog. **WEST PACIFIC ELECTRONICS,** P.O. Box 25837, W. Los Angeles, CA 90025

ALTAIR 8800 & **IMSAI** 8080 plug-ins, low prices *** **8K Memory,** static, exceptionally low power, fast no wait or refresh states, low price. *** **Prototyping Board.** *** **Extender Card.** *** 8800 **Octal Encoder** *** **IC Sockets** TI. *** **Microprocessor Coding Form Pads.** Send for latest information and * low prices * **ELECTRONIC CONTROL TECHNOLOGY,** Box 6, Union, NJ 07083

TV cameras $125 (new); Cartrivision front panels $12, five heads $12. **ROBERT ALLEN,** 124 Lundy Lane, Palo Alto, CA 94306

TELETYPE equipment for beginners—experienced computer enthusiast. Teletype machines, parts, supplies. Catalog $1.00. **ATLANTIC SALES,** 3730 Nautilus, Brooklyn, NY 11224. Tel: (212) 372-0349

NEW Canadian Magazine, "Electronics Workshop," $5.00 yearly, sample $1.00. **ETHCO,** Box 741 "A," Montreal

LED watches—$29.95—add $1.00 postage, flyer 13¢, **LYNDALL DISTRIBUTORS,** Box 1394 Scottsdale, AZ 85252

RECONDITIONED test equipment. $0.50 for catalog. **WALTER'S TEST EQUIPMENT,** 2697 Nickel, San Pablo, CA 94806

NEW adjustable three output regulated power supply, plus 900 parts worth $400.00 list. Solid-state **Cartrivision** television recorder electronic unit. Schematics, parts cross reference. **Heathkit** television transistor substitution. Power CB radios, **microprocessors.** $17.95 plus $3.50 S & H, USA. Free brochure. **MADISON ELECTRONICS COMPANY, INC.,** Box 369, D101, Madison, AL 35758

8080 utility software modules. I/O and arithmetic package for $25. Engineering, scientific and commercial modules also available. Catalog with descriptions $2. Master Charge and Bank Americard OK. **COMPUTER EASE,** 2107 Walker, Houston, TX 77003

SUPREME Television-Radio Diagram Servicing manuals discounted 50%. Information. **SUPREME PUBLICATIONS,** 1760 Balsam, Highland Park, IL 60035

Circle 106 on reader service card

Spring-Pac super SALE! Each pac only $1.98

All pacs are first quality (no fallout), tested and guaranteed.

Memory pac — 4 MM5016 MOS TO-5 512 BIT shift registers from NATIONAL - with data $1.98

Flip-Flop pac — 10 assorted Flip-Flops, Dual JK's, RST's, and low power FF's, with data $1.98

Comparator pac — 5 assorted DIP's-- LM311, 710, 711, with data $1.98

TTL Gates — 15 assorted DIP's 7400 series-7420, 7430, 7440, etc...All prime, marked parts, with data $1.98

LED pac — 10 assorted discrete LED's-green, red, and infra-red, with data. $1.98

Transistor pac — 40 assorted TO-92 plastic transistors-- PNP's and NPN's, mostly Fairchild house marked. $1.98

Regulators — 4 LM723 DIP variable regulators, 2-40V, with data $1.98

Diodes — 100 Germanium computer signal diodes with leads trimmed for PCB mounting. $1.98

Resistors — 100 ¼ watt 5% resistors of any single standard value from 2.7 ohm to 1M ohm $1.98

Linear pac — 8 assorted linears in mini-DIP or TO-5*741 op amp, LM307 op amp, LM 703 RF-IF amp, with data and circuits $1.98

DIP RC Network — 50 assorted 14 and 16 pin IC packages containing precision resistors and capacitors-no data available $1.98

Switches — 8 SPST momentary contact push button N.O. Red button fits in approx. ½" panel, with lock washer and mounting nut. $1.98

LED Display pac — 2 DL33 - 3 digits each, approximately .1" magnified digits in a 12 pin DIP, with data $1.98

Buy 5 pacs for $9.90 and pic-a-pac for 10¢

The above are special offerings from Babylon Electronics, and will be shipped third class. See bottom of ad for ordering instructions.

Specials

DIP TRIMMER

-12 turn trimpots which plug into a DIP socket
-5K and 200K
-¼" x ¾" x ¼"
-4 leads spaced .3" x .2"

Each $.65 10 for $4.95

25K Trimmer

Printed Circuit Board Type
Each $.20
10 for $1.50

TRANSISTOR

2N3904 - HEP736
TO92 PLASTIC - NPN
300 MW - 60V - β100-300
NEW - FAIRCHILD - MARKED
EACH $ .15 10 FOR $1.00

1 AMP RECTIFIER

1N4007 SALE EACH $ .13 10/ $1.00

NPN TO3 POWER TRANSISTORS

2N3055: PD-115W; VCE-60V; HFE-50; FT-30K.
Each $ .90 10 for $6.95
410 (RCA) 200V-10A
2N3772 70V-30A (max.)
Each $1.75 10 for $15.00

CMOS

CD4001	$ .29	CD4023	.29
CD4002	.29	CD4024	1.50
CD4009	.59	CD4025	.34
CD4010	.59	CD4030	.65
CD4011	.29	74C20	.65
CD4013	.69	74C42	2.00
CD4015	1.98	74C157	2.50
CD4016	.69	74C195	1.00
CD4019	.69		

2102-2 MOS 1024 BIT MEMORY

14 PIN DIP ON CARRIERS
Each $3.00 10 for $27.00

1 Amp OP AMP

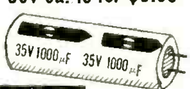
Similar to National LH0021 General purpose operational amplifier in a TO-3 package. Capable of large output currents.

$4.50 each 5/$20.00

Capacitors

PCB vertical mount electrolytic capacitors. 2" long, 3/4" dia.

59¢ ea. 10 for $5.00



TTL

7400	$ .20	74L54	$ .25
74H00	.25	74L55	.25
7401	.14	7460	.16
74H01	.25	74L71	.20
7402	.25	7472	.40
7404	.25	74L72	.60
74H04	.30	7473	.35
7405	.30	74L73	.75
7406	.40	7474	.45
7408	.30	74H74	.75
7410	.12	7475	.8-
7413	.75	7476	.35
7417	.40	74L78	.70
7420	.12	7480	.50
74L20	.25	7483	.70
74H20	.18	7489	2.00
74H22	.30	7490	.70
7430	.10	7492	.35
74H30	.30	7493	1.00
74L30	.30	7495	.65
7440	.10	74L95	1.00
74H40	.22	74107	.25
7442	1.00	74123	.75
7447	1.50	74145	1.25
7450	.10	74155	.90
74H50	.30	74174	1.00
7451	.10	74180	1.00
74H51	.25	74192	.70
7453	.10	74193	1.00
7454	.20	75492	1.00

More Memories

1702-2048 BIT PROM. 2K static units. Ultra-violet light erasable. EACH $9.95

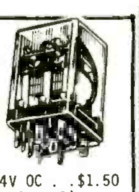
SPACE AGE CLOCK KIT

Instructions & parts - 12 or 24 hour format.
Four digit clock kit includes all parts for complete clock: 3¼"x 2":
-FND 70 readouts
-MM5314 clock chip & all transistors, etc.
-extruded aluminum case
-cord with transformer plug

$16.95

POTTER BRUMFIELD

Type KHP Relay
4 PDT 3A Contacts



24V DC . . $1.50 (650 coil)
120V AC. .$1.75 (10.5 MA coil)

Your BANKAMERICARD welcome here

Mail orders to: Send a stamp for our flyer listing more money-saving bargains!

P.O. Box 41778
Sacramento, CA 95841
Phone (916) 334-2161
TWX # 910-367-3521

BABYLON ELECTRONICS

MONEY BACK GUARANTEE ON ALL GOODS!

All IC's are new and fully tested. Leads are plated with gold or solder. Due to increased costs, orders under $7.00 add $1.00 postage and handling. Residents of California add sales tax. Orders are shipped within 2 workdays-kits are shipped within 10 days. $10 minimum order on C.O.D.'s.

Circle 102 on reader service card

Sharpen your Altair's Memory.

Add Processor Technology's new 8KRA Static Memory Module to your Altair or IMSAI system. You'll have 8192 eight-bit word capacity, using full speed, low power RAM's, manufactured to stringent military standards. The 8KRA uses less power per bit than any other true static memory module (including our own 4KRA)—power requirements so low that two flashlight "D" cells will maintain memory for 4-5 hours. (Re-charging circuitry for Ni-Cad cells and battery connections are on the card.) The 8KRA occupies any 8K segment at 1K intervals within the 8080 addressing range. Card address is selected by a DIP switch, conveniently located at the top of the card. And, all 76 Integrated Circuits have their own **premium grade, low-profile IC sockets**—increasing reliability and making assembly, testing, or repair many times easier.

8KRA 8192-word Static Memory Module **$295**
4KRA 4096-word Static Memory Module **$154**
(all sockets included)

Write Us, about our other plug-in modules, compatible with the 8800 system.

Processor Technology

6200-J Hollis Street
Emeryville, CA 94608

Circle 104 on reader service card

P.O. Box 4430E Santa Clara, CA 95054

TERMS:
$5.00 min. order U.S. funds.
Calif. residents add 6% tax.

Quest ELECTRONICS

Integrated Circuits

7400 TTL	
SN7400N	17
SN7404N	19
SN7408N	23
SN7410N	17
SN7416N	39
SN7420N	17
SN7430N	17
SN7438N	37
SN7440N	17
SN7447N	78
SN7447AN	78
SN7451N	17
SN7460N	17
SN7474N	39
SN7475N	69
SN7489N	3 00
SN7493N	65
SN74107N	39
SN74121N	49
SN74145N	89
SN74150N	95
SN74154N	1 10
SN74157N	1 15
SN74161N	1 35
SN74162N	1 35
SN74163N	1 35
SN74164N	1 45
SN74166N	1.35
SN74174N	1 40
SN74175N	1 10
SN74181N	3 55
SN74190N	1 25
SN74193N	1 15
SN74198N	2 20
SN74251N	2 50
SN74298N	1 65

74LS00 TTL	
SN74LS00N	34
SN74LS04N	39
SN74LS08N	39
SN74LS10N	39
SN74LS20N	34
SN74LS38N	39
SN74LS74N	59
SN74LS75N	75
SN74LS90N	1 10
SN74LS93N	1 10
SN74LS95N	1 89
SN74LS107N	52
SN74LS132N	1 50
SN74LS151N	1 28
SN74LS157N	1 40
SN74LS160N	2 05
SN74LS170N	2 65
SN74LS192N	2.60
SN74LS197N	2 00
SN74LS258N	2 20
SN74LS290N	2 00
SN74LS670N	3 50

LINEAR	
CA3018	1 00
CA3026	1 00
CA3045	90
CA3046	95
CA3047	90
CA3054	1 00
CA3082	1 90
CA3089	2 25
LM301AN	35
LM301AH	35
LM307N	35
LM308N	89
LM309K	1 25
LM311H	90
LM339N	1 55
LM350N	1 00
LM351N	60
LM380N	1 25
LM710N	65
LM723N	44
LM733N	89
LM741N	35
LM1303N	82
LM2111N	1 95
LM3900N	.55
MC1458V	59
NE540L	5 00
NE550N	65
NE553B	2 30
NE555V	43
NE556A	1 00
NE565A	1 95
NE566 V	1 85
NE567V	1 75
SN75450CN	47
SN75451CN	39
SN75452CN	39
SN75453CN	37
SN75454CN	37

CMOS	
CD4000	25
CD4001	25
CD4011	25
CD4012	25
CD4013	75
CD4017	2 00
CD4020	2 30
CD4027	85
CD4049	62
CD4050	62

Same Day Shipment

First line parts only, guaranteed satisfaction. Broad line of IC's and other components at low factory prices. Try us. You'll like the quality and service.

DISPLAY LEDS	
MAN1	1 80
MAN3	30
MAN4	1 95
MAN7	1 35
MAN72	1 35
MAN74	1 35
DL707	1 35
DL727	2 55
DL747	1 80
FND 503	1 75

INTERFACE	
N8T25V	3 20
N8T26V	2 75
N8T28B	2 75
N8T80A	2.75
N8T90A	2 75
N8T97B	2 00

MOS MEMORY RAM	
2102	2 75
2102-1	2 75
2102-2	2 75
21L02	2 75
2107	18 50
2112-2	7 90
MM5314	3 30

PROM	
1702A	15 20
N82S23	2 90
N82S123	2 90
N82S126	4 85

MICRO-PROCESSOR	
8080	24.50
8080A	39 50

CRYSTALS	
1 MHz	4 50
2 MHz	4 50
4 MHz	4.25
5 MHz	4.25
10 MHz	4 25
18 MHz	3 90
20 MHz	3 90
32 MHz	3 90

ALSO AVAILABLE

Switches
Sockets
Capacitors
Resistors
Transistors
Diodes
Rectifiers

FREE—Send for your copy of our 1976 Quest Catalog.

IC Update Master Manual

1976 integrated circuit data manual with free quarterly updates. Complete IC data from all manufacturers devices. **14,000 cross references.** Everything you need to select IC's in one hardbound manual. **$30.00 complete with Update service.**

Money Back Guaranteed if not satisfied within first week.

Digital Clock Kit $12.95

6 digit .05 in. LED readout. Add $1.50 for transformer and $3.00 for PC board. A tremendous value! Wood grain and plexiglas cases available.

Circle 103 on reader service card

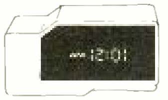
NEW CLOCK KITS!

MODEL OC1032

JUMBO DIGITS
ALARM CLOCK
1.2" Bright Yellow
Color Readouts

Features: 12/24 Hour Display, 24 Hour Alarm Set, 10 Min Snooze Switch, AM/PM Indicator
Kit Includes: Woodlike Color Plastic Case, 4 Digit 1.2" Neon Display with AM/PM. TMS 3834 Alarm Chip, 2 pcs. double sided PC Boards, 16 transistors, all other components, Transformer and speaker

SPECIAL $35.90



MODEL OC1030

4 DIGIT
ALARM CLOCK KIT
0.5" Green Color
Readouts

Features: 12/24 Hour Displays, 24 Hour Alarm Set, 10 Min Snooze Switch, AM/PM Display.
Kit Includes: Orange Color Plastic Case, 0.5" LD8132 Green Color Readouts PC boards with transformer, all electronic parts with speaker.

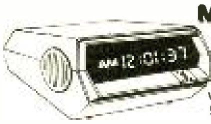
Only $28.50

THE MOST POPULAR

MM5314 KIT

WITH A NEW CASE!!
Features: 12/24 Hour Display
50/60 HZ Input 6 Digits Readout
Kit Includes: Grey Color Plastic Case MM5314 Clock Chip PC Boards and Transformer, 6 Green Color 0.3" Tube Readouts, All other transistor Drivers and other Components.

Special Only $19.95 ea.



MODEL CT7001

Drive 6
Fairchild FND
0.5" Red LED
with MONTH & DATE
50/60HZ and ALARM

Only $28.50 ea.
(without case)

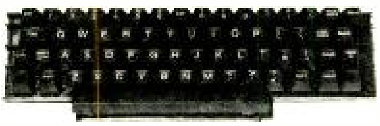
COMPLETE ALARM KIT

- 4 Digits 0.5" LED with brightness control
- 12 Hour display with AM/PM indication
- True 24 hour alarm with repeatable snooze
- Power failure indication for power interrupt

MODEL EC 400
(Not a Kit)

Only $22.50

COMPUTER KEYBOARDS



Standard Teletype Keyboards with gold plated contact switches. All switches are independent and allow you to connect into any form of output. **Only $22.50**

MODEL B SPECIAL ONLY $16.50 ea.
Fully ASCII decoded with electronic parts TTL logic. Used but all in good condition.

ROCKWELL A4001 I.C.

ELECTRONIC SLIDE RULE
SCIENTIFIC CALCULATOR KIT!!

Kit Includes: Rockwell A4001 IC
HP 9 Digit LED Readouts
Complete Keyboard with Case
PC Board with all Electronic Parts
Instructions and Batteries

SPECIFICATION
- 9 digit HP Red Led Displays
- 8 digits capacity for data entry or results
- $(10^{8} \sim 10^{8})$
- Full floating point
- Dome keyboard for excellent response and preventing double entry input

BASIC FUNCTION
- Algebraic mode operation
- Constant operations
- Repeat Operations
- Chain operations
- Change sign operation
- Display and Y register exchangeable
- One accumulating memory
- Display and memory exchangeable

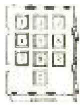
SPECIAL FUNCTION
- Trigonometric functions (sin, cos, tan)
- Inverse trigonometric functions ($\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$)
- Radian or degree selectable
- π constant
- Logarithms (ln, log)
- Anti logarithms (e^x)
- Power functions (y^x)
- Reciprocal (1/x)
- Square root ($\sqrt{x}$)
- Display recall

AC adapter for the unit
$4.50 ea.
*postage $1.50 per unit.

ONLY $28.50

Dimension. 32.5mm(H) x77mm(W) 145mm (L)
1 9/32 in (H) x 3 1/32 in (W) x 5 23/32 in (L)

TOUCH TONE KEYBOARD



no electronic parts
10 key switches only
LIMITED QUANTITY
Only $4.50 ea.

TRANSFORMERS

12V AC 300 MA output Wall Type Adapter (designed for clock with limited space) $2 50ea

12V 0 12V or 24V 1 Amp output $2 25ea

0 0 8V 12V 300 MA output (for our fluorescent tubes) $2 50ea

12V CT 500MA output $1 50 ea.

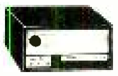
0 3V 12V 24V 500MA output
(for CT 7001 Drive LD 8132 Readouts) 2 50 ea

0-15V 160V 150MA output
(for Gas discharge Readouts) 1 00 ea

* * NEW ITEMS * *

MM 5330	4½ Digits DVM Chip	$12 50 ea
TI TMS 2501	Static USACII 64 x 5 x 7 Charactor Generator	$8 50 ea
Motorola MC1733	Video Amp IC	$1 20 ea
LM 566	Volt Controlled Oscillator	$1 60 ea
NE 540L	Power Driver	$2 00 ea
LM 339	Quad Comparator	$1 70 ea
UA 739	Dual Low Noise Pre-Amp	$1.00 ea.
NE 8038	Wave Form Generator	$4 50 ea
1702A	Erasable Roms	$13 50 ea
2102-1	RAMS 256x1	$2 60 ea.
LM 3900	Quad Op Amp	$0 50 ea
75491	Quad Seg Drivers	$0.50 ea
75492	Hex Digit Drivers	$0 50 ea
Bridge Rectifier	1 5 Amp 200V	$0.60 ea
Bridge Rectifier	25 Amp 200V	$2.50 ea
IN 4002 Rectifier	1 Amp 100V	12 for $1.00

AUTO ALARM KIT

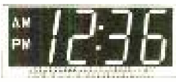


The Crimefighter Auto Alarm is an electronic, self - controlled auto protection system, normally mounted within the glove box of an automobile. Two minutes after turning off the ignition, the alarm automatically turns itself "on." When the auto is re-entered, the horn will sound after a 10-45 second entry delay. The automobile owner, by inserting the ignition key, will activate the alarm. Once activated, the alarm will sound for two minutes before automatically turning off. The alarm then resets and is ready to again protect the vehicle from unwanted entry

FEATURES Simple installation: 5 wires, Automatically turns on when auto is parked, Adjustable entry time, Extended exit time to allow for unrushed exit from vehicle, Numerous applications include protection of boats, campers, trailers, motorcycles, trucks, Cannot be deactivated by "hot wiring" an auto, Cannot be turned off without ignition key, Negative ground only

ONLY $10.00 per kit Completed Unit $16.00

LED READOUTS

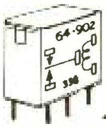


Fairchild FSC 8000
0 8" Red LED 3½ Digits
with AM/PM
Direct Drive by MM 5316 or Fairchild 3817
$10.50 ea.

JUMBO LED

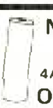
Fairchild
FND 800
0 8" Common Cathode
Red Color
ONLY $3.50 ea.

MAN 74	Red	$1 00
MAN 84	Yellow	$1 50
HP 0 3"	Red	$1 20
DL 747	RZ D	$2 50
DL 727	Double Digit	$2 50
DL 707	0 3" Red	$1 30
FND 70	0 25" Red	$0 60
FND 503	0 5 Red	$1 60
FLV 50	Subm ni Red	$0 15 ea
FLV 209	Mini Red	$0 15 ea
	Jumbo Red	$0 15 ea
	Jumbo Green	$0 25 ea
	Jumbo Orange	$0 25 ea



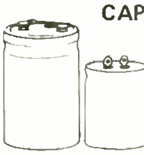
12 VDC Relay
SPDT 1amp
$1.25 ea.

DIRECT DRIVE LED!!
F3817
Alarm Clock by Fairchild
4 digit 24 hr Alarm
$4.95 ea.



Ni-Cd Rechargeable
Batteries
4AA size to a pack (1.25V ea.)
Only $2.50 per pack

COMPUTER GRADE
CAPACITOR



15500 MFD
75V-DC
$4.95 ea.

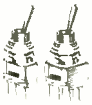
5600 MFD
60V-DC
$1.25 ea.

SAE DIP SWITCHES

Part No 1004 692 4XSPST SW
1008 692 8XSPST SW

4 Toggle SPST Switches on a Mini DIP (8 pins) Only $1 50 ea
8 Toggle SPST Switches on a DIP (16 pins) Only $2 60 ea

SUBMINIATURES TOGGLE SWITCHES



SPDT On-None On $1 30ea
DPDT On None-On $1.50 ea

EECO BCD THUMBWHEEL SWITCHES

8 positions	$1 25 ea
10 positions	$2 15 ea
12 positions	$2 50 ea

QUARTZ CRYSTALS

1MHZ Computer Crystals $4 25 ea
3 58 MHZ Color TV Crystals $1 25 ea
Use with Nation MM 5369 to make a perfect time base for clock.

NEW!

NATIONAL MM 5369 17-STAGE PROGRAMMABLE OSC/DIVIDER generate A 60 Hz reference Frequency with a 3 58 MHZ Color TV X'TAL in Mini DIP Package
ONLY $2.25 ea.

NEW ALARM CLOCK CHIPS

MM 5375 Series by National 24 pin package Multiplex output with brightness control
ONLY $3.50 ea. Data .25 ea.

PROGRAMMABLE OPTIONS		PART #				
FEATURE	OPTION	AA	AB	AC	AD	AE
Input Frequency	60 HZ	X	X		X	X
	50 HZ			X		
Time Display	12 Hour	X	X		X	
	24 Hour			X		X
Duplicate Register	Alarm Counter	X	X			
	Date Counter			X		
	Minute Timer				X	
	Second Timer					X
Alarm Signal	Tone	X	X			X
	DC Level			X	X	
Alarm Output	Modulated @ 2 0Hz	X	X		X	X
	Not Modulated			X		
Alarm at Power Failure	ON	X	X			
	OFF			X	X	X
Segment Output Polarity	Vss for Display		X		X	
	Vdd for Display	X		X		X
AM or PM Indication	Off during time display	X	X			
	Displayed at all times			X	X	X

MINIMUM ORDER $10.00. California residents add 6% sales and 1.50 to cover postage and handling.
Out-of-state and overseas countries add $2.50.
SEND CHECK OR MONEY ORDER TO:

FORMULA INTERNATIONAL INC.

12603 CRENSHAW BOULEVARD • HAWTHORNE, CALIFORNIA 90250
For more information please call (213) 679-5162
STORE HOURS 10-7 Monday - Saturday

Circle 101 on reader service card

CLOCKS

GIANT NIXIE CLOCK — 4 digits — 2.5" displays. Line frequency operated. Uses opto-isolaters for drivers. Complete kit includes circuit board set, instructions, and all parts except case. Complete kit — only $29.95 ppd.

6 digit AUTOMOTIVE CLOCK KIT complete with a CRYSTAL TIMEBASE accurate to .01 percent. 12 volts d.c. operation — built in noise suppression and voltage spike protection. Readouts blank when ignition is off — draws 25 mA in standby mode. Has .3 in. readouts. Use it in your car or for all applications where a battery-operated clock is needed. Approximate size 3" x 3.5" x 1.75"

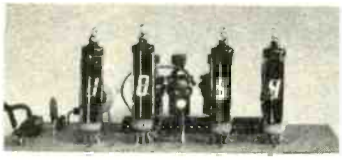
WITH BLACK PLASTIC CASE	$34.95 ppd.
WITHOUT CASE	$29.95 ppd.
ASSEMBLED AND TESTED	$45.95 ppd.

CMOS CRYSTAL TIMEBASE KITS with .01 percent accuracy. 5-15 v.d.c. operation. Draws only 3 mA at 12 volts. Single I.C. — very small size — the P.C. board is 7/8" x 1-5/8". Choose a main output of 50 or 100 Hz., 60 Hz., 500 or 1000 Hz., or 1 Hz. Several related frequencies are also available on each board, in addition to the main ones listed above. Be sure to specify the Frequency you want. All kits are $10.95 ppd.

Flyer available — write for it or circle the reader service card.

NEXUS TRADING CO.
Box 3357
San Leandro, Ca 94578

Circle 107 on reader service card



CLOCK KIT $14.00

Includes all parts with MM5316 chip, transformer, drilled & etched PC board, all except case. #SP-284 $14 or 2/$25

ASCII KEYBOARD, brand new w/paperwork $45.00

AA NICAD CELLS brand new $1.25 each 9/$9.00

C-MOS LINEAR all brand new RCA

				CLOCK CHIPS	
301	$ .60	747	$ .82		
307	.52	748	.50	MM5314	$3.00
324	1.80	1458	.96		
339A	1.60	3401	.80	MM5316	3.00
741	.50	555	.60	7001	8.00

POWER SUPPLY KIT

Puts out 24-12-6 volt DC 2 amps. Includes xfmr, line cord, filter, silicon bridge. #PK-2B $9.00

B & L HELIUM NEON GAS LASER

Fully assembled, runs on 115 volts AC. Less Laser tube. $15.00

POWER AMP TRANSFORMER $9.00

115 volts input, output of 96 VCT 2 amps. $9.00 each 3/$25

Please add shipping cost on above.

FREE catalog

Meshna SURPLUS ELECTRONIC MATERIAL
P.O. Box 62
19 ALLERTON STREET
E. LYNN MASS. 01904

Circle 108 on reader service card

TEST equipment, surplus parts excess to my needs. Send SASE for list. **BRIAN KENT,** 22 Wake Ct., Eatontown, NJ 07724

PROGRAMMING—Octal Calculator: $14.95. Hexadecimal Calculator: $35.95. Literature free. **RADIX PRECISION,** Box 13861-R, Atlanta, GA 30324

Govt. SURPLUS ELECTRONIC EQUIPMENT CATALOG

New ITEMS . . . New BARGAINS!

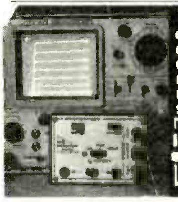
FREE UPON REQUEST! If you haven't received our new Catalog, write for free copy today. Address: Dept. RE

FAIR RADIO SALES
1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

MANUALS for Govt. surplus radios, test sets, scopes. List 50¢ (coin). **BOOKS,** 7218 Roanne Drive, Washington, DC 20021

QUALITY in all brands, military-industrial surplus. No junk. Free catalog. **BRAND X,** Box 444, Baker, OR 97814

FREE catalog. Ultrasonic devices, LED's, transistors, IC's, strobe lights, UART's, memories, digital thermometers, unique components. **CHANEY'S,** Box 15431, Lakewood, CO 80215



— econotrace — $39.50 —
CONVERT YOUR 'SCOPE TO A CALIBRATED SEMICONDUCTOR CURVE TRACER FOR THE LOWEST COST EVER. MEASURE GAIN, LEAKAGE, BVCEO, MATCH PAIRS, ETC. ALL CMOS, BATTERY INCLUDED. EASY TO OPERATE. MONEY BACK GUARANTEE. SEND CHECK FOR $39.50 PLUS $2.00 FOR POSTAGE, INS. & HANDLING. COLO. RES. ADD 3½% SALES TAX.
lab science
PO BOX 1972
BOULDER, COLO. 80302

CARBON film resistors—¼W, 5% 10—4.7 megohms for 3½¢ each. Fifty per value $0.85. Discounts available. Free samples/specifications. Other quality components. $1.00 postage. **COMPONENTS CENTER,** Box 134R, New York, NY 10038

FREE catalog. IC's, Semi's. **CORONET ELECTRONICS,** 649A Notre Dame W., Montreal, Que. Canada, H3C-1H8. US Inquiries.

A COMPUTER SYSTEM CHEAPER THAN A KIT

PDP8 4K w/ASR33 & CAB $1800
ALSO FOR SALE: DEC • DG • CAI • HP • MICRO • SEL • WANG • XLO
MODULES • PERIPHERALS
ELECTRONIC COMPONENTS
— 90-DAY WARRANTY —
617-261-1100
AMERICAN USED COMPUTER CORP.
Box 68, Kenmore Station, Boston, Mass. 02215
member COMPUTER DEALERS ASSOCIATION

LOADS of June goodies—100 1% precision resistors/$1—100 mica capacitors/$1—¼ lb. semiconductors/$1—75 ½W carbon resistors/$1—DL 707/95¢—7400, 7402/10¢—transistors, IC's, Zeners, optoelectronics, pots, pilot lamps, solar cells, kits, assortments . . . WOW! Catalog 25¢ **DIAMONDBACK ENGINEERING,** PO Box 194, Spring Valley, IL 61362

CASSETTES/LABELS

Plain white cassette labels. Norelco cassette cleaners, famous brand cassettes. Send for open reel and cassette discount catalog.

	1-9	10-99	100	1000	10M
Cassette Labels		.02	.015	.01	.005
Norelco Cassette Cleaner	.65	.60	.55	.50	.45
10" Fiberglass used ⅜" Hole	.50	.50	.40	.35	.30

Plus Postage by Weight and Zone. Minimum Order $5.00

OPEN REEL STEREO TAPE BUYERS!

We've Got the "Spirit" The Prices And The Address To Prove It

Saxitone's Bicentennial Tape Shoppe
1776 Columbia Rd., N.W., Wash. D.C. 20009

RECORDS-TAPES! Discounts to 73%; all labels; no purchase obligations; newsletter; discount dividend certificates; 100% guarantees. Free details. **DISCOUNT MUSIC CLUB,** 650 Main St., Dept. 3-66, New Rochelle, NY 10801

CANADIAN discount and factory clearouts catalog. Top brand stereo equipment, calculators, test gear, CB & communications, telephones. Factory dumps—government surplus. Amazing bargains. Unusual items. Rush $1. **ETCO-RE,** 521 5th Ave., NYC, 10017

USED television picture tube equipment with 4-position oven, horizontal renecking machine, vertical sealing machine. Ready for production. **109 Hansel St.,** New Iberia, LA 70560—Phone 318-364-8666

RADIO & TV tubes 36¢ each. One year guaranteed. Plus many unusual electronic bargains. Free catalog. **CORNELL,** 4217-E University, San Diego, CA 92105

PRINTED CIRCUIT

Positive Acting Photo Resist; Carbide bits; Bubble etchers; Artwork; Epoxy Glass Boards.

Send stamp & address label for flyer

TRUMBULL
833 Balra Dr., El Cerrito, CA 94530

PLANS & KITS

CB'ers—"triple your power" using new 46' all-directional CB antenna!!! Plans $2.—**ASTROBEAM-9,** 704 Edwards, Visalia, CA 93277

AMAZING ELECTRONIC PROJECTS and PRODUCTS:

Lasers Super Powered, Burning, Cutting, Rifle, Pistol, Pocket. See in Dark—Shotgun Directional Mike—Unscramblers—Giant Tesla—Stunwand—TV Disrupter—Energy Producing, Surveillance, Detection, Electrifying, Ultrasonic, CB, Auto and Mech. Devices, Hundreds More—All New Plus INFO UNLTD PARTS SERVICE. Catalog $1. **Information Unlimited, Box 626, Lord Jeffery Court, Amherst, N.H. 03031.**

TV-GAMES, construction plans: **PONG** series —5 game set $5.00, big 12 game set $12.00. **JAWS-2** and **SPACE RACE**—both games for $8.00. **ANTI-AIRCRAFT** 1 & 2—both for $8.00. Full description and specs—$1.00. **ADVANCED ELECTRONICS,** P.O. Box 1128, Cupertino, CA 95014

NEGATIVE ion generator built at home. Complete instructions. $5.00. **GOLDEN ENTERPRISES,** Box 1282RE, Glendale, AZ 85311

TV Ping Pong game. Plays through your set's antenna terminals: Plans $3.25. ARS SYSTEMS, Box 61922, Sunnyvale, CA 94088

C-MOS PROBE

will convert your voltmeter into a sensitive FET INPUT millivoltmeter. Complete kit $11.95 plus shipping. Also • Temp Meters • Power Supplies • Design Consoles.

Send for FREE CATALOG

DAGE SCIENTIFIC INSTRUMENTS
BOX 1054R • LIVERMORE • CA • 94550

ANALOG adjustable modem kit, TTL compatible, +5-9 volts, 110 TTY, clock output standard, $35.00, **E. CADOTTE,** 1027 Windihill Circle, Knoxville, TN 37919

ELECTRONIC kits for home or school project. Select from over 50 kits. Many under $5.00. Send $1.00 for catalog. Refundable with first order. **GRAYMARK,** 1751 McGaw Ave., Irvine, CA 92714

ALTAIR 8800 OWNERS

Is your Altair:
- Slow to start-up
- Writing all 0's or 1's into memory
- Having troubles running BASIC

Our 'CPU Clock Fix-kit' may solve your problems. Good clock pulses are a must. Send for your kit today!
Only $15 postpaid. Brochure available.
PARASITIC ENGINEERING
P.O. Box 6314, Albany, Ca. 94706

VIDEO GAME KIT

5IVE GAMES TO PLAY

A CHALLENGE TO BUILD, A CHALLENGE TO PLAY.

This is a unit featuring a true "state of the art" design. It is something you will be proud to show your friends.

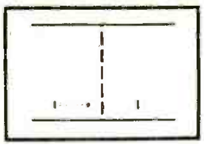
With a basic knowledge of electronic circuitry, this kit can be assembled and playing in just a few hours. If you have trouble, test facilities are available at nominal cost to remedy the problem.

FEATURES

1. Unique curve button adds extra thrill and skill to game.
2. Disappearing score - allows full vision of playing field when ball is in action.
3. 16 different angles of deflection for the ball compared to 3 with most competitive designs.
4. Fast action paddles.
5. Commercial quality design.

PRICES FOR THE UNITS ARE:

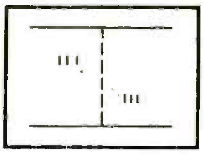
VK-1	PC board only includes parts list & wiring diagram.	25.00 net
VK-2	PC board with parts Includes PC board, 78 IC's (those necessary are pre-programmed), resistors & capacitors to stuff the board.	125.00 net
VK-3	Hardware, wire, controls, switches Does not include housing or case.	17.50 net
VK-4	RF Module To convert video signal to TV receiver signal eliminates internal "wire in" on TV set. This unit can be used with other manufactured or kit type video games.	22.50 net
VK-5	Power Supply Kit	12.50 net
	Trouble shoot & Test Buyer assembled set	25.00 net
	Preassemble & Test	75.00 plus components



GAME 1

Let's start with a Tennis "**MATCH**". Fun for all, particularly beginners. This is the game that started the craze.

Scores to 12 points



GAME 2

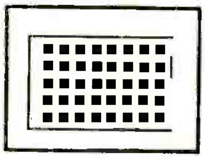
Then go to the "**PRO MATCH**". You'll need 3 paddles to return the ball on this one, almost as fast as a Hockey Puck. A challenge for the 2 players this is designed for.

Scores to 12 points.

GAME 3

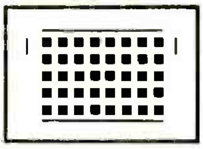
Now to deflate the ego's of the "Pros" put them to a "**GRAVITY MATCH**". A bouncing ball adds more fun and excitement plus it plays havoc with the skill of the 2 players.

Scores to 12 points.



GAME 4

WIPE OUT I
A game for a single player. Test your reflexes and see how many squares you can knock out. As your score increases so does the speed of the ball.
Top Score is 2400 points in 6 trys.



GAME 5

WIPE OUT II
If you can't beat the machine by yourself, get someone to help you. Together you can (that is it is possible to) score 2800 points in 6 trys.

All games have sound.

C-MOS

34001	FSC Quad 2-Input NOR Gate	1.00
4000	Dual 3-Input NOR Gate/Inver	3/1.00
4001	Quad 2-Input NOR Gate	3/1.00
4002	Dual 4-Input NOR Gate	3/1.00
4006	18-bit St. Shift Register	1.50
4007	Dual Comp Pair + Inverter	1.25
4008	4-bit Full Adder	1.25
4009	Hex Buffer Inverter	2/1.50
4010	Hex Buffer Converter	2/1.50
4011	Quad 2-Input NAND Gate	3/1.00
4012	Dual 4-Input NAND Gate	3/1.00
4013	Dual Type D FlipFlop	2/1.00
4014	8-bit St. Shift Register	1.25
4015	Dual 4-bit Static Shift Reg	1.25
4016	Quad Analog SW/Quad Multi	1.00
4017	Decade Counter/Divider	1.25
4018	Divide by N Counter	1.25
4019	Quad AND-OR select gate	1.50
4020	14-bit Binary Counter	1.40
4021	8-bit St. Shift Register	1.50
4022	Octal Counter/Divider	1.25
4023	Triple 3-In NAND Gate	3/1.00
4024	7 Stage Ripple Counter	1.00
4025	Triple 3-Input NOR Gate	3/1.00
4027	Dual J-K FlipFlop	2/1.25
4028	BCD to Decimal Bi. Octal Dec	1.25
4029	4-bit BIN/BCD UP/DN CTR	1.90
4030	Quad Exclusive OR Gate	2/1.25
4032	Triple Serial Adder (pos.)	1.50
4033	Decade counter/divider	2.00
4035	4-bit Parallel IN&OUT Shift Reg.	1.45
4040	12-Binary Counter	1.50
4041	QD True/Comp Buffer	1.45
4042	Quad Latch	1.00
4043	Quad 3-state NOR R/S latch	1.50
4044	Quad 3-state NAND R/S latc	1.25
4049	Hex Inverter/Buffer	1.00
4050	Hex Non Inverting Buffer	1.00
4051	8 Input Analog Multi	1.50
4052	Diff 4 Input Analog Mx.	1.50
4053	Triple 2 channel Mltplx	1.50
4066	Quad Bilateral Sw.	1.00
4068	8 Input NAND	2/1.00
4069	Hex Inverter	1.00
4070	Quad Exclusive OR	1.00
4071	Quad 2 Input OR Gate	1.00
4077	Quad Exclusive OR	1.00
4081	Quad 2 Input AND Gate	1.00
4402		1.00
4403		1.00
4404		1.00
4412		1.00
4416		1.50
4426		2.00
4508		2.60
4510		1.75
4511	BCD TO 7 Seq. Latch/DEC	2.00
4512	8 Input Multiplexer	1.50
4518	Dual 4 Bit Decade Counter	1.50
4520	Dual 4 Bit Binary Counter	1.65
4528	Dual One Shot	1.50

LINEAR IC's

309K	5-V Reg	1.25
310H	V Fol	1.95
310M	Fol	2.25
311H	V Comp	1.25
311M	V Comp	1.25
311N	V Comp	1.50
312H	Op Amp	2.00
318H	Hi Per Op Amp	2.00
320T-5V	Neg Reg	1.75
320T-6V	Neg Reg	1.75
320T-8V	Neg Reg	1.75
320T-12V	Neg Reg	1.75
320-15V	Neg Reg	1.75
320T-18V	Neg Reg	1.75
324N	Quad Op Amp	2.50
339N	Lo V Quad Comp	1.50
340T-5V	Pos Reg	1.75
340-8V	Pos Reg	1.75
340T-12V	Pos Reg	1.75
340T-15V	Pos Reg	1.75
340T-18V	Pos Reg	1.75
370N	AGC/Sg Amp	1.75
373N	AM/FM IF Det	2.00
380M	Audio Amp	1.00
380N	Audio Amp	1.00
381N	Dual Pre Amp	1.50
531H	Op Amp	2.00
555M	Timer	2/1.25
556N	Dual Timer	1.35
566M		2.00
567M	Tone Decoder	2.50
702H	Linear	1.50
703H	RF/IF Amp	1.50
709H	Op Amp	1.25
709N	Op Amp	2/1.25
710H	V Comp	1.00
711H	Dual Comp	1.00
711N	Dual Comp	1.00
723H	V Reg	2/1.25
723N	Reg	2/1.25
725H	Ins Op Amp	3.75
733H	Dif Vid Amp	1.00
733N	Dif Vid Amp	1.00
739N	Dual Aud Pre Amp	1.00
740H	FET Op Amp	7.00
741H	Op Amp	2/1.00
741M	Op Amp	2/1.00
747H	Dual Op Amp	1.00
747N	Dual Op Amp	1.50
748H	Op Amp	3/1.25
748M	Op Amp	3/1.25
749N	Dual Aud Pre Amp	1.50
760N	Dif V Comp	3.00
781N	Gain Cont IF Amp	2.00
909H	Buffer	3.00
1458M	Dual Op Amp	2/1.15
2900N	Quad Amp	1.00
3065N	TV Snd Sys	2/1.50
3900N	Quad Amp	1.00
4136N	Quad 741	2.00
4558M	Dual 741	1.00

TTL IC's

Low Power

74L00	3/1.25
74L02	3/1.25
74L03	2/1.00
74L04	3/1.25
74L10	3/1.25
74L20	3/1.25
74L30	3/1.25
74L42A	2.25
74L51	3/1.25
74L54	3/1.25
74L55	3/1.25
74L71	2/1.25
74L73	2/1.00
74L75	2/1.25
74L86	2/1.35
74L90	1.50
74L93	1.50
74L95	1.50
74L98	2.50
74L122	1.00
74L123	1.00
74L154	2.00
74L157	1.75
74L164	2.00
74L191	2.00
74L192	2.50
74L193	2.50

RESISTORS

¼W 5% 100/$1.95

Asst. 1
10 each of 10, 18, 20, 36, 75, 180, 360, 2.4K, 3.3K and 18K Ohm Values.

Asst. 2
10 each of 5.6, 18, 27, 180, 200, 270, 360, 10K, 470K and 8.2M Ohm Values.

Asst. 3
10 each of 10, 18, 51, 180, 360, 1.8K, 3.3K, 18K, 470K, and 1.8M Ohm Values.

Asst. 4
10 each of 11, 20, 30, 75, 240, 360, 820, 1.1K, 3.3K, and 120K Ohm Values.

Asst. 5
10 each of 10, 18, 75, 150, 180, 270, 330, 910, 4.7K, and 470K Ohm Values.

Asst. 6
10 each of 13, 24, 27, 33, 39, 43, 56, 62, 75, 160, and 200 Ohm Values.

Asst. 7
10 each of 240, 300, 510, 1.3K, 1.6K, 3.0K 3.9K, 39K, 560K, and 8.2M Ohm Values.

IC Sockets

	Low Pro	Standard	Wire Wrap
10	--	4/1.00	--
14	4/1.00	4/1.25	3/1.00
16	4/1.25	3/1.00	3/1.25
24	3/1.00	3/1.25	2/1.25
28	--	3/1.25	2/1.25

POTENTIOMETER ASSORTMENT

10 (each different) 1.00

MC1303L Dual Stereo PreAmp 1.00

DIODES

1N4148 Switching Diode 20/1.00 100/4.00

Zeners

400MW 5%

1N746A	3.3V	7/1.00	100/11.00
1N747A	3.6V	7/1.00	100/11.00
1N748A	3.9V	7/1.00	100/11.00
1N749A	4.3V	7/1.00	100/11.00
1N750A	4.7V	7/1.00	100/11.00
1N751A	5.1V	6/1.00	100/13.00
1N752A	5.6V	6/1.00	100/13.00
1N753A	6.2V	6/1.00	100/13.00
1N754A	6.8V	6/1.00	100/13.00
1N755A	7.5V	6/1.00	100/13.00
1N756A	8.2V	5/1.00	100/15.00
1N757A	9.1V	5/1.00	100/15.00
1N758A	10V	5/1.00	100/15.00
1N759A	12V	5/1.00	100/15.00

1N4728-57 Series

1 Watt 5% Zeners

5/1.00 or 100/15.00

Any 1 Voltage Listed Below

3.3V	5.6V	10V	18V	33V
3.6V	6.2V	11V	20V	36V
3.9V	6.8V	12V	22V	39V
4.3V	7.5V	13V	24V	43V
4.7V	8.2V	15V	27V	47V
5.1V	9.1V	16V	30V	51V

TERMS:
10% Discount over $50 - Parts Only
$1 Minimum per line item
Add $1 for postage & insurance

Top Quality Products at these low, low prices.

JADE Co

P.O. Box 4246 -Torrance, Ca. 90510
Telephone 213-320-1250

Give us your name & address. We will send our catalogue.

TERMS:
California Residents add 6% Sales Tax
BofA & M.C. accepted on orders over $20
C.O.D.'s accepted

Satisfaction Guaranteed or your Money Refunded.

Circle 109 on reader service card

Circle 110 on reader service card

Circle 111 on reader service card

Circle 112 on reader service card

Circle 113 on reader service card

VIDEO CAMERA KIT

A UNIQUE ALL SOLID STATE CAMERA KIT
FEATURING A . . . 100 x 100 BIT
SELF SCANNING CHARGED
COUPLED DEVICE

INCLUDES THE FOLLOWING UNIQUE FEATURES . . . FOUND IN FAR MORE EXPENSIVE CAMERAS IF AVAILABLE

- LOW VOLTAGE SUPPLY (OR BATTERIES) + 5 AND + 15 VOLTS
- SENSITIVE TO INFRA RED AS WELL AS VISIBLE LIGHT
- MAY BE USED FOR IR SURVEILLANCE WITH AN IR LIGHT SOURCE
- EXCELLENT FOR STANDARD SURVEILLANCE WORK BECAUSE OF ITS LIGHTWEIGHT AND SMALL SIZE
- ALL COMPONENTS MOUNTED ON TWO PARALLEL 3"x5" SINGLE SIDED BOARDS TOTAL WEIGHT UNDER 2 LBS
- MAY BE WIRED BY PERSON WITH SOME TECHNICAL EXPERIENCE IN 4-6 HRS

SUPER UNBELIEVABLE

ONLY **$225.00**

MAY BE USED WITH AMATEUR RADIO FOR VIDEO

USED FOR CHARACTER RECOGNITION FOR COMPUTERS WITH EXTERNAL CIRCUITS

MAY BE USED IN A VACUUM, UNDER WATER, HIGH ALTITUDE, AND IN MAGNETIC ENVIRONMENT BECAUSE THERE IS NO HIGH VOLTAGE OR MAGNETIC DEFLECTION

WE SUPPLY ALL SEMICONDUCTORS, BOARDS, DATA SHEETS, DIAGRAMS, RESISTORS AND CAPACITORS

SORRY, WE DO NOT SUPPLY THE CASE, BATTERIES (OR SUPPLY) THE LENS (NOT SUPPLIED) DEPENDS UPON THE USE

ADD $2.00 POSTAGE AND HANDLING, PLUS $6.00 FOR ALL IC SOCKETS (Optional)

F8 MICROPROCESSOR KIT

WE'VE GOT THE F8 MICROPROCESSOR KIT, ONE OF THE MOST ADVANCED MCU SYSTEMS ON THE MARKET TODAY FOR ONLY **$159.00**

This three chip microprocessor system has the following advantages:
1) Driven by a +5 and +12 volt power supply.
2) Two I/O ports on the CPU chip, and ROM, making 32 bidirectional lines.
3) 64 bytes of fast RAM scratchpad built into the CPU chip.
4) A built in clock generator and power-on reset built into the CPU chip
5) A programmable internal timer built into the ROM chip.
6) 60% of the instructions are 1 byte.
7) TTL I/O compatibility.
8) Consumes less than 300mw of power per chip.
9) A local interrupt with automatic adress vector.
10) Expandable to 64K bytes (2102-1's) of memory.
11) 20 mil loop and RS — 232 included

The F8 Kit has enough parts and instructions to demonstrate microprocessor programs up to 1K byte, and to debug those programs.

We supply:
1 - 3850 CPU
1 - 3851 A FAIR-BUG programmed storage unit, provides the programmer with all its I/O subroutine, and allows the programmer to display or alter memory, and register contents via a teletype terminal.
1 - 3853 Static memory interface
8 - 2102
Plus CMOS gates and buffers, PC card, instruction manuals, programming guide, and time sharing guide.

4K MEMORY KIT $159.00

Memory Board: Our unique memory card features:
1) 8 bit bidirectional port, outputs buffered.
2) On board decoding for any four of 64 pages.
3) Address buffered.
4) 4K bytes of 2102-1 static RAM's.
5) No on board regulation to cause heat problems.

The memory card, like our other computer cards, has a 44 pin gold plated edge (.156 spacing). This feature makes the system completely stackable to save space, service problems, and hard wiring. It will also allow plug-in capability for our other cards when they become available.

EXPANDER BOARD

This board will expand the memory capability to 16 kilobytes with full buffering. Individual power terminals for each memory card are available. This system can be expanded to the full 64 kilobytes of memory by plugging other expander cards into this one with the 44 pin connector options.

To the best of our knowledge, ours is the only kit on the market designed for easy expansion to full memory capability.

EXPANDER KIT WITH ONE EDGE CONNECTOR $59.00 Extra 44 Pin Connectors

INTEL 8080 CPU . . . $29.50
8008 8 BIT MICRO PROCESSING CHIP (with Data Book) . . . $19.00
2102-1 1024 BT RAM . . . $ 2.60
5202A UV PROM . . . $12.50
MM5203 UV PROM . . . $12.50
1702A UV PROM . . . $12.50
5204-4K PROM . . . $24.95
MINIATURE MULTI-TURN TRIM POTS 100, 500, 5K, 10K, 25K, 50K, 100K, 200K $.75 each . . . 3/$2.00
MULTI-TURN TRIM POTS Similar to Bourns 3010 style 3/16"x5/8"x1-1/4"; 50, 100, 1K, 10K, 50K ohms $1.50 ea. . . . 3/$4.00
LIGHT ACTIVATED SCR's TO-18, 200V 1A . . . $ 1.75

PRINTED CIRCUIT BOARD

4-1/2"x6 1/2" SINGLE SIDED EPOXY BOARD 1/16" thick, unetched $.50 ea. . . . 5/$2.20
VECTOR BOARD 1" SPACING 4.5"x6.5" SHEET . . . $1.50

4 WATT IR LASER DIODE $7.95

2N 5460 P FET . . . $ 45
2N 5457 N FET . . . $ 45
2N 4891 UJT . . . $ .45
TIS 43 UJT . . . $ .35
ER 900 TRIGGER DIODES . . . 4/$1.00
2N 6028 PROG. UJT . . . $ .65

VERIPAX PC BOARD

This board is a 1/16" single sided paper epoxy board, 4½"x6½" DRILLED and ETCHED which will hold up to 21 single 14 pin IC's or 8, 16, or LSI DIP IC's with busses for power supply connector. . . . $5.25

MV 5691 YELLOW-GREEN BIPOLAR LED . . . $1.25
MT-2 PHOTO TRANS . . . $ .60
RED, YELLOW, GREEN OR AMBER LARGE LED's . . . ea. $ 20
14 PIN DIP SOCKETS . . . $ .35
16 PIN DIP SOCKETS . . . $ .35
MOLEX PINS . . . 100/$1.00 1000/$8.00
8 PIN MINI DIP SOCKETS . . . $ .30
10 PIN TO-5 TEFLON PC SOCKETS . $ .60
10 WATT ZENERS 3, 9, 4, 7, 18 OR 22V . . . ea. $ .60
1 WATT ZENERS 4, 7, 5, 6, 10, 12, 15, 18 OR 22V . . . ea. $ .25

Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A
100	.06	.14	.30	.80	
200	.07	.20	.35	1.15	4.25
400	.09	.25	.50	1.40	6.50
600	.11	.30	.70	1.80	8.50
800	.15	.35	.90	2.30	10.50
1000	.20	.45	1.10	2.75	12.50

REGULATED MODULAR POWER SUPPLIES

+ – 15 VDC AT 100ma 115VAC INPUT . . . $27.95
5VDC AT 1A. 115VAC INPUT . . . $24.95
12 VDC AT .54 . . . $24.95
IN 4148 (IN914) . . . 15/$1.00
2518-HEX 32 BIT SR. . . . $6.00
SILICON SOLAR CELLS 2¼" diameter .5V at 500 ma. . . . $5.00 ea., 6/$27.50
7 POLE 1 THROW TO-5 MINIATURE ROTARY SWITCH . . . $ .95

TRANSISTOR SPECIALS

2N3585 NPN Si TO-66 . . . $ .95
2N3772 NPN Si TO-3 . . . $ 1.80
2N4901 PNP Si TO-3 . . . $ .85
2N5086 PNP Si TO-92 . . . 4/$ 1.00
2N4898 PNP TO-66 . . . $ .60
2N404 PNP GE TO-5 . . . 5/$ 1.00
2N3919 NPN Si TO-3 RF . . . $ 1.50
MPSA 12 NPN Si TO-92 . . . 3/$ 1.00
2N3767 NPN Si TO-66 . . . $ .70
2N2222 NPN Si TO-18 . . . 5/$ 1.00
2N3055 NPN Si TO-3 . . . $ .80
2N3904 NPN Si TO-92 . . . 5/$ 1.00
2N3906 PNP Si TO-92 . . . 5/$ 1.00
2N5296 NPN Si TO-220 . . . $ .50
2N6109 PNP Si TO-220 . . . $ .55
2N3866 NPN Si TO-5 . . . $ .75
2N3638 PNP Si TO-5 . . . 5/$ 1.00
2N6517 NPN TO-92 Si . . . 3/$ 1.00

TANTULUM CAPACITORS

.22UF 35V 5/$1.00	6.8UF 35V 3/$1.00
.47UF 35V 5/$1.00	33UF 25V $ .40
.68UF 35V 5/$1.00	30UF 6V 5/$1.00
1UF 35V 5/$1.00	150UF 20V $ .50
4.7UF 35V 4/$1.00	

CT7001 ALARM CLOCK CHIP . . . $5.75
FPA 711-7 LEVEL Diode Array Optical Tape Readers . . . $5.95

NATIONAL MOS DEVICES

MM1402–3.20	MM5057–4.00
MM1403–3.20	MM5058–4.95
MM1404–2.50	MM5060–4.95
MM5013–7.75	MM5061–4.30
MM5016–3.50	MM5555–6.25
MM5017–4.75	MM5556–6.25
MM5055–4.00	MM5210–1.95
MM5056–4.00	MM5260–2.95

TTL IC SERIES

74L00– .30	7483– .90
7400– .18	7485–1.05
7401– .18	7486– .45
7402– .18	7489–1.80
7403– .18	7490– .60
7404– .22	7491– .79
7405– .22	7492– .60
7406– .35	7493– .60
7407– .33	7494– .80
7408– .22	7495– .85
7409– .25	7496– .79
7410– .18	74107– .34
7411– .25	74121– .50
7412– .30	74123– .85
7413– .60	74125– .70
7414–1.45	74126– .90
7416– .33	74150–1.00
7417– .33	74151– .90
7420– .18	74153– .79
7425– .35	74154–1.40
7426– .35	74155–1.40
7427– .35	74157– .75
7430– .18	74161–1.20
7432– .24	74164–1.50
7437– .35	74165–1.50
7438– .35	74173–1.35
7440– .18	74175– .95
7441– 95	74177–1.00
7442– .70	74180–1.05
7445– .85	74181–2.30
7446–1.00	74191–1.50
7447– .87	74192–1.10
7448–1.00	74193–1.25
7472– .35	74194–1.25
7473– .40	74195– .74
7474– .40	74196–1.20
7475– .60	75324–1.75
7476– .40	75491– .80
7480– .48	75492– .80

ALCO MINIATURE TOGGLE SWITCHES
MTA 106 SPDT . . . $1.20
MTA 206 DPDT . . . $1.70

C/MOS (DIODE CLAMPED)

74C02– .30	4016– .60	4035–1.75
74C01– .30	4017–1.30	4042–1.00
4001– .30	4018–1.40	4046–2.75
4002– .30	4019– .60	4047–3.00
4006–1.60	4022–1.40	4049– .75
4007– .30	4023– .30	4050– .75
4009– .60	4024–1.25	4055–1.95
4010– .60	4025– .30	4066–1.10
4011– .30	4027– .75	4071– .30
4012– .30	4028–1.20	4077– .30
4013– .50	4029–1.45	4081– .30
4015–1.40	4030– .55	

LED READOUTS

FND 500-.5" C.C. . . . $1.75
HP 7740-.3" C.C. . . . $1.40
MAN-4-.25" C.C. . . . $1.20
MAN-7-.3" C.A. . . . $1.25
DL747-.6" C.A. . . . $1.95
NS 33-3 dig. array . . . $1.35

Full Wave Bridges

PRV	2A	6A	25A
200	.95	1.25	2.00
400	1.15	1.50	3.00
600	1.35	1.75	4.00

CD 110 LINEAR 256 XI BIT SELF SCANNING CHARGED COUPLED DEVISE . . . $125.00

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS . . . $ 6.90
Si 1020 G 20 WATTS . . . $13.95
Si 1050 G 50 WATTS . . . $24.95

LINEAR CIRCUITS

LM 309K 5V 1A REGULATOR . . . $1.00
723 – 40 + 40VV REGULATOR . . . $ .54
301/748-Hi Per. Op. Amp. . . . $ .35
320T 5, 12, 15, OR 24V NEGATIVE REG. . . . $1.35
741A or 741C OP AMP. . . . $ .35
709c OPER. AMP. . . . $ .32
307 OP AMP . . . $ .25
CA 3047 Hi Pef. Op. Amp. . . . $ .95
340T 5, 6, 8, 12, 15, 18, 24V POS REG. TO-220 . . . $1.20
101 OPER. AMP. HI PERFORM. . . . $ .75
LM 308 Oper. Amp., Low Power . . . $1.05
747 – DUAL 741 . . . $ .65
556 – DUAL TIMER . . . $ .95
537 – PRECISION OP. AMP. . . . $2.80
540-70W POWER DRIVE . . . $2.75
LM 3900 – QUAD OP. AMP . . . $ .49
LM 324 – QUAD 741 . . . $1.50
560 – PHASE LOCK LOOP . . . $2.50
561 – PHASE LOCK LOOP . . . $2.50
565 – PHASE LOCK LOOP . . . $1.50
566 FUNCTION GEN. . . . $2.50
567 – TONE DECODER . . . $2.00
LM 1310N FM STEREO DEMOD. . . . $2.75
8038 IC VOLTAGE CONT. OSC. . . . $3.90
LM 370 – AGC SQUELCH AMP. . . . $1.15
555 – 2μs – 2 HR. TIMER. . . . $ .53
553 QUAD TIMER . . . $2.50
FCD 810 OPTO-ISOLATOR . . . $ .80
1458 DUAL DP AMP. . . . $ .55
LM 380 – 2W AUDIO AMP. . . . $ .95
LM 377 – 2W Stereo Audio Amp. . . . $2.50
LM 381 – STEREO PREAMP. . . . $1.25
LM 382 – DUAL AUDIO PREAMP . $1.25
LM 311 – HI PER. COMPARATOR . $ .95
LM 319 – Dual Hi Speed Comp. . . . $1.25
LM 339 – QUAD COMPARATOR . $1.40

TRIACS / SCR'S

PRV	TRIACS 1A	TRIACS 10A	TRIACS 25A	SCR'S 1.5A	SCR'S 6A	SCR'S 35A
100	.40	.70	1.30	.40	.50	1.20
200	.70	1.10	1.75	.60	.70	1.60
400	1.10	1.60	2.60	1.00	1.20	2.20
600	1.70	2.30	3.60		1.50	3.00

Send 25¢ for our catalog featuring Transistors and Rectifiers
145 Hampshire St., Cambridge, Mass.

Terms: FOB Cambridge, Mass.
Send Check or Money Order.
Include Postage, Minimum Order $5.00, CPD'S $20.00

SOLID STATE SALES
P.O. BOX 74B
SOMERVILLE, MASS. 02143 TEL. (617) 547-4005

WE SHIP OVER 95% OF OUR ORDERS THE DAY WE RECEIVE THEM

Circle 115 on reader service card

Radio-Electronics®

is available in

MICROFILM

UNIVERSITY MICROFILMS
300 N. Zeeb Road
Ann Arbor, Michigan 48106

and

MICROFICHE

MICROCARD EDITIONS
A Division of Information Handling Services
P.O. Box 1154
Englewood, Colorado 80110

BELL & HOWELL CO.
Micro Photo Division
Old Mansfield Road
Wooster, Ohio 44691
Attn.: Mr. Spiers

Please write for complete information

DO COLLEGES HELP BUSINESS AS MUCH AS BUSINESS HELPS COLLEGES?

Yes, they do. But not in the same proportion.

Business contributes about 15% of the total voluntary support received by colleges.

But today, business gets half the college-trained people who are employed. Tomorrow, it will need even more.

As a result, businessmen should think seriously about increasing the level of corporate giving to education. Can you, as a businessman, think of a better investment?

For the latest national figures on corporate giving to higher education, write on your letterhead for "CFAE Survey of Corporation Support of Higher Education," and enclose $2.00 to help cover costs. Mail to: Council for Financial Aid to Education, 6 East 45th Street, New York, N.Y. 10017.

Give to the college of your choice. Now.

Advertising contributed for the public good.

FND 807 / FND 800

.8 in. High. The Best on the market. Ideal for large readout application. $4.95

DL727

One of our best readouts .5 in. high, 20mA per segment. Common anode. $3.75

DL707

Red, .30 in. high 15mA per segment. Common anode.... $1.25

DL33

If you like an array of displays, we have it. Common cathode. $1.45

FND503

New .5 in. display by Fairchild. Common Cathode. $1.60 5/$7.50

MAN 5 GREEN / MAN 7 RED / MAN 8 YELLOW

Why not make a clock in 3 diff. colors. .27 in. high Common anode. $1.25

HP7730

.33 in. high red very bright 25mA per seg. Common anode.

TI

Fully multiplexed common cathode. Goldplated. Ideal for mini 6 digit clock. $1.30

BURROUGHS 12 DIGIT

.25 in. high orange digit. 160v dc. Free socket. $2.50

LEDS

Mini red	.12
Jumbo red	.15
Jumbo green	.20
Jumbo yellow	.25

4 & 6 DIGIT PC BOARDS

PC Board for 4 digit display FND 800 or 807	$2.75
PC Board for 6 digit display FND 800 or 807	$3.50
PC Board for 4 digit display MAN series or DL707	$1.75
PC Board for 6 digit display MAN series or DL707	$2.25
PC Board for 4 digit display FND503	$2.00
PC Board for 6 digit display FND503	$3.00
PC Board for 4 digit display DL747	$2.50
PC Board for 6 digit display DL747	$3.00
PC Board for 4 digit display DL727	$2.25
PC Board for 6 digit display DL727	$3.00
PC Board for 4 digit display FND70	$1.75

All PC display boards are multiplexed for adding additional digits.

TRANSISTORS-DIODES

RCA200V 115W T05 NPN		1.25
GE D40C1 NPN Darl.		0.25
2N4443SCR 400v8A T0220		0.65
2N2222 NPN Gen. Ampl.		0.20
2N3904 NPN Driver		0.15
2N3906 PNP Compl. 2N3904		0.15
2N4400 NPN Low level noise		0.20
2N5401 PNP Nixie driver		0.25
1N4004	400PIV	15 for 1.00
1N4007	4000PIV	10 for 1.00
1N746	3.3 Zen.	4 for 1.00
1N4148	Switch	20 for 1.00

GE TRANSISTOR ASSORTMENT

T098 cased Darling., SCRs, NPN,PNP, etc.

50 for $0.95
100 for $1.75
300 for $5.00

TTL BOARDS

MEMOREX computer boards with TTL's Diodes and Transistors, etc.

5 Boards containing 150-250 IC's. $3.95

$$$ SAVE! 4-DIGIT ALARM CLOCK

KIT NO.1 $13.95 (with PC Board)

FEATURES:

Direct drive display outputs, *Current control regulation-on chip, *Low power brightness control-on chip, *RFI eliminating slowup circuitry, *Sleep radio feature, *24 hour snooze alarm, *Independent digit setting, *Non multiplexed output circuitry. 12VAC CT 1/2 amp transformer for Kit No. 1 $2.00

*KIT NO. 2

Complete kit with components, PC Board, Transformer, wood grain case, and filter for display window. Includes .25 in. readouts. $21.50

*KIT NO. 3

Complete kit with components, PC Board, Transformer, wood grain case, and filter for display window. Includes .5 inch readouts. $22.50

*Components for Kit No. 2 or Kit No. 3 sleep radio feature, add $.95

NEW Proto Board $19.95

CSC 100

(Complete Kit)

(Allow 2 weeks for delivery)

We now offer a full line of Continental Specialties Proto Boards, Clips, Monitors, etc.

LOOK!

From Altaj to you, a special offer.

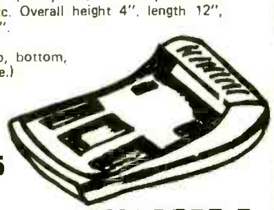
Power Supply Kit; 5 Volt 1 Amp. Reg.
Line regulation .005%
Load regulation 50mV

Kit includes Components: PC board, Transf., Fuse, Pilot Light
Nothing else to buy: $5.50

GOT A CASE? HERE'S THE CURE!

Ideal for Frequency counter case, function generator, etc. Overall height 4". length 12", width 7 1/2".

(Includes top, bottom, and hardware.)



$5.95

MASTER II

LIGHTS MUSIC 60 WATT COLOR ORGAN

Completely self contained unit with 120 volt power cord included.

$1.50

THE KING OF ALTAJ INTRODUCING: DELILA

APPLIANCE STARTER $9.95

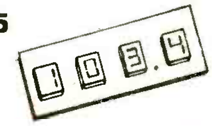
OPERATION:

(Example) Set your alarm for 7: a.m., set timer for 15 min. At exactly 7: a.m., the appliance will start; at 7:15, your clock alarm will wake you.

Kit includes all components, PC Board and instructions for interfacing with THE KING 6-digit alarm clock. Addition Number 2

FATIMA

4-DIGIT TEMP. KIT $19.95



Features 4-digit temperature display; farenheit or Centigrade; complete C-Mos application; uses 7002 4-digit counter.

Kit includes all components, PC Board and instructions for interfacing with THE KING 6-digit alarm clock. Addition Number 1

THE KING

6-DIGIT ALARM CLOCK

$23.50

THE KING FEATURES:

1) 6 digit, 12 hr. 60 cycle or 24 hr. 50 cycle alarm clock
2) Time sharing capability for display of additional information.
3) Single 12v. supply and a minimum of interface components
4) AM-PM and automatic power failure indications
5) 10 minute snooze
6) Intensity control of LEDs.

Kit No. 70250-1R (Red readout)
Kit No. 70250-1G (Green readout)
Kit No. 70250-1Y (Yellow readout)
Kit No. 70250-2R (DL727 readout)... $28.50
Kit No. 70250-3R (FND807 readout). $29.50

All kits include components, PC Boards, Transformer, case, and construction manual.

TTL

7400	.16	7483	.85
7402	.16	7490	.69
7404	.16	7492	.75
7406	.24	7493	.75
7408	.16	7495	.75
7410	.16	7496	.75
7413	.49	74121	.38
7420	.16	74123	.75
7427	.24	74151	.75
7430	.16	74153	.89
7437	.39	74154	.95
7438	.35	74161	.99
7440	.16	74163	1.19
7442	.69	74164	1.89
7447	.89	74165	1.49
7448	.89	74174	1.29
7453	.16	74175	1.39
7473	.37	74181	2.75
7474	.37	74192	1.25
7475	.65	74193	1.25
7476	.39	74195	.79
		74197	.79

CMOS

4000	.24	4026	1.49
4001	.24	4027	.59
4002	.24	4028	.99
4006	1.49	4029	1.39
4007	.24	4030	.49
4008	1.15	4032	.24
4009	.59	4033	1.49
4010	.55	4034	3.25
4011	.24	4035	1.39
4012	.24	4037	4.50
4013	.59	4040	1.59
4014	1.49	4041	.89
4015	1.19	4042	.79
4016	.59	4043	.80
4017	1.29	4044	.59
4018	1.49	4047	.59
4019	.59	4049	.59
4020	1.59	4050	.59
4021	1.49	4066	.99
4022	1.19	4077	.39
4023	.24	74C92	.29
4024	.99	74C04	.29
4025	.24	74C107	1.29

LSI INTEGRATION

MM5316	4-6 digit alarm clock 40 pin dip w/spec	$ 4.25
7002	4 digit counter/latch decoder; 7 segment and BCD outputs. 28 pin dip w/spec	$12.50
7005	4 digit counter/latch decoder; 7 segment output only. 24 pin dip w/spec	$ 9.50
7007	4 digit counter/latch decoder with BCD output only. 16 pin dip w/spec	$ 7.00
70250	4-6 digit alarm clock 28 pin dip w/spec	$ 5.50
PC Board for 70250		$ 4.25
70380	4 digit non-multiplexed radio alarm clock featuring direct drive display output 40 pin dip w/spec	$3.50
PC Board for 70380		$ 3.75
8008	8 bit parallel CPU	$19.50
2102	1K static RAM for 8008	$ 2.25
MM5203	2K UV eraseable PROM	$12.25
75491	segment driver	$ 0.35
75492	digit driver	$ 0.45
7020	6 function calculator chip with direct segment drive. 8 digit	$ 2.25

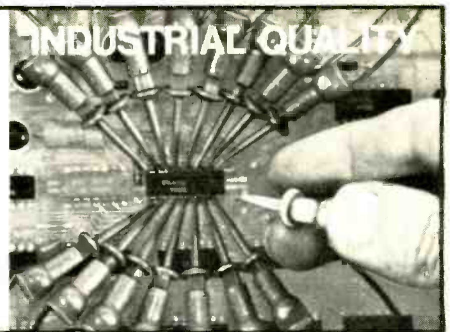
LINEARS

555 Timer Mini dip	0.45
8038 Functional generator	4.25
RCA 3043 FM IF, Aud. Preamp	1.20
565 Phase Lock Loop	1.95
567V Tone Decoder	1.50
LM723 Pos. Volt. Reg.	0.55
LM309 5v. Lamp Reg.	1.10
LM380 2w. Audio Amp. 8 pin dip	1.00
LM741 Operational Amp.	0.25

ALTAJ ELECTRONICS

P.O. BOX 38544R, Dallas, Texas 75238
TERMS: Check or money order. No COD.
Telephone (214) 278-3561
Texas Residents Add 5%

SOLVE YOUR TEST CONNECTION PROBLEMS WITH E-Z-HOOK®



E-Z Hooks have been designed and field tested throughout the industry to save time and money in commercial electronic production and servicing. The spring-loaded hook attaches firmly, yet so gently it will not damage component – frees hands while testing. Durably constructed and fully insulated to a single contact point assuring true readings. Meets exacting laboratory and space age computer technology requirements. **AVAILABLE IN 10 RETMA COLORS:** Red, black, blue, green, orange, yellow, white, violet, brown or gray. The most unique field-serviceable test connectors available. Fast, safe, sure and trouble-free. **NOW AVAILABLE FROM ANCRONA** . . . the source you can trust for fine quality, industrial-grade electronic components and accessories.

Jumper with X-100W Mini Hooks

Order No.	Length	Price
204-12W*	12"	$1.60
204-24W*	24"	1.60

Specify color.

Jumper with XM Micro Hooks

Order No.	Length	Price
204XM-12*	12"	$1.70
204XM-24*	24"	1.70

Specify color.

MICRO HOOK

XM Micro Hook (1.75" long, <1 gram) for difficult IC Testing. Permits hookups to delicate wires where weight and leverage may damage component. **$.80 ea.**

Specify color. **ORDER P/N XM**

MINI HOOK

X100W Mini Hook (2.25" long) combines rugged construction, miniature size and Finger-eze Hypo Action for all the best test connections. The hook is large enough for component leads, yet small enough to get into tight places. **$.75 ea.**

Specify color. **ORDER P/N X100W**

Jumper, XM Micro Hook to Banana Plug

Order No.	Length	Price
201XM*	32"	$1.40

Specify color.

EXTRA LONG MINI HOOK

XL-1 Mini Hook (5.0" long) combines all the proven features of the X100W with an extra long body. It will make safe, short-free test connections in card racks and through deep wiring nest up to 4". $1.25 ea. **ORDER P/N XL-1**

Jumper with XL-1 Mini Hooks

Order No.	Length	Price
204XL1-12	12"	$2.80
204XL1-24	24"	2.80

Specify color.

Jumper X-100W Mini Hook to Stacking Banana Plug**

Order No.	Length	Price
201W*	32"	$1.35

Specify color.

Jumper, XL-1 Mini Hook to Stacking Banana Plug**

Order No.	Length	Price
201XL-1*	32"	$1.95

Specify color.

*Specify color. **Square hole tip for hooking laterally to leads or vertically over square wire-wrap pins.

NEW FROM PLESSEY

LOW COST INTEGRATED CIRCUITS FOR RADIO COMMUNICATIONS

Plessey SL1600 Radio Communications Circuits are used in all types of military, commercial and amateur radio systems. These same devices are now available in economical, easy-to-use plastic minidip packages. Now you can afford to make extensive use of Plessey circuits in the design of synchrodyne, superhet, SSB and multimode receivers, transmitters and transceivers.

92 PAGE APPLICATIONS MANUAL

Contains Circuit Data, System Design and Technical Data for SL1600 series integrated circuits **$1.95**

A TYPICAL TRANSCEIVER SYSTEM

SSB transmitters and receivers of the same type contain many identical components. Therefore, by a little signal switching, it is possible to make one set of filters and SL1600 devices perform alternately as a transmitter and as a receiver – i.e. as a transceiver. This, of course, results in a real cost saving, both on SL1600 devices (which in any case are relatively inexpensive) and on filters (which are not!). These points are illustrated by the Figure above, a typical SSB transceiver, and also in Applications Manual Appendices B and D.

RF AMP
Low noise, low distortion, amplifiers with integral supply line decoupling and AGC. SL1610 has voltage gain of 10 and bandwidth of 140MHz: the SL1611 has voltage gain of 20 and bandwidth of 100MHz. Both have 50dB AGC range with max signal handling of 250 mV rms. Both offer high input impedance and low output impedance.
SL1610, SL1611 . . $2.03

DOUBLE BALANCE MODULATOR
Replaces diode ring modulator, in RF/communications systems up to 75MHz. At 30 MHz, carrier and signal leaks are typically –40 dB referred to the desired output product frequency. Intermodulation products are –45dB with a 60 mV rms input signal. SL1641 is similar for receiver mixer applications w/lower noise figure and power consumation. **SL1640, SL1641 . . . $2.03**

AF AMP, VOGAD SIDETONE
Accepts signals from a low-sensitivity microphone providing an essentially constant output signal for a 60 dB range of input. Constant gain amplifier provides an amplitude-limited output for sidetone in mobile transmitter/receiver applications. 10 lead TO-5 operates from a 6 to 12 volt supply, produces an independent supply line at 4.7 Volts stabilized. **SL1622 . $3.01**

IF AMP
Low noise, low distortion amplifier similar to SL1610 and SL1611 with voltage gain of 50, bandwidth of 15MHz and 20mW power consumption. 70dB AGC range with max signal handling of 250mV rms.
SL1612. . . . . $2.03

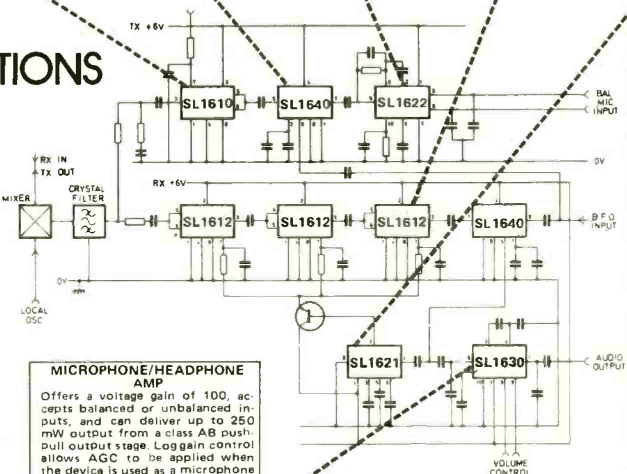
LIMITING AMP/DET
A low noise limiting amplifier for use as an RF clipper, a limiting stage in IF amplifiers, or an RF Compressor in SSB transmitters. Detector detects AM or AGC. Gain of 12 dB when not limiting, upper and lower 3 dB points of 150 MHz and 5 MHz. Limits when input exceeds 120 mV rms. Detected output during limiting is 1 mA.
SL1613. . . . . $2.45

AGC GEN
SL1620 VOGAD is an AGC generator for use with the SL1630 in microphone amplifier. Maintains amplifier output between 70mV and 87mV rms over 35 dB range. One second 'hold' period prevents increase of background noise during pauses in speech. **SL1621** is for use in SSB receivers with SL1621, SL1611 and SL1612. Generates a suitable AGC voltage from the detected audio waveform, provides a 'hold' period, is immune to noise interference. Smoothly follows fading HF signals.
SL1620, SL1621 . . . . . . $2.58

AM DET, AGC AMP SSB DEMOD
For use in SSB/AM receivers with SL1610, SL1611 and SL1612. Complementary to the SL1621. AGC voltage is generated directly from detected carrier signal independent of depth of modulation. Follows the most rapidly fading signals. SL1610 and SL1612 maintains the output within a 5 dB range for a 90 dB range of receiver input signal.
SL1623. . . . . $3.01

MULTIMODE DET
Detects AM, FM, SSB or CW, acting as a synchronous detector, a quadrature detector and a product detector with built-in oscillator. Contains a voltage-controlled gain system and a separate audio amplifier capable of driving a single transistor output stage. Does not give an output on broad band IF noise when used following a block filter and a broadband IF amplifier.
SL1624. . . . . $2.91

MICROPHONE/HEADPHONE AMP
Offers a voltage gain of 100, accepts balanced or unbalanced inputs, and can deliver up to 250 mW output from a class AB push-pull output stage. Loggain control allows AGC to be applied when the device is used as a microphone amplifier, and also allows remote volume control with a linear potentiometer. Gain reduction of 100 dB may be obtained.
SL1630. . . . . $3.85



Prices effective through June 30, 1976
Minimum order $10.00. Add $1.00 to cover postage and handling.
California residents add 6% sales tax.
SEND CHECK OR MONEY ORDER TO:

ANCRONA CORP.

Mail order: P.O. Box 2208R, Culver City, CA 90230. Phone order: (213) 641-4064
Visit our Electronic Shop: 11080 Jefferson Blvd., Culver City, CA
(Studio Village Shopping Center)
Prices may vary at over-the-counter locations.

IF IT ISN'T INDUSTRIAL QUALITY OR BETTER, WE WON'T SELL IT TO YOU.

PLEASE VISIT OUR ELECTRONIC STORES

ARIZONA	CALIFORNIA		CANADA
4518 East Broadway	11080 Jefferson Blvd.	1300 E. Edinger Ave.	5656 Fraser St.
Tucson, Arizona 85711	Culver City, CA 90230	Santa Ana, CA 92705	Vancouver, B.C. V5W 2Z4

Circle 98 on reader service card

ZENER DIODES 500 mW – 5%

	V	1-9	10up		V	1-9	10up
IN5223B	2.7	.45	.40	IN5246B	16	.45	.40
IN5224B	2.8	.45	.40	IN5247B	17	.45	.40
IN5225B	3.0	.45	.40	IN5248B	18	.45	.40
IN5226B	3.3	.45	.40	IN5249B	19	.45	.40
IN5227B	3.6	.45	.40	IN5250B	20	.45	.40
IN5228B	3.9	.45	.40	IN5251B	22	.45	.40
IN5229B	4.3	.45	.40	IN5252B	24	.45	.40
IN5230B	4.7	.45	.40	IN5253B	25	.45	.40
IN5231B	5.1	.45	.40	IN5254B	27	.45	.40
IN5232B	5.6	.45	.40	IN5255B	28	.45	.40
IN5233B	6.0	.45	.40	IN5256B	30	.45	.40
IN5234B	6.2	.45	.40	IN5257B	33	.45	.40
IN5235B	6.8	.45	.40	IN5258B	36	.45	.40
IN5236B	7.5	.45	.40	IN5259B	39	.45	.40
IN5237B	8.2	.45	.40	IN5260B	43	.45	.40
IN5238B	8.7	.45	.40	IN5261B	47	.45	.40
IN5239B	9.1	.45	.40	IN5262B	51	.45	.40
IN5240B	10	.45	.40	IN5263B	56	.55	.50
IN5241B	11	.45	.40	IN5264B	60	.55	.50
IN5242B	12	.45	.40	IN5265B	62	.55	.50
IN5243B	13	.45	.40	IN5266B	68	.55	.50
IN5244B	14	.45	.40	IN5267B	75	.55	.50
IN5245B	15	.45	.40				

LINEAR IC's

H=TO-5 N=DIP M=MINI-DIP D=CER-DIP K=TO-3

LM105H	3.90	LM311H	1.20	LM710CH	.90
LM108H	4.90	LM311D	.90	LM710CN	.90
LM114H	3.00	LM311M	1.75	LM711CH	.90
LM300H	1.20	LM312N	1.75	LM711CN	.90
LM300N	1.20	LM318H	1.50	LM715CH	3.50
LM301AH	.50	LM318M	2.40	LM715CD	4.60
LM301AM	.80	LM324N	1.90	LM723CH	.60
LM301AN	1.10	LM331N	1.25	LM723CN	.65
LM301M	.95	LM336K	2.40	LM725CH	1.50
LM302N	1.30	LM339N	2.20	LM725CD	5.00
LM302H	1.40	LM320-5K	2.90	LM733CH	1.40
LM304H	1.20	LM320-5T	2.50	LM733CD	3.50
LM305H	.85	LM320-12K	2.90	LM733CN	1.30
LM305AH	1.05	LM320-12T	2.50	LM741CH	.40
LM305N	1.00	LM340-5K	2.60	LM741CD	1.25
LM306N	.95	LM340-6K	2.60	LM741CM	.39
LM307H	.60	LM340-8K	2.60	LM747CH	.75
LM307M	1.50	LM340-12K	2.60	LM747CN	.90
LM308H	.85	LM340-15K	2.60	LM748CM	.55
LM308AH	5.00	LM340-18K	2.60	LM777CH	2.15
LM308D	2.25	LM340-24K	2.60	LM777CM	2.10
LM308M	1.00	LM555CM	.70	LM3046CN	.95
LM309H	1.75	LM556CM	1.30	LM3054CN	1.50
LM309K	1.50	LM567CM	1.70	SG4501T	2.40
LM310H	1.50	LM709CH	.75	SG4501N	2.40
LM310M	1.80	LM709CN	.75	LM5000K	7.50

MICROPROCESSOR SPECIAL

8080A	$34.90
8080	27.50
AM2901	31.50

F8 MICROPROCESSOR KIT . . . $185.00

RAM'S	1-9	10up	SHIFT REGISTER	1-9	10up	75107	
P1101A	2.20	2.10	AM2841PC	8.25	6.55		
P1101A1	3.50	3.30	AM2847PC	5.00	4.50	75208N	2.70
P1103	2.90	2.70	AM2855PC	7.15	5.75	75234N	2.50
P2101	5.00	4.80	AM2856PC	7.15	5.75	75450N	1.25
P2101-1	5.10	4.85	AM2857PC	7.15	5.75	75451N	1.00
p2101-2	5.20	4.90	AM2896PC	5.00	4.50	75452N	1.00
P2102	2.48	2.30	AM3341PC	8.25	6.50	75453N	1.00
P2102-1	2.80	2.65	AM3347PC	6.40	5.10	7520 SERIES	
P2102-2	2.70	2.60	AM4025D	73.00	58.40	SENSE AMPS	
P2102A	2.90	2.70	AMD-MSI			7520N	4.00
P2102A-2	3.00	2.80	AM2501DC	9.00		7521N	2.00
P2102A-4	2.95	2.75	AM2502PC	9.50		7522N	4.25
P2111	5.70	5.50	AM2503PC	9.50		7523N	1.75
P2111-1	5.80	5.60	AM2504PC	16.05		7524N	2.00
P2111-2	5.90	5.70	AM2505PC	15.00		7525N	4.50
P2112	5.90	4.70	AM2506PC	8.80		TWO-PHASE MOS CLOCK DRIVER	
P2112-2	6.00	4.80	AM25L02PC	10.70			
P2401	9.90	9.80	AM25L03PC	10.70		MH0026CN	5.50
P2405	8.80	8.00	AM25L04PC	16.05		MM	
2602B	2.48	2.30	AM25L05PC	15.00			
2602-1B	2.80	2.65	AM25L06PC	8.80		MM404H	12.00
2602-2B	2.70	2.60				MM405H	23.00
IM7552CPE	2.48	2.30	AM25S05PC	19.00		MM406H	6.50
IM7552-1CPE	2.80	2.65	AM25S07PC	3.78		MM407H	6.50
IM7552-2CPE	2.70	2.60	AM25S08PC	3.51		MM451H	11.40
TMS4035NL	2.48	2.30	AM25S09PC	5.40		MM454F	18.00
TMS4034NL	2.70	2.60	AM25S10PC	4.50		MM500H	2.00
P8101	5.00	4.80	AM25S18PC	5.40		MM506H	3.20
P8101-2	5.20	4.90	AM25LS07PC	2.79		MM507H	3.20
P8102	2.48	2.30	AM25LS08PC	2.76		MM550H	5.90
P8102-2	2.70	2.60	AM25LS09PC	3.49		MM551H	5.60
P8111	5.70	5.50	AM25LS14PC	31.00		MM555H	5.60
P8111-2	5.90	5.70	AM25LS15PC	2.14		MOS-LSI	
AM9101APC	3.50	3.30	AM25LS138PC	2.12		1402AN	3.80
AM9101BPC	3.90	3.80	AM25LS139PC	2.12		1403AH	4.00
AM9101CPC	5.50	5.30	AM25LS151PC	2.14		1403AN	3.80
AM9101DPC	7.80	7.00	AM25LS153PC	2.14		1404AH	4.50
AM9102PC	2.70	2.60	AM25LS157PC	1.54		1404AN	2.30
AM9102APC	3.00	2.80	AM25LS158PC	1.54		1405A	4.00
AM9102BPC	4.90	4.50	AM25LS160PC	2.94		1406	8.40
AM9102CPC	6.20	6.00	AM25LS161PC	2.94		1407	8.40
AM9102DPC	7.80	7.00	AM25LS162PC	2.94		1506	3.00
LOW POWER RAM'S			AM25LS163PC	2.94		1507	3.00
AM91L02PC	2.75	2.70	AM25LS174PC	3.10		1602	33.00
AM91L02APC	3.90	3.70	AM25LS175PC	2.76		TMS3114J	9.40
AM91L02BPC	5.00	4.40	AM25LS181PC	8.00		TMS3120JC	7.00
AM91L02CPC	7.00	6.00	AM25LS190PC	3.87		TMS3120NC	6.00
PROMS			AM25LS191PC	3.87		TMS3133NC	7.50
	1-9	10up	AM25LS194APC	2.62		3341ADC	8.00
1702A	15.95	14.50	AM25LS195APC	1.77		3341APC	7.00
SHIFT REGISTER			AM25LS251PC	2.66		3347DC	5.80
	1-9	10up	AM25LS253PC	2.66		3347PC	4.60
P2401	23.00	19.00	AM25LS257PC	2.00		4102	4.95
P2405	10.85	9.90	COMPUTER INTERFACE			7552	4.95
P2505K	3.70	3.30				7552-1	5.40
2512K	4.30	4.05	DM8820N	2.40		7552-2	5.50
2521V	2.50	2.20	DM8820AN	6.90		MM4055D	12.00
2524V	2.40	2.20	DM8830N	2.40		MM4056H	9.70
2525V	3.60	3.50	DM8831N	5.20		MM4057D	13.00
2533V	10.50	8.50	DM8832N	6.00		MM5025N	20.00
AM2802PC	4.40	3.50	N8T26B	4.40		MM5026N	20.00
AM2803PC	4.40	3.50	9600PC	1.30		MM5027N	20.00
AM2804PC	4.40	3.50	9601PC	1.20		MM5055N	5.50
AM2805HC	3.70	3.30	9602PC	1.95		MM5056N	5.50
AM2806HC	7.00	5.60	9614PC	2.30		MM5057N	5.50
AM2807PC	2.40	2.20	9615PC	2.40		MM5058N	5.50
AM2808PC	3.60	3.50	9616PC	5.00		BIPOLAR MEMORY	
AM2809PC	2.50	2.20	9617PC	3.50			
AM2810DC	10.00	8.00	9620PC	4.00			
AM2812ADC	24.00	19.20	9621PC	4.00		C3101	6.50
AM2812DC	21.00	16.80	75107			P3101	4.90
AM2813ADC	24.00	19.20	75107BN	2.60		C3101A	7.30
AM2813DC	21.00	16.80	75108BN	2.30		P3101A	5.80
AM2814DC	12.45	9.15	75109N	2.20		IM5501CDE	7.30
AM2825PC	18.75	15.00	75110N	2.20		IM5501CPE	5.80
AM2826DC	22.50	18.00	75115N	2.25		MM5560D	7.30
AM2827PC	18.75	15.00	75138N	2.95		MM5560N	5.80
AM2833PC	10.85	8.70	75150N	3.10		DM8599N	5.80
AM2841APC	10.50	8.40	75154N	4.10		93403PC	5.80

7400N TTL

	1-9	10up		1-9	10up		1-9	10up
7400N	.14	.13	7470N	.40	.30	74152N	1.04	.94
7401N	.18	.16	7472N	.40	.30	74153N	.85	.75
7402N	.18	.16	7473N	.42	.38	74154N	1.08	.94
7403N	.18	.16	7474N	.44	.40	74155N	1.02	.92
7404N	.21	.19	7475N	.55	.50	74156N	1.02	.92
7405N	.20	.19	7476N	.44	.40	74157N	.90	.80
7406N	.36	.28	7480N	.80	.72	74158N	1.50	1.30
7407N	.36	.28	7481N	1.30	1.25	74160N	1.02	.92
7408N	.24	.21	7482N	.98	.96	74161N	1.10	1.00
7409N	.28	.21	7483N	.82	.76	74162N	1.40	1.30
7410N	.22	.19	7484N	1.80	1.70	74163N	1.00	.90
7411N	.26	.20	7485N	1.20	1.08	74164N	1.16	1.05
7412N	.34	.32	7486N	.44	.40	74165N	1.20	1.10
7413N	.45	.42	7489N	2.20	2.10	74166N	1.20	1.10
7414N	.98	.95	7490N	.56	.51	74167N	5.00	4.50
7416N	.35	.32	7491N	.84	.76	74170N	2.00	1.80
7417N	.35	.32	7492N	.56	.50	74173N	1.66	1.50
7418N	.30	.27	7493N	.62	.56	74174N	1.00	.90
7420N	.15	.14	7494N	.88	.80	74175N	.96	.90
7421N	.30	.26	7495N	.80	.72	74176N	1.08	1.00
7422N	.50	.45	7496N	.75	.68	74177N	1.08	1.00
7423N	.37	.36	7497N	5.00	4.50	74178N	1.42	1.30
7425N	.30	.23	74100N	1.10	1.00	74179N	1.80	1.70
7426N	.28	.26	74104N	1.00	.90	74180N	1.12	1.02
7427N	.28	.25	74105N	1.00	.90	74181N	3.00	2.70
7428N	.40	.33	74107N	.40	.36	74182N	1.00	.90
7430N	.26	.20	74109N	.40	.36	74184N	2.80	2.50
7432N	.32	.30	74110N	1.00	.90	74185N	3.00	2.70
7433N	.44	.40	74111N	1.00	.90	74188N	5.00	4.80
7437N	.29	.20	74116N	2.00	1.80	74190N	1.20	1.10
7438N	.29	.27	74118N	2.20	2.00	74191N	1.20	1.10
7439N	.44	.40	74119N	4.00	3.60	74192N	.98	.90
7440N	.17	.16	74121N	.60	.54	74193N	.92	.88
7441N	.85	.83	74122N	.48	.43	74194N	1.36	1.23
7442N	.40	.39	74123N	.68	.62	74195N	.75	.70
7443N	.72	.65	74125N	.50	.45	74196N	1.40	1.30
7444N	.72	.65	74126N	.50	.45	74197N	1.40	1.30
7445N	.90	.81	74128N	.50	.45	74198N	1.40	1.30
7446N	.90	.81	74132N	.92	.85	74199N	1.40	1.30
7447N	.98	.90	74136N	.80	.72	74200N	9.00	8.00
7448N	.98	.90	74141N	1.70	1.50	74221N	1.36	1.25
7450N	.14	.13	74145N	1.10	1.00	74247N	2.40	2.20
7451N	.14	.13	74147N	1.90	1.70	74251N	1.90	1.80
7453N	.14	.13	74148N	1.50	1.35	74278N	2.90	2.50
7454N	.14	.13	74150N	1.52	1.40	74279N	.66	.60
7459N	.20	.18	74151N	1.02	.92	74298N	2.00	1.80
7460N	.14	.13						

HIGH SPEED TTL

74H00N	.33	74H20N	.33	74H52N	.36	74H73N	.80
74H01N	.25	74H21N	.33	74H53N	.36	74H74N	.80
74H04N	.33	74H22N	.33	74H54N	.36	74H76N	.75
74H05N	.33	74H30N	.33	74H55N	.36	74H102N	.75
74H08N	.40	74H40N	.36	74H60N	.36	74H103N	.90
74H10N	.33	74H50N	.36	74H71N	.75	74H106N	.95
74H11N	.33	74H51N	.36	74H72N	.75		

LOW POWER TTL

74L00N	.24	74L10N	.24	74L51N	.34	74L90N	1.62
74L02N	.24	74L20N	.33	74L73N	.43	74L93N	1.51
74L03N	.39	74L42N	1.33	74L74N	.90	74L95N	1.62
74L04N	.33						

74LS00

	1-9	10up		1-9	10up		1-9	10up
74LS00N	.36	.35	74LS55N	.39	.38	74LS161N	3.00	2.70
74LS01N	.44	.40	74LS73N	.58	.55	74LS162N	3.06	2.80
74LS02N	.36	.35	74LS74N	.56	.54	74LS163N	3.00	2.70
74LS03N	.45	.43	74LS76N	.65	.64	74LS170N	5.80	5.30
74LS04N	.44	.40	74LS78N	.92	.90	74LS174N	2.20	2.00
74LS05N	.45	.44	74LS95N	2.08	2.00	74LS175N	2.40	2.20
74LS08N	.38	.37	74LS107N	.59	.58	74LS181N	3.69	3.68
74LS09N	.44	.40	74LS109N	.92	.86	74LS190N	2.85	2.70
74LS10N	.36	.35	74LS112N	.58	.55	74LS191N	2.85	2.70
74LS11N	.46	.42	74LS113N	.92	.85	74LS193N	2.50	2.40
74LS15N	.58	.54	74LS114N	.92	.85	74LS194N	2.25	2.20
74LS20N	.44	.20	74LS123N	1.60	1.50	74LS195AJ	2.40	2.20
74LS21N	.58	.54	74LS138N	1.89	1.80	74LS196AJ	2.76	2.50
74LS22N	.58	.54	74LS139N	2.00	1.80	74LS197AJ	2.20	2.10
74LS27N	.44	.40	74LS151N	1.68	1.50	74LS251AJ	2.08	1.90
74LS30N	.39	.38	74LS153N	1.80	1.79	74LS253AJ	2.42	2.20
74LS32N	.45	.44	74LS157N	1.55	1.54	74LS257AJ	1.89	1.80
74LS38N	.58	.53	74LS158N	1.68	1.60	74LS258AJ	2.06	1.90
74LS51N	.39	.38	74LS160N	3.00	2.70	74LS260AJ	.44	.40
74LS54N	.58	.54						

SCHOTTKY TTL

74S00	.44	74S32	.80	74S113	1.50	74S174	3.30
74S01	.76	74S40	.65	74S114	1.20	74S175	2.90
74S02	.60	74S50	.76	74S133	.80	74S181	6.00
74S03	.75	74S51	.80	74S138	2.20	74S189	4.40
74S04	.55	74S60	.80	74S139	2.20	74S194	3.30
74S05	.76	74S64	.80	74S140	.80	74S195	3.30
74S08	.80	74S65	.80	74S151	2.20	74S251	2.20
74S09	.76	74S74	.90	74S153	3.40	74S253	2.40
74S10	.55	74S76	1.15	74S157	2.40	74S257	2.40
74S11	.65	74S78	1.16	74S158	2.00	74S258	2.40
74S15	.76	74S85	6.10	74S160	3.90	74S260	1.20
74S20	.65	74S86	2.50	74S161	4.70	74S280	5.70
74S21	.76	74S112	1.00	74S172	6.00	74S289	4.00
74S30	.80						

9300 SERIES

9300PC	$1.00	9318PC	2.30	9366PC	1.75	93L18	3.50
9301PC	1.20	9321PC	1.20	93L00	1.50	93L21	1.50
9304PC	1.50	9322PC	1.30	93L01	1.60	93L22	1.80
9306PC	6.90	9324PC	2.00	93L08	3.20	93L24	2.80
9308PC	2.50	9328PC	2.50	93L09	1.80	93L28	3.70
9309PC	1.60	9334PC	2.95	93L10	2.80	93L34	4.00
9310PC	1.50	9338PC	3.30	93L11	4.20	93L38	4.20
9311PC	2.30	9340PC	5.00	93L12	1.80	93L40	6.50
9312PC	1.20	9341PC	4.10	93L14	1.70	93L41	6.50
9314PC	1.30	9342PC	1.15	93L16	3.20	93L60	3.00
9316PC	1.50	9360PC	1.75	93L18	3.50	93L66	2.70

CMOS

	1-9	10up		1-9	10up		1-9	10up
4000AE	.15	.14	4021BE	1.35	1.25	4056AE	1.99	1.98
4000AF	.28	.24	4022AE	1.05	1.00	4056BE	2.04	2.03
4000BE	.19	.18	4022BE	1.10	1.05	4060AE	1.70	1.68
4001AE	.24	.20	4023AE	.24	.22	4063AE	2.50	2.49
4001BE	.27	.24	4023BE	.30	.28	4066AE	.90	.89
4002AE	.24	.15	4024AE	.80	.70	4068AE	.44	.43
4002AF	.34	.25	4024AF	.95	.85	4068BE	.53	.48
4002BE	.30	.18	4024BE	.85	.75	4069AE	.44	.43
4004AE	4.00	3.80	4025AE	.24	.20	4069BE	.53	.48
4006AE	1.30	1.20	4025AF	.40	.35	4070BE	.60	.59
4006AF	1.50	1.30	4025BE	.30	.28	4071AE	.45	.44
4006BE	1.35	1.25	4026AE	1.50	1.49	4072AE	.34	.33
4007AE	.24	.23	4027AE	.55	.50	4073AE	.40	.39
4007AF	.40	.35	4027BE	.60	.55	4075AE	.40	.39
4007BE	.27	.28	4028AE	.95	.90	4076AE	1.24	1.22
4008AE	1.15	1.14	4028BE	1.00	.95	4077AE	.40	.39
4008AF	1.30	1.25	4029AE	1.20	1.10	4078BE	.44	.43
4009AE	.50	.45	4029BE	1.25	1.15	4078AE	.40	.39
4009BE	.55	.50	4030AE	.48	.40	4081BE	.40	.39
4010AE	.50	.45	4030AF	.65	.60	4082AE	.39	.38
4010BE	.55	.50	4030BE	.55	.50	4082BE	.43	.42
4011AE	.24	.23	4033AE	2.00	1.90	4093AE	1.65	1.64
4012AE	.24	.22	4035AE	1.20	1.10	4095BE	1.95	1.94
4012AF	.34	.32	4035BE	1.25	1.15	4098AE	1.30	1.29
4012BE	.29	.27	4040AE	1.20	1.10	4099AE	2.90	2.89
4013AE	.30	.28	4040AF	1.50	1.40	4502AE	1.50	1.49
4013AF	.45	.43	4040BE	1.30	1.20	4507BE	.60	.55
4014AE	1.05	1.00	4041AE	1.25	1.00	4508BE	2.20	2.19
4014AF	1.30	1.15	4042AE	1.00	.85	4510AE	1.40	1.39
4014BE	1.10	1.05	4043AE	.95	.90	4510BE	1.45	1.44
4015AE	1.15	1.10	4044AE	.95	.90	4511BE	2.00	1.99
4015BE	1.20	1.15	4046AE	3.10	3.05	4512BE	1.30	1.29
4016AE	.55	.49	4047AE	2.00	1.90	4514AE	5.00	4.99
4016BE	.60	.54	4048AE	1.43	1.40	4515AE	5.00	4.99
4017AE	1.05	1.00	4049AE	.58	.53	4516AE	1.75	1.74
4017BE	1.10	1.05	4049BE	.63	.58	4518AE	1.28	.98
4018AE	1.24	1.23	4050AE	.58	.53	4520AE	1.28	.98
4018BE	1.30	1.28	4051AE	1.49	1.48	4528AE	2.20	2.19
4019AE	.54	.49	4052AE	1.40	1.39	4528BE	2.25	2.24
4019AF	.70	.68	4052BE	1.45	1.44	4585AE	2.05	1.95
4019BE	.60	.55	4053AE	1.40	1.39	4901AE	.32	.31
4020AE	1.45	1.35	4053BE	1.45	1.44	4911AE	.32	.31
4021AE	1.30	1.20	4055AE	1.95	1.94			

INDUSTRIAL QUALITY COMPONENTS

What is more important?
QUALITY or PRICE?
We have decided to offer only the highest quality components. When quality counts, you can count on Ancrona

FIRST QUALITY ONLY

IC SOCKETS WIRE-WRAP GOLD DIP

FIN	1-24	25	100
14	.45	.41	.37
16	.64	.49	.44

SOLDER – GOLD DIP

14	.34	.31	.28
16	.37	.34	.31

TEFLON TO-5

3 PIN	.55 EA
4 PIN	.65 EA
6 PIN	.90 EA
8 PIN	1.10 EA
10 PIN	1.40 EA

PLASTIC TO-5
8 PIN .40 EA

SOLDER-TIN DIP

	1-24	25	100
8	.21	.19	.17
14	.25	.22	.20
16	.28	.25	.23
18	.34	.31	.28
22	.37	.36	.35
24	.47	.43	.40
28	.88	.80	.70
36	1.09	.98	.89
40	1.24	1.12	.90

INTERSIL 8038 PRECISION WAVEFORM GENERATOR & VCO

For simultaneous sine, square and triangular waveforms <.001 Hz to 1MHz.

Part No.	1-9	10 up
8038CCPD	$3.90	$3.70

1-AMP RECTIFIERS

	10	100	1000
1N4001	1.00	7.00	60.00
1N4002	1.10	8.00	70.00
1N4003	1.20	9.00	80.00
1N4004	1.30	10.00	90.00
1N4005	1.40	11.00	100.00
1N4006	1.50	12.00	110.00
1N4007	1.60	13.00	120.00

HYBRID POWER AMPLIFIERS

SI-1010G	10W	$6.40
SI-1020G	20W	9.90
SI-1030G	30W	18.70
SI-1050E	50W	24.90
SI-1050G	50W	24.90

HIGH VOLTAGE TRANSISTORS

BU204	3A	1300V	$4.14
BU205	3A	1500V	4.95
BU206	3A	1700V	5.94
BU207	6A	1300V	5.85
BU208	6A	1500V	6.93
BU209	6A	1700V	8.64

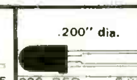
LEDs

.125" dia.


209	RED	$.25
209	YELLOW	.35
209	GREEN	.35

.160" dia.


216	RED	$.25
216	YELLOW	.30
216	GREEN	.30

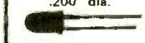
.200" dia.


220	RED	$.25
220	YELLOW	.30
220	GREEN	.30

LOW PROFILE

.200" dia.

226	RED	$.25
226	YELLOW	.30
226	GREEN	.30
226	ORANGE	.30

.200" dia.


5053	RED	$.35
5053	YELLOW	.40
5053	GREEN	.40
5053	ORANGE	.40


MV50 RED $.30
216 = MV5024
5053 = MV5053

PICO-PAC

THE SMALLEST AC/DC POWER SUPPLY EVER!
Only 1.70" x 1.00" x 0.85", output preset ± 5%, 9 models:

V	mAdc	V	mAdc
5	140		
8	115	18	50
10	100	20	35
12	90	22	25
15	70	24	15

$39.80 each

POWER SUPPLIES – ADTECH

Model No.	Output Vdc	Output Amps	1-4	5 up
APS5-3	5	3.0	$29.95	$28.60
APS12-1.6	12	1.6		
APS15-1.5	15	1.5		
APS24-1	24	1.0		
APS28-0.8	28	0.8		
APS5-6	5	6	$48.45	$46.05
APS12-4	12	4		
APS15-3	15	3		
APS24-2.2	24	2.2		
APS28-2	28	2		
APS5-10	5	10	$72.25	$68.65
APS12-7	12	7		
APS15-6	15	6		
APS24-5	24	5		
APS28-4	28	4		

DISPLAYS

0.6" IN.			LARGE 1"		
EP62R	RED	3.00	EP1000	RED	5.50
EP62G	GREEN	3.60	3 pcs EP1000		15.00
EP62Y	YELLOW	3.60	5 pcs EP1000		22.50

Data sheet for EP62 $.25 — Data sheet for EP1000 $.25

XCITON

XAN72	RED	2.00
XAN52	GREEN	2.00
XAN82	YELLOW	2.00

LITRONIX

DL80	RED	6.00	DL44	RED	6.00
DL81	RED	6.00	DL402	RED	4.00
DL10	RED	6.00	DL701	RED	3.40
DL10A	RED	4.00	DL704	RED	2.25
DL101	RED	4.90	DL707	RED	2.35
DL57	RED	9.90	DL747	RED	2.50
DL61	RED	12.00	DL33	RED	4.00

OPTOISOLATORS

LITRONIX						MONSANTO	
IL1	$1.30	IL16	$1.80	ILD74	$1.00	MCT2	.60
IL12	1.40	IL74	1.35	ILQ74	3.40		

WAVEFORM GENERATOR KIT

EXAR XR205K $25.00

Here's a highly versatile lab instrument at a fraction of the cost of conventional unit. Kit includes 2 XR205 IC's, data & applications, PC board (etched and drilled, ready for assembly) and detailed instructions.

Prices effective through June 30, 1976
Minimum order $10.00. Add $1.00 to cover postage and handling. California residents add 6% sales tax.

PLEASE VISIT OUR ELECTRONIC STORES

ARIZONA
4518 East Broadway
Tucson, Arizona 85711

CALIFORNIA
11080 Jefferson Blvd., Culver City, CA 90230
1300 E. Edinger Ave., Santa Ana, CA 92705

CANADA
5656 Fraser Street
Vancouver, B.C. V5W 2Z4

SEND CHECK OR MONEY ORDER TO:

ANCRONA CORP.

Mail order: P.O. Box 2208R, Culver City, CA 90230. Phone order: (213) 641-4064
Prices may vary at over-the-counter locations.

SGS-ATES RHYTHM GENERATORS

Designed specifically for electronic organs and other musical instrument designs. Detailed applications book, only . . . . $1.95.

M252BIAA 16 PIN DIP $15.00
15 programmable rhythms which cannot be superimposed

M253BIAA 24 PIN DIP $19.50
12 programmable rhythms which can be superimposed

16-page data sheet for both devices only $.90

Circle 99 on reader service card

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

MARKET CENTER

MOVING?

Don't miss a single copy of **Radio-Electronics.** Give us:

Six weeks' notice

Your old address and zip code

Your new address and zip code

ATTACH LABEL HERE

name (please print)

address

city state zip code

Mail to: Radio-Electronics SUBSCRIPTION DEPT., BOULDER, COLO. 80302

FAIRCHILD
F-8 MICROPROCESSOR EVALUATION KIT

Fairchild's Microprocessor Evaluation Kit is designed for use by engineers, scientists and technicians in order to provide a straightforward method for constructing, using and evaluating prototype F8 microprocessor systems in real applications or training situations. It provides all of the semiconductor components, technical specifications, and instructions necessary to interconnect devices, demonstrate microprocessor programs up to 1K bytes in length, and to debug those programs.

The F8 Microprocessor Evaluation Kit contains the following semiconductor parts and documentation:

- 16 Semiconductor Devices, including
  - 1 – 3850 Central Processing Unit
  - 1 – 3851A FAIR-BUG Programmed Storage Unit
  - 1 – 3853 Static Memory Interface
  - 8 – 2102-2 1K Static RAM Devices
  - 1 – 34001, 2 – 340097, 1 – 34023 } CMOS Gates and Buffers
  - 1 – 9N06 TTL Hex Inverter
- 1 PC Card to Facilitate Device Hook-up
- F8 Microprocessor Brochure
- F8 Design Evaluation Kit Instruction Manual
- A Guide to Programming the Fairchild F8 Microprocessor
- F8 Microprocessor Data Book
- F8 Timesharing Systems Operator's Guide

Unit Price: $185.00

GUARANTEED ORIGINAL FAIRCHILD PRODUCTS

CMOS/LSI FROM STANDARD MICROSYSTEMS

COM2502	UART – Ceramic	$13.20
COM2502P	UART – Plastic	8.00
COM2502H	UART – Cer High Speed	14.20
COM2502HP	UART – Plastic High Speed	9.00
COM2017	UART – Ceramic	13.20
COM2017P	UART – Plastic	8.00
COM2017H	UART – Cer High Speed	14.20
COM2017HP	UART – Plastic High Speed	9.00
COM2601	USRT	30.00
COM5016	Dual Baud Rate Gen	12.00
COM5016T	Dual Baud Rate Gen	11.70
KR2376-XX	Keyboard Encoder ROM	20.00
NMX5010	10-Channel Multiplexer	12.00
CAL1022	12-Digit Printing Calculator	60.00

FAIRCHILD 3814DC 4½-DIGIT VOLTMETER

GENERAL DESCRIPTION – The 3814 provides the logic required to implement a 4½-Decade Digital Voltmeter. In addition to four full decade counters and two overflow latches, the device is designed to drive a multiplexed display providing a Binary Coded Decimal output (to drive a BCD converter) and five decoded outputs to strobe the display.

Automatic leading zero blanking is simply accomplished, and a separate input is provided to blank the entire display. Other outputs provide counter overflow information and auto-ranging control signals. The 3814 is manufactured using silicon gate P-channel enhancement mode technology.

Price: $16.50

10-Page Data Sheet with Typical Application Information: $1.00

MM5316 DIGITAL ALARM CLOCK CIRCUIT

MM5316 utilizes line frequency (50 or 60 Hz) as its timing base, and provides a variety of timing functions suitable for a digital alarm clock, digital clock radio, and other applications. Four display modes are provided (hours and minutes, minutes and seconds, alarm, and sleep) . . . . . . 12 or 24 hour display format • 24 hour alarm setting • 9 minute snooze alarm • Presettable 59 minute sleep timer • AM/PM outputs (12 hr. format) • Flashing colon for seconds indication • All counters resettable • Power failure indication • Direct interface to fluorescent tubes or liquid crystal displays. Also operates with LEDs. • Alternate to AMI 1998. . . . . Price. . . . . 1-4, $4.95 . . . . . 5 up, $4.50

MATSUO DIPPED TANTALUM CAPACITORS

MFD	WVDC	1-9	10up	50up	MFD	WVDC	1-9	10up	50up
.1	35	$.30	$.25	$.20					
.15	35	.30	.25	.20	4.7	35	$.40	$.32	$.26
.22	35	.30	.25	.20	6.8	35	.40	.32	.26
.33	35	.30	.25	.20	10.0	16	.38	.30	.24
.47	35	.30	.25	.20	10.0	35	.40	.32	.26
.68	35	.30	.25	.20	15.0	35	.95	.64	.66
1.0	35	.30	.25	.20	22.0	16	.40	.32	.26
1.5	35	.35	.28	.23	33.0	20	.96	.64	.66
2.2	20	.30	.25	.20	47.0	20	1.40	1.05	.90
3.3	35	.38	.30	.24	68.0	16	1.40	1.05	.90

XR FUNCTION GENERATOR

XR-2206KA ... SPECIAL ... $16.95. Includes monolithic function generator IC, PC board, and assembly instruction manual.
XR-2206KB ... SPECIAL ... $26.95. Same as XR-2206KA and includes external components for PC board.

HIGH QUALITY CARBON FILM RESISTORS

From 10 ohm to 10 megohms. . . ¼ Watt 5% . . $1.69 per 100
Only in multiples of 100 per value • 150 different values in stock

OHM	OHM	OHM	OHM	OHM	OHM
10	100	1K	10K	100K	1M
11	110	1.1K	11K	110K	1.1M
12	120	1.2K	12K	120K	1.2M
13	130	1.3K	13K	130K	1.3M
15	150	1.5K	15K	150K	1.5M
16	160	1.6K	16K	160K	1.6M
18	180	1.8K	18K	180K	1.8M
20	200	2K	20K	200K	2M
22	220	2.2K	22K	220K	2.2M
24	240	2.4K	24K	240K	2.4M
27	270	2.7K	27K	270K	2.7M
30	300	3K	30K	300K	3M
33	330	3.3K	33K	330K	3.3M
36	360	3.6K	36K	360K	3.6M
39	390	3.9K	39K	390K	3.9M
43	430	4.3K	43K	430K	4.3M
47	470	4.7K	47K	470K	4.7M
51	510	5.1K	51K	510K	5.1M
56	560	5.6K	56K	560K	5.6M
62	620	6.2K	62K	620K	6.2M
68	680	6.8K	68K	680K	6.8M
82	820	8.2K	82K	820K	8.2M
91	910	9.1K	91K	910K	9.1M

PULSE GENERATOR

Interdesign 1101: 0.1Hz - 2MHz, 0.5V Output, var. width, line or battery operation $159.00

SPDT MINIATURE TOGGLE SWITCH

105D . . . . 115V . . . . 5A Rating . . . . $.95

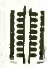
CONTINENTAL SPECIALTIES

PROTO BOARDS

Build & test circuits as fast as you think!

PB-6	6 IC cap breadboard kit	$15.95
PB100	10 IC cap breadboard kit	19.95
PB101	10 14-DIP cap, 5-way post, 940 solderless tie points, 5.8 x 4.5"	29.95
PB102	12 14-DIP cap., like PB101 with 1,240 tie points, 7.0 x 4.5"	39.95
PB103	24 14-DIP cap., 4 5-way posts, 2,250 tie points, 6.0 x 9.0"	59.95
PB104	32 14-DIP cap., 3060 solderless tie points, 8.0 x 9.76"	79.95

LOGIC MONITOR



Simultaneously displays static and dynamic logic states of DTL, TTL, HTL or CMOS DIP ICs. Pocket size.

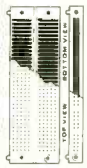
$84.95

PROTO-CLIP

For power on/hands-off signal tracing. Bring IC leads up from PC board surface for fast trouble-shooting.

PC14	14-pin	$4.50
PC16	16-pin	4.75
PC24	24-pin	8.50

SOCKETS & BUS STRIPS



Plug-in, wire, test, modify or expand without patch cords or solder. Snap together to form breadboard needed.

PN/Description	L.	Hole-to-Hole	Term'ls	Price
QT59S Socket	6.5"	6.2"	118	$12.50
QT59B Bus	6.5"	6.2"	20	2.50
QT47S Socket	5.3"	5.0"	94	10.00
QT47B Bus	5.3"	5.0"	16	2.25
QT35S Socket	4.1"	3.8"	70	8.50
QT35B Bus	4.1"	3.8"	12	2.00
QT18S Socket	2.4"	2.1"	36	4.75
QT12S Socket	1.8"	1.5"	24	3.75
QT8S Socket	1.4"	1.1"	16	3.25
QT7S Socket	1.3"	1.0"	14	3.00

PROTO BOARDS

With built-in regulated short-proof power supplies

PB203	5V, 1 amp regulated power supply	$75.00
PB203A	5V, 1 amp and ±15V, ½ amp regulated power supply	120.00

DESIGN MATES

DESIGN MATE 1. . . . . CIRCUIT DESIGNER
With built-in, regulated, metered power supply to design unusual circuits fast $49.95

DESIGN MATE 2. . FUNCTION GENERATOR
Complements Design Mate 1. Produces clean, accurate wave forms with variable amplitude and frequency controls. $64.95

DESIGN MATE 3. . . . . R/C BRIDGE
Saves design time by measuring and selecting capacitors and resistors to better than 5% . . . . instantly! $54.95

BREADBOARD JUMPER WIRE KIT

Each kit contains 350 wires cut to 14 different lengths from 0.1" to 5.0". Each wire is stripped and leads are bent 90° for easy insertion. Wire length is classified by color coding. All wire is solid tinned 22 gauge with PVC insulation. The wires come packed in a convenient plastic box. BK-1........$9.95

PREMIUM QUALITY TRANSISTORS

IF IT ISN'T INDUSTRIAL QUALITY OR BETTER, WE WON'T SELL IT TO YOU.

2N125	1.40	2N1534	1.00	2N2526	4.40
2N173	2.15	2N1540	1.05	2N2527	5.40
2N293	.60	2N1543	3.40	2N2538	2.40
2N321	.50	2N1544	1.40	2N2600	7.00
2N324	.55	2N1549	1.80	2N2605	.49
2N336	1.00	2N1551	3.90	2N2605A	.58
2N338A	.82	2N1552	3.90	2N2606	3.60
2N388A	.82	2N1554	1.90	2N2608	2.05
2N389	8.90	2N1557	1.70	2N2646	1.00
2N393	3.70	2N1613	.40	2N2647	1.50
2N398B	1.00	2N1671B	2.30	2N2648	3.90
2N404	.30	2N1693	13.90	2N2658	6.90
2N417	.85	2N1711	.40	2N2708	.30
2N456	1.30	2N1715	.70	2N2712	.30
2N491	4.90	2N1720	4.80	2N2713	.14
2N497	1.10	2N1893	.36	2N2714	.44
2N508A	.40	2N1907	4.80	2N2715	.10
2N511A	3.50	2N1924	1.25	2N2716	.20
2N512B	2.90	2N1934	9.30	2N2754	94.00
2N514	6.90	2N1990	.75	2N2802	9.70
2N662A	.50	2N2060	2.05	2N2833	3.90
2N677C	5.50	2N2080	4.90	2N2850-1	16.00
2N681	2.80	2N2081A	2.50	2N2857	3.00
2N683	2.90	2N2100	2.90	2N2880	10.90
2N697	.25	2N2102	.45	2N2890	3.50
2N697A	.50	2N2143	1.50	2N2893	9.70
2N699	.66	2N2147	1.40	2N2894	.50
2N700	3.50	2N2148	.68	2N2895	1.00
2N705	.60	2N2152	3.00	2N2903	4.10
2N706B	.40	2N2192	.60	2N2904	.36
2N711	.34	2N2192A	.66	2N2904A	.38
2N711B	.60	2N2193	.44	2N2905	.36
2N718	.28	2N2197	2.40	2N2905A	.38
2N718A	.31	2N2217	.80	2N2906	.20
2N720A	.50	2N2218	.25	2N2906A	.21
2N741	2.80	2N2218A	.28	2N2907	.16
2N744	.35	2N2219	.29	2N2907A	.26
2N829	2.80	2N2219A	.36	2N2911	21.00
2N834	.35	2N2221	.24	2N2913	.89
2N859	7.90	2N2221A	.25	2N2925	.20
2N894	2.90	2N2222	.24	2N2926	.14
2N918	.40	2N2222A	.26	2N2947	14.40
2N929	.26	2N2259	1.10	2N2949	5.90
2N930	.28	2N2270	.40	2N2950	6.40
2N960	.45	2N2289	3.60	2N2958	1.90
2N962	.45	2N2290	5.90	2N2969	30.90
2N967	.48	2N2297	.95	2N3019	.50
2N976	1.70	2N2323A	2.00	2N3022	17.90
2N984	.95	2N2326	3.30	2N3053	.34
2N1035	1.80	2N2356	5.90	2N3054	.80
2N1132	.30	2N2356A	6.90	2N3055	.94
2N1136	1.40	2N2359	15.90	2N3060	2.95
2N1137A	1.80	2N2368	.28	2N3066A	1.19
2N1143	1.90	2N2369	.28	2N3107	.78
2N1168	.65	2N2369A	.28	2N3117	1.50
2N1204	1.40	2N2382	4.40	2N3130	4.90
2N1302	.60	2N2440	3.45	2N3202	15.90
2N1303	.60	2N2465	7.40	2N3209	.89
2N1305	.50	2N2468	1.00	2N3227	2.30
2N1307	.65	2N2475	.54	2N3239	2.90
2N1377	1.40	2N2476	.79	2N3247	3.80
2N1404	.48	2N2483	.28	2N3250	.49
2N1408	.60	2N2484	.25	2N3307	8.50
2N1420	.50	2N2492	4.00	2N3308	6.50
2N1485	2.60	2N2509	.95	2N3309	7.10
2N1521	4.80	2N2511	1.98	2N3323	1.15
2N1523	6.00	2N2518	5.90	2N3324	.80

2N3325	.70							2N4032	1.90
2N3368	.80	2N3565	.18	2N3693	.21	2N3824	1.00	2N4037	.70
2N3375	5.50	2N3567	.26	2N3694	.22	2N3851	7.40	2N4045	1.90
2N3390	.40	2N3568	.28	2N3702	.30	2N3856	.28	2N4058	.25
2N3391	.41	2N3569	.19	2N3705	.32	2N3858	.26	2N4059	.24
2N3391A	.20	2N3570	5.50	2N3706	.21	2N3859	.28	2N4060	.25
2N3392	.20	2N3571	3.90	2N3707	.18	2N3860	.29	2N4061	.25
2N3393	.20	2N3572	2.60	2N3708	.22	2N3866	1.25	2N4062	.25
2N3394	.22	2N3584	1.80	2N3709	.22	2N3877	.42	2N4093	1.05
2N3395	.24	2N3614	1.10	2N3710	.20	2N3900	.38	2N4123	.20
2N3396	.26	2N3616	1.24	2N3711	.18	2N3901	.30	2N4124	.20
2N3397	.28	2N3617	2.40	2N3713	1.20	2N3903	.20	2N4125	.25
2N3398	.25	2N3634	7.90	2N3721	.22	2N3904	.22	2N4126	.25
2N3414	.20	2N3638	.18	2N3725	.50	2N3905	.20	2N4141	.26
2N3415	.20	2N3640	.19	2N3730	1.80	2N3906	.22	2N4142	.17
2N3416	.20	2N3642	.19	2N3731	2.00	2N3909	.80	2N4143	.16
2N3417	.38	2N3643	.16	2N3732	2.25	2N3924	3.50	2N4220A	1.00
2N3436	1.60	2N3645	.16	2N3740	1.10	2N3925	4.75	2N4225	3.75
2N3440	.98	2N3646	.10	2N3741	1.60	2N3933	1.30	2N4226	3.90
2N3441	1.70	2N3649	4.70	2N3771	2.20	2N3945	.90	2N4227	.34
2N3442	2.15	2N3650	6.10	2N3772	2.30	2N3954	4.40	2N4228	.49
2N3445	4.90	2N3651	9.20	2N3773	3.30	2N3954A	5.80	2N4235	1.90
2N3467	1.45	2N3656	8.50	2N3789	3.00	2N3955	2.70	2N4237	1.20
2N3468	1.85	2N3657	9.90	2N3793	.25	2N3955A	3.20	2N4238	1.30
2N3478	2.00	2N3662	.42	2N3796	3.00	2N3956	2.90	2N4248	.17
2N3501	6.40	2N3663	.44	2N3799	3.15	2N3957	1.45	2N4249	.20
2N3506	7.40	2N3684	1.20	2N3804	8.00	2N3958	1.45	2N4250	.22
2N3554	3.90	2N3685	1.35	2N3805	10.40	2N3964	1.09	2N4256	.28
2N3546	2.90	2N3685A	1.75	2N3819	.30	2N3970	1.20	2N4258	.34
2N3553	1.80	2N3686	1.50	2N3821	1.35	2N3971	1.00	2N4289	.40
2N3563	.16	2N3687	1.60	2N3822	1.40	2N3972	1.39	2N4291	.35
2N3564	.14	2N3692	.20	2N3823	.69	2N4012	10.40	2N5157	9.85

2N4293	.50	2N5172	.14	2N5592	1.00
2N4303	.30	2N5190	.95	2N5637	26.90
2N4341	1.35	2N5191	1.00	2N5644	7.10
2N4347	1.60	2N5198	4.25	2N5655	.95
2N4348	2.10	2N5210	.22	2N5657	1.20
2N4352	2.00	2N5219	.16	2N5679	1.39
2N4395	1.25	2N5220	.28	2N5742	35.00
2N4400	.29	2N5221	.30	2N5777	.50
2N4401	.33	2N5222	.16	2N5778	.54
2N4402	.35	2N5223	.16	2N5779	.80
2N4409	.30	2N5224	.22	2N5780	.85
2N4416	.89	2N5225	.30	2N5810	.34
2N4424	.35	2N5226	.26	2N5811	.38
2N4425	.40	2N5227	.16	2N5812	.36
2N4427	1.30	2N5232	.22	2N5813	.42
2N4441	1.30	2N5232A	.24	2N5815	.36
2N4443	1.40	2N5249	.30	2N5816	.38
2N4852	.85	2N5249A	.31	2N5817	.38
2N4858	1.10	2N5294	.75	2N5818	.40
2N4859	1.20	2N5295	.60	2N5819	.42
2N4863	5.45	2N5296	.95	2N5821	.60
2N4870	.60	2N5298	1.00	2N5822	.56
2N4878	3.85	2N5306	.26	2N5823	.66
2N4890	.95	2N5306A	.40	2N5824	.24
2N4898	1.10	2N5307	.40	2N5825	.26
2N4901	2.70	2N5308	.44	2N5826	.28
2N4902	3.00	2N5309	.36	2N5827	.30
2N4903	3.90	2N5310	.40	2N5828	.32
2N4904	2.90	2N5311	.44	2N5828A	.38
2N4905	4.10	2N5322	.70	2N6000	.50
2N4906	4.30	2N5323	.66	2N6001	.52
2N4918	1.30	2N5354	.35	2N6002	.54
2N4919	1.35	2N5355	.35	2N6004	.54
2N4921	1.30	2N5365	.40	2N6010	.62
2N4922	1.00	2N5366	.40	2N6011	.64
2N4923	1.05	2N5367	.42	2N6014	.66
2N4983	.80	2N5368	.24	2N6015	.68
2N4984	1.10	2N5369	.25	2N6027	.50
2N4985	1.90	2N5370	.26	2N6028	.64
2N4986	.95	2N5371	.22	2N6076	.16
2N4987	.65	2N5373	.26	2N6099	1.00
2N4988	.95	2N5375	.25	2N6101	.95
2N4989	1.40	2N5380	.50	2N6103	.98
2N4990	.75	2N5381	.56	2N6107	1.90
2N4991	.75	2N5382	.50	2N6109	2.30
2N4992	1.10	2N5383	.56	2N6111	2.60
2N4993	1.60	2N5397	2.90	2N6114	4.50
2N4994	.25	2N5407	28.90	2N6115	2.10
2N4995	.26	2N5409	31.90	2N6218	.60
2N5016	12.70	2N5418	.30	2N6219	.59
2N5036	1.17	2N5419	.34	2N6220	.58
2N5064	.90	2N5420	.40	2N6221	.52
2N5088	.45	2N5447	.26	2N6222	.28
2N5089	.80	2N5448	.27	2N6223	.30
2N5105	3.05	2N5449	.26	2N6224	.32
2N5109	2.40	2N5450	.24	2N6225	.34
2N5127	.16	2N5451	.24	3N81	3.60
2N5130	.20	2N5453	5.35	3N82	5.00
2N5131	.20	2N5457	.65	3N83	1.70
2N5133	.17	2N5458	.50	3N84	1.68
2N5134	.18	2N5490	1.40	3N85	3.30
2N5135	.16	2N5491	.80	3N86	6.10
2N5137	.26	2N5492	1.45	3N153	1.05
2N5138	.24	2N5494	1.70	3N189	4.10
2N5154	7.05	2N5496	1.90	40290	1.70
2N5155	3.20	2N5562	12.40	40319	1.00
2N5161	2.60	2N5563	8.90	40346	.70

Prices effective through June 30, 1976
Minimum order $10.00. Add $1.00 to cover postage and handling
California residents add 6% sales tax.

PLEASE VISIT OUR ELECTRONIC STORES

ARIZONA	CALIFORNIA		CANADA
4518 E. Broadway	11080 Jefferson Blvd.	1300 E. Edinger Ave.	5656 Fraser Street
Tucson, AZ 85711	Culver City, CA 90230	Santa Ana, CA 92705	Vancouver, BC V5W 2Z4

SEND CHECK OR MONEY ORDER TO:

ANCRONA CORP.

Mail order: P.O. Box 2208R, Culver City, CA 90230. Phone order: (213) 641-4064

Prices may vary at over-the-counter locations.

Circle 118 on reader service card

Circle 85 on reader service card

For free information on products advertised or mentioned in the editorial pages of this issue...

Use one of these Reader Service Cards

RADIO-ELECTRONICS READER SERVICE 676

The numbers I have circled below indicate the material I would like to receive:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

Reader Service available to U.S.A. and Canadian readers only

NAME ______________________________

ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP ________

Cards without Zip Codes will not be processed

Void after August 31, 1976

RADIO-ELECTRONICS READER SERVICE 676

The numbers I have circled below indicate the material I would like to receive:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120

Reader Service available to U.S.A. and Canadian readers only

NAME ______________________________

ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP ________

Cards without Zip Codes will not be processed

Void after August 31, 1976

HERE'S HOW:

1. **Circle the number** on the attached postcard that corresponds to the number at the bottom of each advertisement or editorial item of interest.
2. **Detach the postcard.** Fill in your name and address and mail.
3. **Be sure to print or type** your name and address. Be sure to include zip code.

IMPORTANT: The Clinton, Iowa Reader Service address is a data processing center which handles *only* Reader Service literature request cards. All other mail sent there may be delayed in reaching the proper department. *For subscription problems* (missing copies, change of address, etc.) write Radio-Electronics Subscription Service, Boulder, Colorado 80302. *Address all other correspondence to* Radio-Electronics, 200 Park Avenue South, New York, New York 10003.

FIRST CLASS
PERMIT 597
BOULDER, COLO

BUSINESS REPLY MAIL
no postage stamp necessary if mailed in the United States

POSTAGE WILL BE PAID BY

Radio-Electronics

SUBSCRIPTION SERVICE
BOULDER, COLORADO 80302

For new ideas in electronics read Radio-Electronics

PLACE STAMP HERE

Radio-Electronics

READER SERVICE

P.O. Box 2707

Clinton, Iowa 52732

PLACE STAMP HERE

Radio-Electronics

READER SERVICE

P.O. Box 2707

Clinton, Iowa 52732

Subscribe today to the magazine which keeps you up-to-date with the newest ideas and innovations in electronics. (If you already are a subscriber, do a friend a favor and pass this subscription card along to him.)

check offer preferred

☐ 1 Year — 12 issues **ONLY $8.75**

☐ 2 Years — 24 Issues **SAVE MORE $16.50 (You save $1.50 over newsstand)**

☐ 3 Years — 36 Issues **GREATER SAVINGS $24.50 (You save $2.50 over newsstand prices)**

☐ Payment enclosed ☐ Bill Me ☐ Check here if you are extending or renewing your subscription

☐ Check here if this is a new subscription

Name ______________________________

Address ______________________________

City__________ State__________ Zip__________ ← IMPORTANT

Canada same as U.S.A. Extra Postage: Pan American $1.50 per year, all other foreign $2.00 per year.

4066

During the next 12 months

Radio-Electronics will carry up-to-the minute articles on:

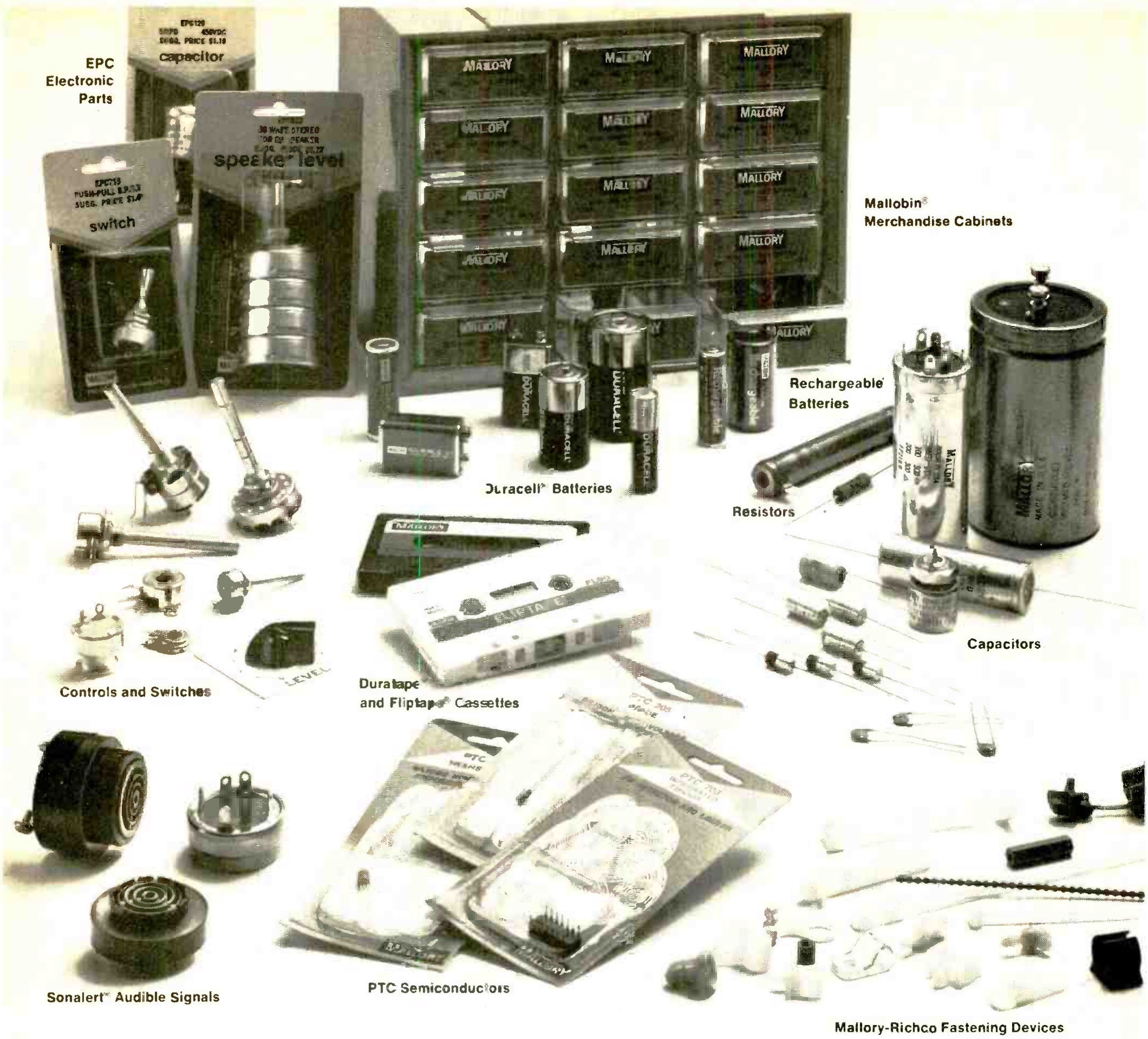
- solid-state technology
- color TV • stereo
- test equipment • radio
- computers • careers
- industrial electronics
- servicing TV-radio-stereo
- experimenter circuits
- exceptional construction projects

Don't take a chance on missing even one issue. Subscribe now and save!

NEW IDEAS AND INNOVATIONS IN ELECTRONICS

The newest ideas and innovations in electronics appear in Radio-Electronics. Keep up-to-date!

Subscribe Today!



With a line like this, no wonder your Mallory distributor is a yes man.

He almost never has to say no. Which adds up to a lot of single-source buying convenience for you.

Give your Mallory distributor a call. You'll like what you hear. You'll like what he delivers.

MALLORY

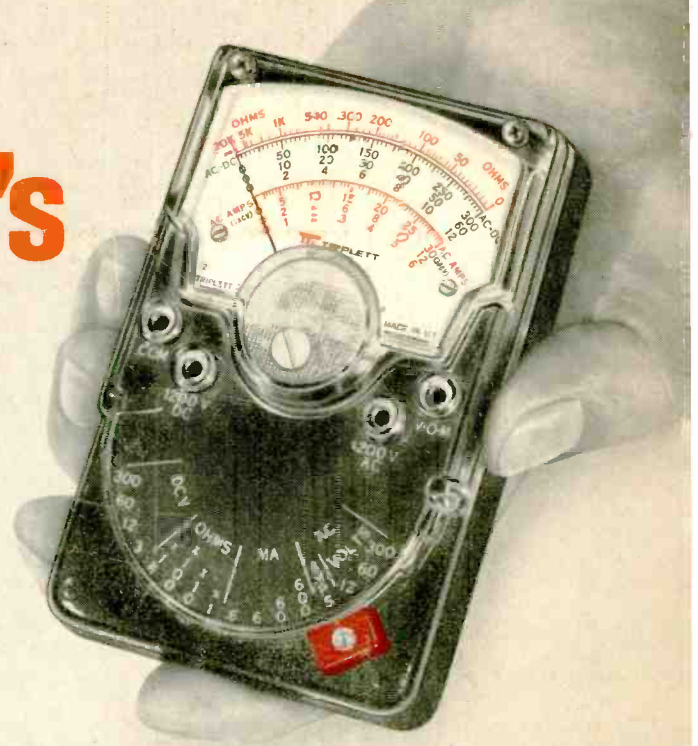
MALLORY DISTRIBUTOR PRODUCTS COMPANY

a division of P. R. MALLORY & CO. INC.
Box 1284, Indianapolis, Indiana 46206; Telephone: 317-856-3731

® Registered trademark of P. R. Mallory & Co. Inc

Circle 86 on reader service card

Triplett 310 mini-VOM's fit your hand and your wallet...



only $51

The high quality Triplett 310 is a little all-in-one VOM. This made in the U.S.A. VOM gets around a lot for half fare. It packs most of the features you'd expect to find only on a meter twice the size and price. It fits in your shirtpocket easily. The small size and its versatility is a boon to field servicemen as well as circuit designers, technicians, electrical maintenance engineers, and the price is right for vocational and hobbyist use.

A newly designed high impact, drop resistant case makes it practically indestructible . . . 20K ohms/volt DC and 5K ohms/volt AC ranges provide plenty of sensitivity for most applications . . . and, there's diode overload protection with a fused R X 1 ohm range. The single range selector switch is a real time saver for reading 0 - 1200 DC or AC volts, 0 - 20 megohms, and 0 - 600 micro-amps or 0 - 600 milliamps at 250 millivolts.

Comes complete with 42" leads, alligator clips, batteries and instruction manual. Accessories triple the versatility of a 310. Adding the Model 10 clamp-on ammeter allows you to measure AC currents easily with one hand.

Visit your local distributor or Mod Center and shake hands with a real bargain.

TRIPLETT
BLUFFTON, OHIO 45817

Triplett. The easy readers

Circle 87 on reader service card