COMPUTER DIGEST TEAR OUT SECTION \$1.75 MAY 1984

COMPUTERS - VIDEO - STEREO - TECHNOLOGY - SERVICE

Stop Wasting Fuel! Build R-E's exhaust analyzer. Use it to tune up your car. It's easy!
It's accurate! It works!

Vote for the 3D TV system you like best. See how they

work and back the one vou like best. DIGITAL EXHAUST CAS ANALYZER

Futurize Your Home with our home control computer. 256 separate control hannels handle everything!

O AM and it's a wrong number! Build our gadget and stop them cold.

It's a cinch to Design With Linear IC's. Now you can design and build those circuits you've always wanted.

Cut through the hype-Select a computer modem that doesn't do more than you need.







- **★ Hobby Corner ★ Equipment Reports**
- ★ Drawing Board ★ Service C inic
 - **★ New Idea** ★ State-Of-Solid-State

BALANCE

CO : CARBON MONOXIDES

DEGA

pypIndustries

A/F: AIR/FUEL RATIO

FUNCTION







Now there's a new breed of Beckman hand-held DMMs tough enough to withstand accidental drops. input overloads

and destructive environments. DMMs are drop-proof, packed

with overload protection and sealed against contamination. You won't find more rugged meters than the

Beckman HDs. Inside or out.

The new HD100 and HD110

Drop Proof

Constructed of double-thick thermoplastics, the HD100 series DMMs resist damage even after repeated falls. All components are heavy-duty and shock mounted.

Contamination Proof

The HD series meters are designed to keep working even around dirt, heavy grime, water and oil. The special o-ring seals, ultrasonically-welded display window and sealed input jacks protect the internal electronics of the HD meters. The oops-proof meters are sealed so tightly, they even float in water.

Accidental Overload Protection

All DC voltage inputs are protected up to 1500 Vdc or 1000 Vrms. Current ranges are protected to 2A/600V with resistance ranges protected to 600 Vdc. Transient protection extends up to 6KV for 10 microseconds.

More Meter for Your Money

For starters you can get 2000 hours of continuous use from a

CIRCLE 100 ON FREE INFORMATION CARD

common 9V transistor battery. You can run in-circuit diode tests and check continuity. You even get

a one year warranty.

The 0.25% basic dc volt accuracy HD meters serve you with 7 functions and 27 ranges. The HD 110 also gives you 10 AMPS ac and dc. With one simple turn of the single selector switch, you can go directly to the function and range you need. There's less chance of error.

Also available is the electrical service kit. It includes the meter of your choice, a current clamp, deluxe test leads and a heavy-duty case designed to carry both meter and accessories, conveniently.

Feature for feature you can't find a more dependable meter with prices starting at just \$169 (U.S. only).

To locate your nearest distributor, write Beckman Instruments, Inc., Instrumentation Products, 630 Puente Street, Brea, CA 92621; (714) 773-8453.

BECKMAN



If it's ECG, it fits. And it works.

PhilipsECG



Communications Electronics. the world's largest distributor of radio scanners, introduces new models with special savings on all radio scanners. Chances are the police, fire and weather emergencies you'll read about in tomorrow's paper are coming through on a scanner today.

We give you excellent service because CE distributes more scanners worldwide than anyone else. Our warehouse facilities are equipped to process thousands of scanner orders every week. We also export scanners to over 300 countries and military installations. Almost all items are in stock for quick shipment, so if you're a person who prefers fact to fantasy and who needs to know what's really happening around you, order your radio today from CE.

NEW! Regency? MX5000

List price \$599.95/CE price \$379.00 Multi-Band, 20 Channel

No-crystal scanner
Search

Lockout

Priority

AC/DC
Selectable AM-FM modes

LCD display World's first continuous coverage scanner Frequency range: 25-550 MHz. continuous coverage. Never before have so many features come in such a small package. The Regency MX5000 mobile or home scanner has continuous coverage from 25 to 550 MHz. That means you can hear CB, Television audio, FM broadcast sta-tions, all aircraft bands including military and the normal scanner bands, all on your choice of 20 programmable channels.

NEW! Regency® MX3000
List price \$299.95/CE price \$181.00
6-Band, 30 Channel • No-crystal scanner
Search • Lockout • Priority • AC/DC
Bands: 30-50, 144-174, 440-512 MHz.
The Regency Touch MX3000 provides the ease

of computer controlled, touch-entry program-ming in a compact-sized scanner for use at home or on the road. Enteryour favorite public service frequencies by simply touching the numbered pressure pads. You'll even hear a "beep" tone that lets you know you've made contact.

In addition to scanning the programmed channels, the MX3000 has the ability to search through as much as an entire band for an active frequency. The MX3000 includes channel 1 priority, dual scan speeds, scan or search delay and a brightness switch for day or night operation.

NEW! Regency® Z30 List price \$269.95/CE price \$179.00 6-Band, 30 Channel • No-crystal scanner Bands: 30-50, 144-174, 440-512 MHz. Cover your choice of over 15,000 frequencies on 30 channels at the touch of your finger.

NEW! JIL SX-200 CE price \$264.00/NEW LOW PRICE

CE price \$264.00/NEW LOW PRICE
8-Band, 16 Channel • No-crystal scanner
Quartz Clock • AM/FM • AC/DC
Bands: 26-88, 108-180, 380-514 MHz.
Tune Military, F.B.I., Space Satellites, Police &
Fire, D.E.A., Defense Department, Aeronautical
AM band, Aero Navigation Band, Fish & Game,
Immigration, Paramedics, Amateur Radio, Justice Department, State Department, Paramedics, Amateur Radio, Justice Department, Paramedics, tice Department, State Department, plus thousands of other restricted radio frequencies no other scanner is programmed to pick up.

Regency® HX1000

Allow 60-120 days for delivery after receipt of order due to the high demand for this product.

List price \$329.95/CE price \$209.00
6-Band, 20 Channel • No Crystal scanner
Search • Lockout • Priority • Scan delay

Sidelit liquid crystal display
Frequency range: 30-50, 144-174, 440-512 MHz.
The new handheld Regency HX1000 scanner is fully keyboard programmable for the ultimate in versatility. You can scan up to 20 channels at the same time. When you activate the priority control, you automatically override all other calls to listen to your favorite frequency. The LCD display is even sidelit for night use. A die-cast aluminum chasis makes this the most rugged and durable hand-held scanner available. There is even a backup lithium battery to maintain memory for two years. Includes wall charger, carrying case, belt clip, flexible antenna and nicad battery. Reserve your Regency HX1000 now.

Regency® R106
List price \$149.95/CE price \$92.00
5-Band, 10 Channel • Crystal scanner • AC/DC
Frequency range: 30-50, 146-174, 450-512 MHz. A versatile scanner, The Regency R-106 is built to provide maximum reception at home or on the road. Rugged cabinet protects the advanced design circuitry allowing you years of dependable listening.

NEW! Regency® D810
List price \$399.95/CE price \$244.00
8-Band, 50 Channel • Crystalless • AC only
Bands 30-50, 88-108, 118-136, 144-174, 440-512 MHz
This scanner offers Public service bands, plus
Aircraft and FM broadcast stations. You can listen to Bach or a Boeing 747, the Rolling Stones or the riot squad, or any of 50 channels Plus special direct access keys let you listen to police, fire, emergency, or any of your favorite channels just by pushing a button.

Regency® R1040
List price \$199.95/CE price \$124.00
6-Band, 10 Channel • Crystalless • AC only
Frequency range: 30-50, 144-174, 440-512 MHz. Now you can enjoy computerized scanner versatility at a price that's less than some crystal units. The *Regency* R1040 lets you in on all the action of police, fire, weather, and emergency calls. You'll even hear mobile telephones.

Programming the R1040 is easy. Merely touch

the keyboard and enter any of over 15,000 frequencies on your choice of 10 channels.

NEW! Regency® HX650 List price \$119.95/CE price \$79.00

5-Band, 6 Channel • Handheld crystal scanner Bands: 30-50, 146-174, 450-512 MHz. Now you can tune in any emergency around town, from wherever you are, the second it happens. Advanced circuitry gives you the world's smallest scanner. Our low CE price includes battery charger/A.C. adapter.

QUANTITY DISCOUNTS AVAILABLE

Order two scanners at the same time and deduct 1%, for three scanners deduct 2%, four scanners deduct 3%, five scanners deduct 4% and six or more scanners purchased at the same time earns you a 5% discount off our super low single unit price.

OTHER RADIOS & ACCESSORIES

Bearing C402 Carrier
Regency* C403 Scanner\$59.00
Regency® Z10 Scanner\$149.00
Panasonic RF-9 Shortwave receiver\$84.00
Panasonic RF-B50 Shortwave receiver \$129.00
Panasonic RF-799 Shortwave receiver \$219.00
Panasonic RF-2600 Shortwave receiver\$199.00
Panasonic RF-2900 Shortwave receiver\$249.00
Panasonic RF-3100 Shortwave receiver\$279.00
Panasonic RF-B300 Shortwave receiver\$195.00
Parasonic NF-B300 Shortwave receiver3195.00
Panasonic RF-B600 Shortwave receiver \$429.00
Panasonic RF-6300 Shortwave receiver\$539.00
Bearcat® † 350 Scanner\$399.00
Bearcat® 300 Scanner \$349.00
Bearcat® 260 Scanner\$259.00
Bearcat® 250 Scanner \$279.00
Bearcat® 200 Scanner \$189.00
Bearcat® 210XL Scanner\$229.00
Bearcat® 20/20 Scanner\$289.00
Bearcat® 151 Scanner
Pearcett 100 Conner
Bearcat* 100 Scanner \$289.00
Bearcat® Five-Six Scanner\$129.00 Bearcat® DX1000 Shortwave Receiver\$489.00
Bearcat DX1000 Shortwave Receiver\$489.00
Bearcat® Weather Alert\$49.00
Freedom Phone® 4000 Cordless telephone \$239.00
Fanon FCT-200 Cordless telephone. \$139.00 SP55Carrying case for Bearcat Five-Six\$15.00
SP55Carrying case for Bearcat Five-Six\$15.00
MA-506 Carring case for Regency HX650 \$15.00
FB-E Frequency Directory for Eastern U.S.A \$12.00
FB-W Frequency Directory for Western U.S.A\$12.00
TSG "Top Secret" Registry of U.S. Government Freq \$15.00
RRF Railroad Frequency Directory\$10.00
FCD Feeren Comises Directory
ASD Frequency Directory for Aircraft Band \$10.00
SRF Survival Radio Frequency Directory \$10.00
TIC Techniques for Intercepting Comm. Manual \$12.00
CIE Covert Intelligence, Elect. Eavesdropping Man\$12.00
B-4 1.2 V AAA Ni-Cad batteries (set of four) \$9.00
B-6 1.2 V AA Ni-Cad batteries (set of four) \$12.00
A-135c Crystal certificate\$3.00
A60 Magnet mount mobile antenna\$35.00
A70 Base station antenna\$35.00
Add\$3.00 shipping for all accessories ordered at the same time.
Add \$12.00 per shortwave receiver for U.P.S. shipping.
Add \$3.00 shipping per scanner antenna.

BUY WITH CONFIDENCE

To get the fastest delivery from CE of any scanner, send or phone your order directly to our Scanner Distribution Center." Be sure to calculate your price using the CE prices in this ad. Michigan residents please add 4% sales tax or supply your tax I.D. number. Written purchase orders are accepted from approved government agencies and most well rated firms at a 30% surcharge for net 30 billing. All sales are subject to availability, accept-ance and verification. All sales on accessories are final. Prices, terms and specifications are subject tinal. Prices, terms and specifications are subject to change without notice. All prices are in U.S. dollars. Out of stock items will be placed on back-order automatically unless CE is instructed differently. A \$5.00 additional handling fee will be charged for all prepaid orders under \$50.00 or purchase orders under \$200.00. Shipments are F.O.B. Ann Arbor, Michigan. No COD's. Most products that we sell have a manufacturer's warranty. Free copies of warranties on these products are available prior to purchase by writing to CE. International orders are invited with a \$20.00 surcharge for special handling in addition to shipping charges. All shipments are F.O.B. Ann Arbor, Michigan. No COD's please. Non-certified and foreign checks

mail orders to: Communications Electronics, Box 1002, Ann Arbor, Michigan 48106 U.S.A. Add \$7.00 per scanner for U.P.S. ground shipping and handling in the continental U.S.A. For Canada, Puerto Rico, Hawaii, Alaska, or APO/FPO delivery, shipping charges are three times continental U.S. rates. If you have a Visa or Master Card, you may call and place a credit of Master Card, you may can and place a credit card order. Order toll-free in the U.S. Dial 800-521-4414. In Canada, order toll-free by calling 800-265-4828. Telex CE anytime, dial 810-223-2422. If you are outside the U.S. or in Michigan dial 313-973-8888. Order today.

Scanner Distribution Center" and CE logos are trade-marks of Communications Electronics."

† Bearcat is a federally registered trademark of Electra Company, a Division of Masco Corporation of Indiana. ‡ Regency is a federally registered trademark of Regency Electronics Inc. AD #031584A

Copyright °1984 Communications Electronics

Order Toll Free ... call 1-800-521-4414



Consumer Products Division

818 Phoenix

Box 1002

Ann Arbor, Michigan 48106 U.S.A. Call TOLL-FREE 800-521-4414 or outside U.S.A. 313-973-8888









THE MAGAZINE FOR NEW **IDEAS IN ELECTRONICS**

Electronics publishers since 1908

MAY 1984 Vol. 55 No. 5

BUILD THIS

47 AUTOMOTIVE GAS ANALYZER

Does your state require an annual emissions test? Now you can be sure that your car will pass. Philip M. Van Praag

NO MORE WRONG NUMBERS

Part 3. We start this month with details on construction. Then we'll show you how to hook everything up to keep those unwanted calls away. Gary McClellan

HOME CONTROL COMPLITER

Part 2. We'll take our first look at the computer's second board, which contains the power-supply and remote-control circuitry. Then we'll look at the I/O system. Steven E. Sarns

TECHNOLOGY

4 VIDEO ELECTRONICS

Tomorrow's news and technology in this quickly changing industry. David Lachenbruch

SATELLITE/TELETEXT NEWS

The latest happenings in communications technology. Gary H. Arlen

CIRCUITS AND COMPONENTS

NEW IDEAS

A proximity power switch

DRAWING BOARD 40

Bipolar power supplies-a look at reader responses. Robert Grossblatt.

DESIGNER'S NOTEBOOK

How to expand the range of the 4017 counter. Robert Grossblatt

MAKING MEASUREMENTS ELECTRONICALLY

We'll introduce you to a variety of transducers and show you how you can use them effectively. Harry L. Trietley

DESIGNING WITH LINEAR IC'S

Part 2. We'll look at the inverting follower and how to solve some problems commonly encountered with op-amps. Joseph J. Carr

92 HOBBY CORNER

Finding the location of a transmitter. Earl "Doc" Savage, K4SDS

STATE OF SOLID STATE

A spatial, stereo, and pseudo-stero sound IC. Robert F. Scott

VIDEO

57 WHAT'S NEW IN 3-D TV

A look at three different methods of achieving three-dimensional effects. Carl Laron

SERVICE CLINIC 100

How to test TV IF's and tuners. Jack Darr

SERVICE QUESTIONS 103

Radio-Electronic's Service Editor solves technicians' problems.

RADIO

COMMUNICATIONS CORNER

Digital communications and RFI. Herb Friedman

COMPUTERS

TELECOMMUNICATIONS

An introduction to computer-communications hardware and software. Herb Friedman

COMPUTER CORNER

Getting started with computer-literacy machines. Lou Frenzel

EQUIPMENT REPORTS

- 22 Kaypro Inc. Kaypro 10 Hard-Disk Computer
- Heath EE-3201 Digital Techniques Course

DEPARTMENTS

- 8 Advertising and Sales Offices
- 138 Advertising Index
- 139 Free Information Card
- 14 Letters
- 111 Market Center

108 New Books

- 109 New Literature
 - 31 New Products
- 8 Publisher's Letter
- 6 What's News

ON THE COVER

Does your state require that your car pass an annual emissions tests? In those states that do, many "do-ityourselfers" are beginning to feel left out. After all, who else but the statelicensed inspection shop can make the emission test? If you build this month's featured project, you'll be able to keep tabs on your own emissions—even while you're driving! The story begins on page 47.



WILL THERE EVER BE A 3-D TV system that will give us more than eye strain? Carl Laron, our Associate Editor takes a look at three systems that look promising. Each has its own advantages—and drawbacks. But one thing is sure: You'll be hearing a lot more about those systems in the future. But read about them here first, starting on page 57.

COMING NEXT MONTH On Sale May 22

- Satellite TV. A special section that deals with antennas, downconverters, receivers, and more, including a look at DBS.
- Repairing PC Boards. It's easy-we'll show you
- Tuning Microwave Downconverters. It's easier than you think and you don't have to perch yourself on your roof!
- And lots more!

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Second-Class Postage Paid at New York, NY, and additional mailing offices. One-year subscription rate: U.S.A. and U.S. possessions, \$14.97. Canada, \$17.97. Other countries, \$22.47 (cash orders only, payable in U.S.A. currency). Single copies \$1.75. © 1984 by Gernsback Publications, Inc. All rights reserved. Printed in U.S.A.

POSTMASTER: Please send address changes to RADIO-ELECTRONICS, Subscription Dept., Box 2520, Boulder, CO 80322.

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

As a service to readers, Radio-Electronics publishes available plans or information relating to newsworthy products, techniques and scientific and technological developments. Because of possible variances in the quality and condition of materials and workmanship used by readers, Radio-Electronics disclaims any responsibility for the safe and proper functioning of reader-built projects based upon or from plans or information published in this magazine.

VIDEO ELECTRONICS

DAVID LACHENBRUCH CONTRIBUTING EDITOR





8mm CAMCORDER

Eastman Kodak's debut in video has upset the plans of the Japanese VCR establishment. Kodak jumped the gun on what seemed to be a tacit agreement to hold up introduction of the new 8mm-Video format until 1985, at the earliest, by demonstrating two one-piece camera-recorder combinations slated for sale in the U.S. in July. (See left-hand photo.) Kodak's machines weigh about 5½ pounds with battery and the little cassette, which is about the size of an audio cassette. The camera section contains a newly designed ½-inch Newvicon pickup tube, a ½-inch electronic viewfinder, and a 6:1 power zoom; the recorder section has two video heads, fast-forward, reverse, and visual scan. The deluxe model adds autofocus, fade-in and fade-out, three heads, still-frame, and the ability to superimpose the date on the recorded picture.

For playback, the entire camcorder is placed in a "cradle," which contains RF circuitry and a battery charger. An accessory to the cradle is a slip-in tuner-timer for recording off the air or from cable. The cassettes initially will be available in 30-, 60- and 90-minute lengths, in either metal powder or metal evaporated tape. Suggested list prices of the camcorders are \$1,599 and \$1,899; the obligatory cradle is \$199, and the tuner-timer \$300. However, the products actually are expected to sell for considerably less. The camcorders are made by Matsushita, the tape by TDK, both in Japan.

TINY CAMERAS

Just about the time that 8mm is being introduced, along comes a barrage of miniaturized, lightweight cameras designed to be used with portable VCR's. Sony has introduced a camera using a CCD pickup; it weighs two pounds five ounces and sells for \$1,350. (See right-hand photo.) RCA countered with a palm-sized MOS camera, weighing two ounces less, for \$995. But the lightest one introduced to date has a pickup tube instead of a solid-state sensor. It's made by Konika and weighs less than one pound ten ounces, has a new ½-inch "Cosvicon" tube, and sells for \$750. Its light weight is due partially to the fact that it lacks such features as electronic viewfinder and motorized zoom lens—it has a 3:1 manual zoom and a through-the-lens viewfinder. Upcoming are solid-state cameras from Sanyo and Fisher patterned after 35mm still-film cameras.

THE SWITCH TO VHS

As I forecasted in this space last month, Zenith has dropped its line of Beta VCR's and joined the VHS camp with a line of recorders made to its specifications by JVC. Included in the five-unit line is the miniaturized *Video Movie* camcorder, the hit of Berlin's Audio-Video Fair (Radio-Electronics, December 1983). *Video Movie* uses the 20-minute VHS-C cassette, which can be played back on any VHS deck by placing it in an adaptor. Zenith's home decks all feature remote control units that will operate any Zenith infrared remote-control TV set that was made since 1977. In addition to Zenith, NEC—long a Beta stalwart—has added VHS to its new line in the United States, but NEC is also retaining its line of Beta machines. Thus NEC, with nine different VCR models, including the *Betamovie* camcorder, has more VCR's than any other brand.

Tek's best-selling 60 MHz scopes: Now 25 ways better for not a penny more!

Now Tek has improved its 2213/2215 scopes with brighter displays. Greater accuracy. And more sensitive triggering. At no increase in price.

The 60 MHz 2213 and dual time base 2215 have been the most popular scopes in Tektronix

history. Now, Tek introduces an "A" Series update with more than 25 specification and feature enhancements—things you have asked for such as single sweep—all included at no added cost.

A brighter display and new vertical amplifier design provides sharp, crisp traces.

That makes the 2213A/ 2215A a prime candidate for tasks like TV troubleshooting and testing, where fast sweeps are typical.

New features include 10 MHz bandwidth limit switch, separate A/B dual intensity controls (2215A only), and poweron light: additions customers have suggested for



giving these scopes the final measure of convenience.

Triggering, sweep accuracy, CMRR and many more major specifications are better than ever.

Check the performance chart: not bad for scopes already considered the leaders in their class!

The price: still \$1200* for the 2213A, \$1450* for the 2213A, \$1450* for the 2215A. Or, step up to the 100 MHz 2235 for just \$1650*! You can order, obtain literature, or get expert technical advice, through Tek's National Marketing Center. Direct orders include operator manuals, two 10X probes,

15-day return policy, world-wide service backup and comprehensive 3-year warranty.

Talk to our technical experts.

Call toll-free:
1-800-426-2200

Ext. 156.
In Oregon call collect:

Specification enhancement	2213/2215 "A" Series	2213/2215	
CRT brightness	14 kv accel. potential	10 kv accel. potential	
Vertical accuracy	3%, 0° to 50°C	3%, +20° to 30°C	
Chop rate	500 kHz	250 kHz	
Input capacitance	20 pF	30 pF	
CMRR	10 to 1 at 25 MHz	10 to 1 at 10 MHz	
Channel isolation	100:1 at 25 MHz	Not specified	
A Trigger sensitivity (int)	0.3 div at 5 MHz	0.4 div at 2 MHz	
TV triggering	1.0 div compos. sync	2.0 div compos. sync	
Sweep accuracy (in 10X)	4%, 15° to 35°C	5%, 20° to 30°C	
Delay jitter	20,000 to 1 (2215A) 10,000 to 1 (2213A)	10,000 to 1 (2215) 5,000 to 1 (2213)	
Holdoff Range	10:1	4:1	

Tektronix 2215A



(503) 627-9000 Ext. 156.

5

RADIO-ELECTRONICS

WHAT'S NEWS

Philips and Sony agree on a CD read-only memory format

Philips and Sony have announced agreement on a basic format for a Compact-Disc Read-Only Memory system. Details will be formalized shortly.

The new format is based on the Compact-Disc Digital-Audio System sound-reproduction format. Since June, 1980, Philips and Sony have been studying the possibilities of using the CD as a readonly memory, to take advantage of its large capacity, compactness, and ease of operation.

The CD read-only memory has a storage capacity of 550 megabytes, which is 500 to 1,000 times that of conventional floppy disks. The 12-cm disc can contain the contents of up to 12,000 standard typewritten sheets.

The new CD read-only memory standard format comes as an addition to the existing CD standard for audio applications, which remains unchanged.

MCI plans new services to Belgium and Greece

MCI, an international voice- and data-communications services company, is preparing to test direct-dial voice services to Greece and Belgium in preparation for implementing service between the United States and those countries.

MCI officials have stated that, with the encouragement of the Federal Communications Commission—which has urged U.S. carriers to seek arrangements to provide international services—negotiations with Belgium and Greece have reached the stage where MCI has asked the FCC for permission to conduct the tests.

Games and education software to boom?

"If 1982 was 'the year the computer came home'," says Frost & Sullivan, international market researchers, "the year 1983 is programmed to be the beginning of a home-computer software boom." But games and education, rather than home-finance and word-processing programs, will dominate.

essing programs, will dominate. Software for machines costing less than \$1,000 should increase 70 percent per year between 1984 and 1986. Games will represent well over 50 percent of the software sold for home use. Educational software will advance from almost 3 million units in 1983 to more than 18 million in 1986, according to the report. That will increase its share of the market to 20 percent.

Home-management software has not been as popular, partly because low-end home computers lack the memory needed by many of the programs. With the coming of more powerful small computers, however, the segment is expected to increase its present 5 percent share over the next few years.

Navigation satellites outlive expectations

The U.S. Navy *Transit* satellites placed in orbit in the early '70's have greatly surpassed their expected lifetimes. RCA Astro Electronics made fifteen satellites for the Navy's Strategic Systems Project Office, three of which were immediately launched, while the others were held as spares. Two of the original three are still operating. Their long life and high reliability have kept the remaining twelve in ground storage.

Those drum-shaped satellites, traveling in polar orbits, beam signals to ground every two minutes. Using those signals, ships or aircraft with the required on-board equipment can ascertain their positions on or over Earth's surface within a few hundred feet.

RCA Astro-Electronics is now modifying eight of the remaining *Transit* satellites for dual launches, beginning in 1985. That operation is known as Stacked Oscars in Service. The satellites will be kept in orbital storage where they will be more readily available when needed.

Videocassette sales pass \$3-million mark

Sales of videocassette recorders (VCR's) in 1983 had topped the \$3-million mark in October, the Electronic Industries Association's Consumer Electronics Group reports. Sales to that date amounted to nearly 400,000 units, up 91.8 percent over the same period in 1982.

Color TV's also registered impressive gains. Sales up to October exceeded 11 million units, an improvement of more than 20 percent over the first 10 months of 1982. Black-and-white-TV sales were slightly lower than in the same period the previous year.

RCA builds three advanced satellites

Three Advanced TIROS-N satellites are being built for NOAA (National Oceanic and Atmospheric Agency) under the supervision of NASA's Goddard Space Flight Center in Greenbelt, MD. Advanced TIROS-N's are the fourth generation of satellites built since the launch of the first weather satellite, TIROS-1, in 1960. They will bring the TIROS-N series to 11 spacecraft.

Each satellite is equipped with systems to collect meteorological data from several-hundred data-collection locations. Those supply information for weather forecasting, hurricane tracking and warnings, agriculture, fishing, and other activities. Since 1966 no storm anywhere in the world has gone undetected by those satellites.

All 29 of the nation's polar-orbiting weather satellites have been provided by RCA Astro-Electronics.

EIA sets new standards for silicon digital IC's

The Engineering Department of the Electronic Industries Association has established JEDEC Standard No. 7, setting industry specifications for three series of new high-speed silicon-gate digital IC's.

The 54/74HC series includes buffered CMOS logic devices with the primary characteristic of VIL (logical low-input voltage) and VIH (logical high input voltage) ratings for good noise immunity in CMOS system designs. The 54/74HCU series includes a limited number of unbuffered (1 active logic circuit) inverters or gates where VIL and VIH ratings are less than those of the HC series. The third series is designated 54/74HCT, having VIL and VIH ratings of 0.8- and 2-volts respectively for direct interfacing with TTL logic IC's.

New G.E. picture tube adds more color to TV

Introducing Neo-Vision, a new picture tube whose faceplate contains neodymimum oxide. General Electric claims two advantages: First, the new blue neodymimum glass absorbs the usually yellowish room light; thus produces richer, more natural colors and is less affected by the ambient illumination.

The second advantage is the appearance of the blue-tube set when turned off, a distinct improvement over the "dull, drab, greenishgrayish blank screen of present-day sets," says G.E.

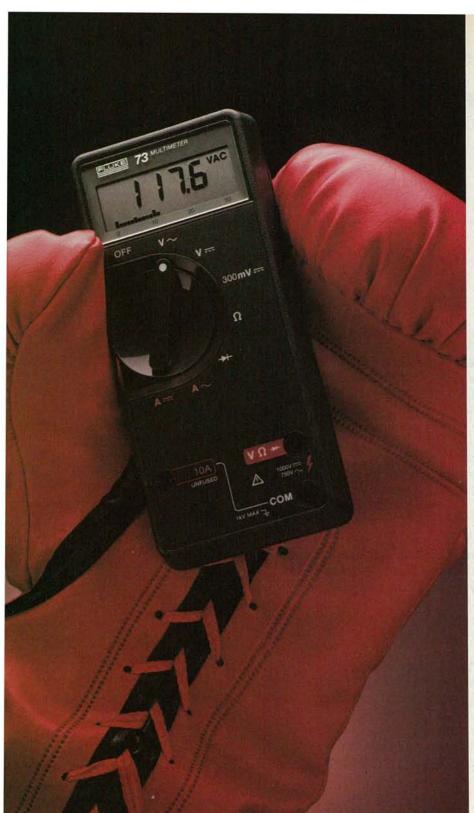
The Neo-Vision tubes will appear in nine models, including the "Command Performance" series.

Police radar inaccurate another test shows

In a recent release, Regency Electronics of Indianapolis, IN urges both police and drivers to be suspicious of the accuracy of police speed radars, citing a report of tests of six speed-measuring radar units; the tests were prepared by the National Bureau of Standards.

GB transmissions in particular were cited as one cause of inaccuracy. While police transmissions from the vehicle in which the radar was operated had a limited effect: 'CB transmission in the same vehicle affected nearly all radars." When radar and CB radio were connected to the same battery. readings on the radar target readout depended on the frequency of the CB audio. "CB radio mounted in a pickup caused readings of 60 to 70 mph at distances up to 75 feet from patrol car. . . 100-watt policeradio transmission did not interfere with the radar units at distances beyond 30 feet from the vehicle in which the radar was operated."

Other sources of error were shadowing, or the tendency of a moving-mode radar to use a slow-moving large vehicle rather than the ground to measure the speed of the patrol car; and batching, or target speed bumping, a change in the target-vehicle speed display when the patrol car changes speed. Shadowing was observed to some extent in all but one of the six radars tested and target-speed bumping was seen in three. R-E



The Digital vs. Analog battle is over.

\$85* buys you the new champion.
The new Fluke 70 Series.

They combine digital and analog displays for an unbeatable two-punch combination.

Now, digital users get the extra resolution of a 3200-count LCD display.

While analog users get an analog bar graph for quick visual checks of continuity, peaking, nulling and trends.

Plus unparalleled operating ease, instant autoranging, 2,000+ hour battery life and a 3-year warranty.

All in one meter.

Choose from three new models. The Fluke 73, the ultimate in simplicity. The feature-packed Fluke 75. Or the deluxe Fluke 77, with its own multipurpose protective holster and unique "Touch Hold" function (patent pending) that captures and holds readings, then beeps to alert you.

Each is Fluke-tough to take a beating. American-made, to boot. And priced to be, quite simply, a knockout.

For your nearest distributor or a free brochure, call toll-free anytime 1-800-227-3800,

Ext. 229. From outside U.S., call 1-402-496-1350, Ext. 229.

FROM THE WORLD LEADER IN DIGITAL MULTIMETERS.



Fluke 73

Analog/digital display Volts, ohms, 10A, diode

Autorange

0.7% basic dc accuracy



Fluke 75

Analog/digital display

Audible continuity Autorange/range hold



Fluke 77

\$129* Analog/digital display Volts, ohms, 10A, mA, Audible continuity Touch Hold" function Autorange/range hold

2000+ hour battery life 3-year warranty Multipurpose holster





PUBLISHER'S LETTER

As I promised last month, this issue of Radio-Electronics includes something new. Directly following pages 106, you'll find the premier issue of ComputerDigest. Yes; Volume 1, Number 1 has arrived. Please note that it is a separate tear-out section. We have tried to put together a package you will enjoy, find valuable, and one that meets your needs as an electronics professional.

We do expect the section to grow, but it will not take any space away from the regular Radio-Electronics editorial lineup of features that you are accustomed to receiving each month.

What's inside? Four feature articles. The lead story presents a quick comparison of LISA - PC - MACINTOSH - PEANUT. Then we go on with a feature that tells how you can upgrade budget printers....present a look at the new Macintosh....and show you why CP/M is an operating system you should learn more about.

If you like ComputerDigest, take a moment to tell me that you do and why you do. If you don't like it, I'd like to know why.

Remember, this is only the beginning. As ComputerDigest grows, we'll be able to bring you even more computer coverage designed for the interests of the electronics professional....you and other readers just like you.

Now go ahead and enjoy this action-packed issue of Radio-Electronics and the bonus 16-page issue of ComputerDigest.

LARRY STECKLER

Publisher

Radio-Electronics

Hugo Gernsback (1884-1967) founder

M. Harvey Gernsback, editor-in-chief

Larry Steckler, CET, publisher

Arthur Kleiman, editor

Carl Laron, WB2SLR, associate

Brian C. Fenton, assistant technical

Robert A. Young, assistant editor

Jack Darr, CET, service editor

Robert F. Scott, semiconductor

Herb Friedman, communications

Gary H. Arlen, contributing editor

David Lachenbruch, contributing editor

Earl ""Doc" Savage, K4SDS, hobby editor

Lou Frenzel, contributing editor

Ruby M. Yee, production manager

Robert A. W. Lowndes, production associate

Dianne Osias, production assistant

Joan Roman, circulation director

Arline R. Fishman

advertising coordinator

Cover photo by Robert Lewis

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

Gernsback Publications, Inc. 200 Park Ave. South New York, NY 10003 Chairman of the Board, M. Harvey Gernsback President: Larry Steckler

ADVERTISING SALES 212-777-6400

Larry Steckler Publisher

EAST/SOUTHEAST

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

MIDWEST/Texas/Arkansas/Okla.

Ralph Bergen Radio-Electronics 540 Frontage Road—Suite 325 Northfield, Illinois 60093 312-446-1444

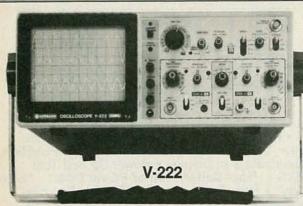
PACIFIC COAST **Mountain States**

Marvin Green Radio-Electronics 15335 Morrison St., Suite 227, Sherman Oaks, CA 91403 818-986-2001

200 F2 F2 OC







HI-PERFORMANCE PORTABLE **OSCILLOSCOPES**

ALL FEATURE 6" RECTANGULAR CRT Full 2 year parts & labor warranty.

MHITACHI

\$**500** 95 V-422

DC to 40 MHz, 1mV/div, dual-trace, DC offset function

V-222

DC to 20 MHz, 1mV/div, dual-trace, DC off. func., Alt. magnify function

V-212

DC to 20 MHz, 1mV/div, dual-trace



V-1050F

100 MHz Quad Trace w/delay sweep

\$939 95 V-650F

60 MHz Dual Trace w/delay sweep

PRICE DOES NOT INCLUDE PROBES. PROBES \$50. A PAIR WHEN PURCHASED WITH SCOPE. \$15 SHIPPING WITHIN CONTINENTAL U.S.

BECKMAN'S CIRCUITMATE ALL UNDER \$100

AVAILABLE NOW....



\$64 95

Circuitmate DM 20-31/2-digit, pocket-size multimeter; 0.8% Vdc accuracy, diode test, FE test, conductance, 10 amps AC and DC ranges, auto-polarity auto-zero, auto

\$7995



Circuitmate DM-25-31/2 digit, pocket-size multimeter; 0.5% Vac accuracy, diode test, capacitance, continuity beeper, conductance, 10 amps AC and DC ranges, auto-polarity, auto-zero, auto



diode test, autopolarity, auto-zero, auto-decimal \$**89** 95

Circuitmate DM 45 -3½-digit multimeter; 0.5% Vdc accuracy, diode test, continuity beeper, 10 amps AC and DC ranges, auto-zero, auto-polarity, auto-decimal



The DM73 is the smallest digital multimeter on the market. Its probe-style design makes it ideal for taking measurements in hardto-reach test areas.

\$**76** 95



The DM 77 gives you the convenience of autoranging plus 10 amps ac/dc measurement capability. You simply select the function you want, and the DM 77 automatically sets the required

- Small Size
- Complete Autoranging
 "Touch Hold"
- Audible continuity checking

TOLL FREE HOT LINE 800-223-0474 THE TEST EQUIPMENT SPECIALISTS

ELECTRONICS

26 WEST 46th STREET, NEW YORK, N.Y. 10036 212-730-7030



 0.3% Accuracy Manual or

Autorange

 10A + mA Range Beeper

"Touch-Hold" Function

WE CARRY A FULL LINE OF FLUKE MULTI-METERS. IN STOCK NOW





- Frequency measurements to 200KHz
- dB measurements
- Basic dc accuracy 0.4%; 10 μV, 10 nA and 10 mΩ sensitivity
- Relative measurements
- True RMS
- High-speed Beeper

PRECISION **POWER SUPPLIES**



\$29995

MODEL 1601

- Isolated 0-50VDC, continuously variable; 0-2A in four ranges
- · Fully automatic shutdown, adjustable current limit
- · Perfect for solid state servicing

man

MODEL

3010

· Sine, square and triangle output

Variable and fixed TTL outputs

Push button range and function

under 0.5% from 1 Hz to 100kHz

0.1 Hz to 1MHz in six ranges

Typical sine wave distortion



MODEL 1650 · Functions as three separate

- supplies
- Exclusive tracking circuit Fixed output 5VDC, 5A
- . Two 0 to 25VDC outputs at 0.5A
- · Fully automatic, current-limited overload protection



SWEEP FUNCTION

- · Four instruments in one package burst generator
- Covers 0.02Hz-2MHz
- Low-distortion high-accuracy outputs

IMETER

 Analog Display • Rotary Knob • Volts AC & DC • Resistance to • 32 MΩ• 10 Amps • Diode Test • 3200 Counts • Fast Autoranging • Function Annunciators in Display • Power-Up Self Test • 2000 + Hour Battery Life w/ Power Down "Sleep Mode" . New Test Leads . VDE & UL Approval



 \mathbf{O}_{00}

75

0.5% Accuracy

INDUSTRIAL TRANSISTOR **TESTER**

\$19995

MODEL

520B

- Manual or Autorange
- 10A + 300 mA Range
- Beeper

PRECISION

\$8500

73

- 0.7% Accuracy
- Autorange Only
- 10 Amp Only

BH PRECISION

70 MHz Dual Time Base MODEL SCOPE 1570



PRICE DOES NOT INCLUDE PROBES

1175

- 1mV/division sensitivity to 70 MHz
 - 500 μ V/division cascade sensitivity
 - Four-input operation provides trigger view on 4 separate inputs

1590 100 MHz Dual Time Base SCOPE



- sweep generator, function generator, pulse generator, tone-
- 1000:1 tuning range



CAPACITANCE METERS

\$**199**95

MODEL 830

Automatically measures capacitance from 0.1pF to 200mF

Now with HI/LO Drive

Works in-circuit when

Identifies all three tran-

Random lead connection

dicates GOOD transistor

■ Audibly and visually in-

others won't

sistor leads

- 0.1pF resolution
- 0.2% basic accuracy
- 31/2 digit LCD display

\$**159**95



- Resolves to 0.1pF
- 4 digit easy-to-read LED display
- Fuse protected against charged capacitors
- Overrange indication



FEATURES

- 1mV/div high sensitivity design. Effective for measurement of weak signals.
- Employs TV sync separator circuitry with one touch synchronization of both TV horizontal and vertical signals.
- Delayed sweep function with one touch control 10 × magnification.
- Trace rotation system for easily adjusting trace inclination caused by terrestrial magnetism.
- Fine adjusting click positioning function enhances measuring efficiency.
- Signal output: Vertical output terminal to Frequency Counter, etc.
- Z axis input provided possible to use as CRT display.
- One touch shifting of waveform slopes for easy observation of rise and fall of waves.



MODEL 302F

DUAL TRACE W/DELAY

All HITACHI Oscilloscopes feature 2 year parts & labor warranty.

HITACHI

Price does not include probes. Probes \$50. a pair when purchased with scope. \$15. shipping within continental U.S.

向HITACHI

15 MHz TRIGGERED SCOPE

QUANTITIES ARE LIMITED

SPECIFICATIONS

Vertical Deflection Sensitivity	5mV/div to 5V/div	+5% 10 0	alibrated stens	
Sensitivity	5mV/div to 5V/div ±5%, 10 calibrated steps 1mV/div to 1V/div ±6%			
	(When using x5 amplifier)			
	Uncalibrated contin		rol between	
	steps 1: < 2.5 (pro			
	function)	noco min	chek positioning	
Bandwidth	DC to 15MHz, -3d	B (at 4 div)	
E-SIGNATURE CONTRACTOR	DC to 7MHz =3dB	(at 4 div)		
	(When using x5 am	plifier)		
Rise Time	24ns. (for x5) 70ns			
Signal Delay Line	TAIN SEE			
Max. Input Voltage	600Vp-p or 300V (DC + AC	peak, at 1kHz)	
Input Coupling	AC, GND, DC			
Input Impedance	Direct 1M ohm, ap	prox. 30pf		
Operating Modes	Single-trace			
X-Y Operation	External trigger Inc			
Control of the Contro	Vertical Input: Y a			
Sensitivity	X axis: approx. 20			
	Y axis: same as Ve			
Phase Difference	DC to 10kHz withi			
X Bandwidth	DC to 500kHz, -3c	JB		
Dynamic Range	4 div or more			
Vertical Output	-			
Output Voltage	20mV/div or more		ed into 50 Ω)	
Bandwidth	50Hz to 5MHz, -3	dB		
Output Impedance	Approx. 50Ω			
Horizontal Deflection	TO THE SHOP OF THE PARTY OF THE	PARTY IN THE REAL PROPERTY.		
Trigger Modes	AUTO, NORM, TV	(+), TV (-)	
Trigger Source	LINE, EXT			
Trigger Coupling	AC	02400400		
TV Sync	TV sync-separation			
Internal	1 div or more (V s			
External	1Vp-p or more (V			
Trigger Sensitivity	Frequency	Internal	External	
	20Hz to 2MHz	0.5div	200mV	
	2 to 15MHz	1.5div	800mV	
AUTO Low Bandwidth	30Hz			
Trigger Slope	+			
External Trigger Input	Input impedance:	approx 1M	A ohm	
External ringger imput	30pF or less	appron. III		
	Max, input voltage	: 100V		
	(DC + AC peak at			
Sweep Time	0.2μs/div to 0.2s/c			
	19 calibrated steps			
	Uncalibrated continuous control between			
		steps 1: < 2.5 (provided with click-positioning		
	function)		Carlo Maria Carlo Maria	
	10 times (±7%)			
Sweep Time Magnifier				
Sweep Time Magnifier Max. Sweep Time	100ns/div (20ns/d	iv and 50n	s/div. not	
		iv and 50n	s/div. not	
	100ns/div (20ns/d	iv and 50n	s/div. not	
Max. Sweep Time	100ns/div (20ns/d	400 M		
Max. Sweep Time Amplitude Calibrator	100ns/div (20ns/d calibrated)	400 M		
Max. Sweep Time Amplitude Calibrator Waveform Voltage	100ns/div (20ns/d calibrated) Approx. 1kHz ±10)% (typ), s		
Max. Sweep Time Amplitude Calibrator Waveform	100ns/div (20ns/d calibrated) Approx. 1kHz ±10 0.5V ±5%	0% (typ), s V ±10%		
Max. Sweep Time Amplitude Calibrator Waveform Voltage Power Requirements	100ns/div (20ns/d calibrated) Approx. 1kHz ±10 0.5V ±5% 100/120/220/240 50 to 60Hz. approx	0% (typ), s V ±10% ox. 40W	quare wave	
Max. Sweep Time Amplitude Calibrator Waveform Voltage	100ns/div (20ns/d calibrated) Approx. 1kHz ±10 0.5V ±5% 100/120/220/240	0% (typ), s V ±10% ox. 40W	quare wave	

Price does not include probe. Probe \$20. when purchased with oscilloscope.

Full 2 year parts & labor warranty.

WE CARRY A FULL LINE OF HITACHI OSCILLOSCOPES



TOLL FREE HOT LINE 800-223-0474

212-730-7030

26 WEST 46th STREET, NEW YORK, N.Y. 10036

THE TEST EQUIPMENT SPECIALISTS

ADVANCE ELECTRON

SATELLITE/TELETEXT NEWS

GARY ARLEN CONTRIBUTING EDITOR

TELETEXT TEST

Several teletext/videotex projects closed down at the end of 1983, forcing reevaluations of the immediate prospects for developing such systems in the U.S. Time Teletext ended its \$25 million, two-year teletext experiment, which had involved satellite-cable TV transmission of a 5,000-page teletext database. Matsushita, which had been working with Time to build a low-cost teletext decoder, will continue its efforts to design teletext equipment using the NABTS format. Meanwhile, ConTelVision, a videotex project in Manassas, Virginia, run by one of the nation's largest independent phone companies, shut down until videotex technology becomes more clearly defined. Another videotex experiment in Connecticut, run by the Southern New England Telephone Co., was temporarily closed after a legal settlement with the state's newspaper publisher's association, which opposes phone-company involvement in videotex operations. And the pioneering British Columbia Telidon trial in Canada has taken a hiatus until commercial operations can be defined.

AUDIO ADD-ON

XCom, a French videotex company, has introduced an audio enhancement that brings digital sound to online systems. The device, called *Demosthene*, permits audio to be linked to individual videotex frames, with digital audio encoded at 2.4 kilobits-per-second. Seventy videotex frames can carry up to eight minutes of sound. The technology costs about \$2,500 per unit, far higher than the price planned for a prototype Japanese audio add-on for videotex—but the XCom system is envisioned primarily for public-access videotex terminals, replacing other audio-visual technologies now used.

DIGITAL TELETEXT IC'S

In a move that could accelerate teletext introduction throughout the U.S., Zenith may begin installing teletext receivers in some 1985 model television sets late this year, using new digital IC's developed by ITT in Europe. Zenith's exclusive deal gives the company a lead of one or two years over other U.S. manufacturers in incorporating a low-cost teletext device into TV sets. The ITT Digivision IC's are built to specifications for British-format teletext service, being sold in the U.S. as "World System Teletext." ITT's teletext processor IC set (MAA 2700) is one of three new integrated circuits developed at ITT's German technology center. Target price is \$10 per set when production begins this spring.

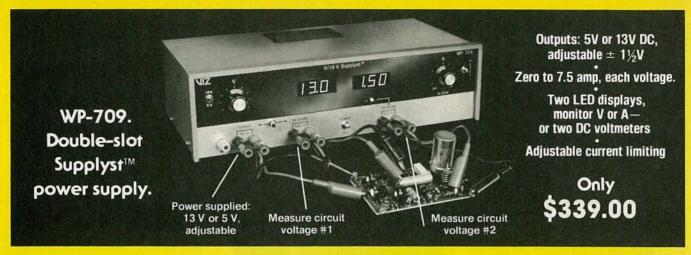
DOWNLOADING TEXT TO COMPUTERS

Financial News Network, a satellite-programming service used by cable TV and some broadcast television stations, is laying the groundwork for a financial-data teletext service to be sent to personal computers via the vertical blanking interval of the business-news channel (Westar IV, transponder 10). The service, due for late-1984 start-up, would download data to home computers, eliminating the need for expensive teletext decoders. Material would be formatted into pages consistent with a teletext standard. Computer software sold as part of the FNN package would format and analyze information as it is fed into the unit.

DBS DEVELOPMENTS

Skyband Inc., the DBS company owned by media mogul Rupert Murdoch, has delayed its DBS service until late 1985 at the earliest. Skyband, which will use an existing 14/12-GHz satellite operated by Satellite Business Systems, had intended to go up in mid-1984. Now it wants to wait until a new generation of higher-powered birds is ready—which is more than a year away.

Home Box Office is working with Turner Broadcasting Co. (which owns Superstation WTBS and Cable News Network) to develop a quasi-DBS service. The service, which could begin by late 1984, would use the newly launched Galaxy I satellite, a 4/6-GHz bird which is becoming a major cable TV programming source. Galaxy I's transponders are turning out to be 60% more powerful than expected, encouraging the belief that dishes as small as 4 to 6 feet in diameter could pick up a high-quality video signal. HBO and Turner are negotiating with other Galaxy programmers (including Group W, Disney, Spanish International, and C-SPAN) about using signals from that bird for direct-to-home service, aimed primarily at areas where there are no cable-TV systems.



DC power to test logic or mobile equipment. Another VIZ Value

HERE'S REAL PRECISION
Select the precise voltage you want:
5V or 13V, adjustable ± 1½V at each
range. Output is laboratory quality.
Ripple less than 10mV, peak to peak.
Regulation better than 0.1%.

HERE'S REAL POWER Up to 7.5 amp. at each voltageplenty for computer circuits, PA systems, mobile transmitters, autos, boats, planes.

HERE'S REAL CONVENIENCE Front panel controls for instant voltage adjustment and precise fine adjustment to within 0.1V. Two 3-digit LED displays permit continuous monitoring of both voltage and current during use. Current limiting control with instant pushbutton reset.

The WP-709 is like two precision power supplies for a price less than you might pay for one—PLUS two digital DC voltmeters.

VIZ Supplyst™

power supplies with digital displays of voltage and current



WP-705 \$325.00

Single output 0-50VDC. 0-2A



WP-707 \$423.00

Dual output Two 0-25VDC. 0-2A. Fully regulated, adjustable current limiting power supplies, PLUS two built-in digital DC voltmeters in a single quality unit. Digitally monitor output voltage or current, or two external voltages.

WP-706 \$341.00

Single output 0-25VDC. 0-4A.

WP-708 \$489.00

Triple output Two 0-20VDC, 0-2A.
One 5VDC, 0-4A.





VIZ DC power supplies

Fully regulated, continuously adjustable voltage outputs with short circuit protection.

Analog meters and overload indicators.





Single WP-703A 0-20VDC. 0-500mA \$119.00



Single WP-704A 0-40VDC. 0-250mA \$125.95

- VIZ RELIABILITY

VIZ is a 50 year-old company. Our instruments are fully warranted, parts and labor, for a year.

All items tested to NBS standards. We offer service and parts availability for a minimum of ten years. Over 15 repair depots in U.S.A.

Want full technical details and a demonstration? Call toll-free. 1-800-523-3696, for the VIZ distributor nearest you



Look to VIZ for value, quality, availability.

Over 70 instruments in the line – PLUS full accessories.

VIZ Mfg. Co., 335 E. Price St., Philadelphia, PA 19144

13

LETTERS

Address your comments to: Letters, Radio-Electronics, 200 Park Avenue South, New York, NY 10003

COMPUTER SECURITY

I would like to comment on Les Spindle's article on page 111 of the February 1984 issue, entitled "Computer Security." He fails to discuss call-back units, an important and relatively new protection device that prevents unauthorized remote-computer access. The unit is placed between the phone line and your modem. When a call is placed to that phone line, the call-back unit receives the call but does not produce a carrier tone; in fact, there is no sound produced at all. Using a tone-phone, you enter a security-access code that indicates who and where you are. Then you hang up, and if the code you have entered is valid, you will be called back automatically at a pre-designated phone number. That prevents the sequential auto-dialer search depicted in War Games (see photo). There are many companies which sell these units: Digital Pathways, 1060 East Meadow



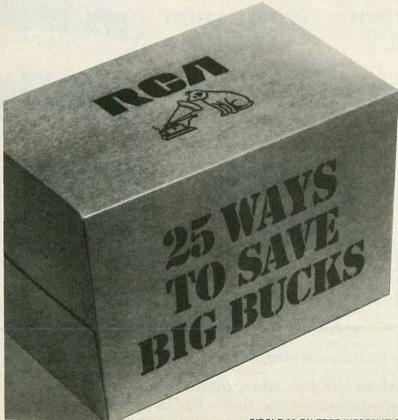
Circle, Palo Alto, CA 94303, (415) 493-5544; International Mobil Machines Corp., 100 N. 20th Street, Philadelphia, PA 19103, (215) 569-1300; LeeMAH, 729 Filbert Street, San Francisco, CA 94133, (415) 434-3780, and Western Datacom Co., 5083 Market Street, Youngston, OH 44512, (216) 788-6583.

One other point needs correction. The arti-

cle states: "When the security problem is not one of remote on-line access (for example, an on-premises computer used by several people), another protection scheme is possible. Passwords can be assigned...". However passwords are useful, and necessary, regardless of whether the access is from on-premises or off-premises. In fact, passwords are probably the least expensive and most beneficial security mechanism.

I enjoy reading your magazine. Despite this long letter about computer security, I read your magazine for the electronics articles. Keep up the good work. In fact, I discontinued my subscription to *Popular Electronics* when the name was changed to *Computers and Electronics*. I do not believe that one magazine can successfully cover both subjects. TONY S. PATTI *Arlington, VA*

continued on page 20



RCR's new VCR Parts Package.

RCA's newest Parts Package holds the 25 fastest-moving VCR parts you'll need for servicing RCA and other brands of VCRs.

And it's priced to save you money. The whole package sells for less than the total cost of the individual parts. You get all 25 mechanical and electrical parts with one convenient order.

For full information, see your RCA Parts Distributor. Also ask him for the RCA VCR Parts Cross Reference (Form 1F6627) and VCR Tool Catalog (Form 1F6857).

Distributor and Special Products Division

CIRCLE 86 ON FREE INFORMATION CARD

We will beat any advertised price BECKMAN Circuitmate® DMM

MODEL DM73 69 95



● Smallest digital multimeter on the market ● Probe style design makes it ideal for taking measurements in hard-to-reach test areas.

3½-digit, pocket-size multimeter
 0.8% Vdc accuracy
 • diode test
 • hFE test
 • conductance
 • 10 amps AC and DC ranges
 • Auto-Decimal.



995 MODEL DM25

3½-digit, pocket-size multimeter • 0.5% Vdc accuracy • diode test • capacitance • continuity beeper • conductance • 10 amps AC and DC ranges • auto-polarity • auto-zero • auto-decimal.



B&K PRECISION

100 MHz FREQUENCY COUNTER OUR PRICE



MODEL 1803 REG. \$169.95

5 Hz to 100 MHz range 8 digit LED display Leading zero blanking Low pass filter 8NC Connector Input Overflow Indicator 8 attery or AC powered Charger/AC Adaptor included with Model 1803.

NTSC COLOR BAR GENERATOR

MODEL 1251 REG. \$995.00

OUR PRICE



- Generates a wide variety of test signals and patterns for comprehensive testing, servicing and adjustment of virtually all types of television and video equipment
 Video patterns include standard NTSC color bars, -IWQ, and staircase at two levels of burst phase chrominance A full assortment of convergence patterns, raster colors gated or full field multiburst.

BPDIGITAL CAPACITANCE METER



MODEL DCM-601 REG. \$149.95 **OUR PRICE**

095

Digital display easy and correct readout High accuracy: 100 PPM 0.5% LSI-circuit provides high reliability and durability LCD display provides low power consumption.

FORDHAM 550 MHZ FREQUENCY COUNTER



OUR PRICE MODEL FM-8 REG. \$199.95

8-digit high frequency counter with a switch selectable input using single BNC Completely assembled Pre-Calibrated. Pre-tested.

FLUKE

- Analog Display Rotary Knob
 Volts AC & DC Resistance to 32 MΩ
 10 Amps Diode Test 3200
 Counts Fast Autoranging Function
 Annunciators in Display PowerUp Self Test 2000+ Hour Battery Life
 w/Power Down "Sleep Mode" New
 Test Leads VDE & UL Approval

75

- 0.5% Accuracy
 Manual or Autorange
 10A + 300 mA Range
 Beeper



\$**85**00

0.7% Accuracy
 Autorange Only
 10 Amp Only

73

- 0.3% Accuracy
 Manual
- Manual or Autorange 10 A + 300mA Range
- Beeper "Touch-Hold" Function



001

PORTABLE OSCILLOSCOPES MODEL V-422 (40 mHz) REG. \$895.00

MODEL V-222 (20 mHz) REG. \$695.00



CALL FOR SPECIAL PRICING

- New series of scopes provides high performance and light weight ◆ Large 6-inch rectangular, internal graticule CRT ◆ Autofocus circuit and scale illumination ◆ DC offset funcion ◆ Voltage and frequency reading outputs ◆ High accuracy ±3%
 High sensitivity 1 mV/div.

EADER



NTSC WAVEFORM MONITOR MODEL LBO-5860 OUR PRICE REG. \$2050.00 18

Permits displaying vertical interval test and reference signals by front panel line selector.

NTSC VECTORSCOPE

MODEL LVS-5850 OUR PRICE REG. \$2050.00

\$1850 Convenient method for observing and measuring the relative phase and amplitude of chrominance signal components.

VIZ DC TRIPLE POWER SUPPLYST

MODEL WP-708 REG. \$479.95 **OUR PRICE**

95



Dual DC Voltmeter
 Triple DC Power Supply
 Three separate completely isolated DC power supplies; two 0-20V at 0-2A, one fixed 5V at 4A.

SOLDERING STATION

Digital temperature readout
 The EC1000 is dial controlled.

MODEL EC1000 **OUR PRICE**

- Identical to the EC2000 except LED
- SOLDERING STATION MODEL EC2000

OUR PRICE

 Continuously variable tip

variable tip temperature from 350 to 850 F • Positive from 350 to 850 F • Positive temperature coefficient sensor inside the tip provides temperature feedback to maintain tip temperature at a set

260 Motor Parkway. Hauppauge, N.Y. 11788

Master Charge
VISA COD

NY State

ADD FOR SHIPPING AND INSURANCE: \$0-\$250.00 \$ 4.50 \$251.00 to \$ 500.00 \$ 6.50 \$501.00 to \$ 750.00 \$ 8.50 \$751.00 to \$1000.00 \$ \$12.50 over \$1000.00 \$15.00

COD's extra (required 25% deposit)

in N.Y. State call 800-832-1446

Free Catalog on Request

Learn robotics and you build this

New NRI home training prepares you for a rewarding career in America's newest high-technology field.

The wave of the future is here. Already, advanced robotic systems are producing everything from precision electronic circuits to automobiles and giant locomotives. By 1990, over 100,000 "smart" robots will be in use.

Over 25,000 New Jobs

Keeping this robot army running calls for well-trained technicians . . . people who understand advanced systems and controls. By the end of the decade, conservative estimates call for more than 25,000 new technical jobs. These are the kind of careers that pay \$25,000 to \$35,000 a year right now. And as demand continues

to grow, salaries have no place to go but up!

Build Your Own Robot As You Train at Home

Now, you can train for an exciting, rewarding career in robotics and industrial control right at home in your spare time. NRI, with 70 years of experience in technology training, offers a new world of opportunity in one of the most fascinating growth fields since the computer.

You need no experience, no special education. NRI starts you at the beginning, takes you in easy-to-follow, bite-size lessons from basic electronics right on through key subjects like instrumentation, digital and computer controls, servomotors and feedback systems, fluidics, lasers, and optoelectronics. And it's all reinforced with practical, hands-on experience to give you a priceless confidence as you build a programmable, mobile robot.

Program Arm and Body Movement, Even Speech

Designed expecially for training, your robot duplicates all the key elements of industrial robotics. You learn to operate, program, service, and troubleshoot using the same techniques you'll use in the field. It's on-the-job training at home!



You get and keep Hero 1 robot with gripper arm and speech synthesizer, NRI Discovery Lab for electronic experimentation, professional multimeter with 3½-digit LCD readout, 51 fast-track training lessons.

industrial control as

Building this exciting robot will take you beyond the state of the art into the next generation of industrial robotics.

You'll learn how your completely self-powered robot interacts with its environment to sense light, sound, and motion. You program it to travel over a set course, avoid obstacles using its sonar ranging capability. Program in complex arm and body movements using its special teaching pendant. Build a wireless remote control device demonstrating independent robot control in hazardous environments. You'll even learn to synthesize speech using the top-mounted hexadecimal keyboard.

Training to Build a Career On

NRI training uniquely incorporates hands-on building experience to



Your mobile robot duplicates functions of state-of-the-art industrial units.

reinforce your learning on a real-world basis. You get professional instruments, including a digital multimeter you'll use in experiments and demonstrations, use later in your work. And you get the exclusive NRI Discovery Lab®, where you examine and prove out theory from basic electrical concepts to the most advanced solidstate digital electronics and microprocessor technology. Devised by an experienced team of engineers and educators, your

experiments, demonstrations, and equipment are carefully integrated with 51 clear and concise lessons to give you complete confidence as you progress. Step-by-step, NRI takes you from the beginning, through today, and into an amazing tomorrow.

Send for Free Catalog Now

Send for NRI's big free catalog describing Robotics and Industrial Control plus over a

dozen other high-technology courses. You'll see all the equipment you get in detail, get complete descriptions of every lesson, find out more about career opportunities for trained technicians. There's no cost or obligation, so send today. Your action today could mean your future tomorrow. If the card has been removed, please write us today.



NRI SCHOOLS

McGraw-Hill Continuing Education Center 3939 Wisconsin Ave. Washington, DC 20016

WE'LL GIVE YOU TOMORROW.

AM STEREO

Marty Bergan's recent construction article dealing with AM stereo (Radio-Electronics, January 1984) was a real delight, but there is one statement that should be more fully explained so that readers will not assume that there are consumer-type AM radios available that are capable of hi-fi performance. The author states that the Realistic 12-656A has a 3-dB bandwidth of 12 kHz. He is clearly referring to the IF bandwidth, but that would imply that the 3-dB audio bandwidth is 6 kHz. The test data (see Fig. 1) shows that the 3-dB audio bandwidth is under 3 kHz for that parRELATIVE AUDIO OUTPUT -20 -25 -30 -35 50 100 200 500 1K 2K 5K 10K 20 FREQUENCY-Hz

FIG. 1

ticular radio, which is still better than the typical AM radio.

The 12-656A uses the standard arrangement of 2 IF amplifiers with 3 singly tuned transformers. The adjacent channel selectivity is set by those coils, and, assuming that the loaded Q's of the coils are equal, an audio response of 3 kHz means that the attenuation at plus and minus 10 kHz is only 18 dB. The attenuation at plus and minus 20 kHz is 33 dB. Since the coils have a loaded Q of 38, each coil has a bandwidth of 12 kHz, and that bandwidth might be what the author had in mind when he made his statement.

F. DAVID HARRIS

West Hartford, Connecticut

COMREX
The article on the abilities of the Comrex to improve the frequency response of remote broadcasting using a telephone company dial line (Radio-Electronics, January 1984— "Communications Corner"), was great as far as it went. However, your readers might be interested in another product line that does a much better job. The C.N. Rood BAX 114 portable transmitter and 110D receiver, when hooked together through two telephone dialup lines, will deliver the sports announcer's voice to the control room with his/her "studio" sound

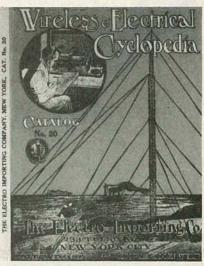
The Rood transmit/receive pair has the frequency response and signal-to-noise ratio of a 5 kHz equalized telephone company line from anywhere in the world. Briefly, the transmitter circuits include a band splitter (50 Hz to 2.5 kHz and 2.5 kHz to 4.95 kHz), an audio compressor for each band, a 350 Hz slide up for the low band and a 2.1 kHz slide down for the high band. The receiver circuits include an audio expander for each band, a 350 Hz slide down for the low band, and a 2.1 kHz slide up for the high band. The two bands are then sent through a combining network.

The result can be considered "nothing short of a miracle" as one grizzled old radio engineer puts it. That "miracle", however, does not come cheap. (Name me a miracle that does!) Expect to pay close to \$9,500 for the required transmit/receive pair.

C. JOHN WEED ABC Radio Network Larchmont, N.Y.

REPRINT APPRECIATED

Thank you for the great idea of this reprint (The Electro Importing Catalog). I am and always will be in love with Hugo Gernsback and all of his publications. If you ever decide



to reprint any other items, please keep me in mind; price is no object. Use the best grade of paper and the latest techniques, you will find that the collecting fraternity is not a pennypinching crowd. Thanks again.

PHIL WEINGARTEN

Forest Hill, N.Y.



R-2000

SSB, CW, AM, FM, digital VFO's, 10 memories, memory/ band scan, optional 118-174 MHz coverage...

The R-2000 is an innovative all-mode SSB, CW, AM, FM receiver that covers 150 kHz-30 MHz, with an optional VC-10 VHF converter unit to provide coverage of the 118-174 MHz frequency range.

R-2000 FEATURES:

- Covers 150 kHz-30 MHz in 30 bands. UP/ DOWN band switches. VFO's tune across 150
- kHz-30 MHz.

 All mode: USB, LSB, CW, AM, FM.

 Digital VFO's. 50-Hz, 500-Hz or 5-kHz steps.

 F. LOCK switch.
- · Ten memories store frequency, band, and mode data. Each memory may be tuned as a VFO. Original memory frequency may be
- Lithium batt, memory back-up. (Est. 5 yr. life).
 Memory scan. Scans all or selected memories.
- Programmable band scan. Scans within pro-
- Programmable band scan. Scans within programmed bandwidth.
 Fluorescent tube digital display of frequency (100 Hz resolution) or time. DIM switch.
 Dual 24-hour quartz clocks, with timer.
 Three built-in IF filters with NARROW/WIDE selector switch. (CW filter optional.)
 Squelch circuit, all mode, built-in.
 Naise blanker built-in.

- Noise blanker built-in.
- Tone control.

- Large front mounted speaker.
 RF step attenuator. (0-10-20-30 dB.)
 AGC switch. (Slow-Fast.)
 "S" meter, with SINPO "S" scale.
 High and low impedance antenna terminals.
 100/120/220/240 VAC, or 13.8 VDC (Option)
- operation.
 RECORD output jack
- Timer REMOTE output (not for AC power)
- "Beeper'
- · Carrying handle.



R-1000 High performance receiver
• 200 kHz-30 MHz • digital display/clock/
timer • 3 IF filters • PLL UP conversion
• noise blanker • RF step attenuator • 120240 VAC (Optional 13.8 VDC).



R-600 General coverage receiver • 150 kHz-30 MHz • digital display • 2 IF filters • PLL UP conversion • noise blanker • RF attenuator • front speaker • 100-240 VAC (Optional 13.8 VDC).

Optional accessories:

- VC-10 118-174 MHz converter.
- HS-4, HS-5, HS-6, HS-7 headphones.
 DCK-1 DC cable kit.
- YG-455C 500-Hz CW filter.
- HC-10 World digital quartz clock.
 AL-2 Surge Shunt

TRIO-KENWOOD COMMUNICATIONS 1111 West Walnut/Compton, CA 90220 Telephone: (213) 639-9000

HADIO-ELEC I HOINICO

NO MORE COMPUTER MAGAZINES

Why don't you tell Edward W. Loxterkamp of New York, that if he wants to read more about computers, there are plenty of magazines he can buy. I definitely agree with Stephen F. Wiley. You don't need any more emphasis on computers than you have now.

Radio-Electronics is the last good general-interest electronics magazine on the stands. I have subscribed to both Radio-Electronics and Popular Electronics since 1976. As long as you stay the all-around electronics magazine that you are, I plan to be a subscriber for life.

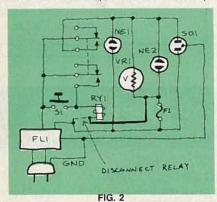
The February 1984 issue of *Computers & Electronics* I just received doesn't have a single article dealing with anything but computers. The next renewal slip I get from them goes in the round file.

RICHARD D. TAYLOR Shorewood, IL

POWERLINE TRANSIENT SUPPRESSOR

In reference to the powerline transient suppressor, **Radio-Electonics**, September 1983, pages 57–58: As that circuit is presented, when an excessive transient causes fuse F1 to blow, whatever is plugged into the suppressor is not protected from any *further* transients that may occur.

When I built this powerline transient sup-



pressor, I altered the circuit as shown in Fig. 2. If the fuse blows, the relay drops out and stays out to protect the equipment. Disconnect the relay from FL1 and reconnect it to fuse top-see Fig. 2.

I would appreciate it if you would publish this letter, so readers could make this modification to their transient suppressors.

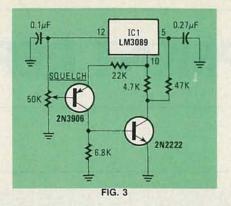
ERIC DEUTSCHMANN Spence Bay, Carrada

TV SOUND CONVERTER

The article on the "TV Sound Converter", that appeared in the November, 1983 of Radio-Electronics seems to have generated quite a bit of interest and has brought an excellent response from the readers!

Many people have asked questions regarding the circuitry. Here are a few answers to the most frequent ones.

If you wish to use the project with your stereo amplifier, simply tap off the audio at switch S1. In addition, it will probably be necessary to connect a 1μ F capacitor in series with the hot lead to remove the DC-offset voltage. If you chose to do that, it may not be necessary to build the rest of the audio circuit-



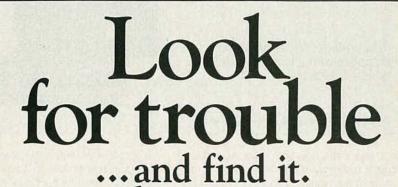
ry, as it isn't used.

With some LM3089 IC's, squelch operation may be poor or nonexistent. You can easily snap up the squelch performance by building the circuit shown in Fig. 3 onto the back of the board. No foil cuts are necessary, but you must remove all parts connected to pins 5 and 12 before starting the wiring. Pin 10 wiring stays as is.

And finally, for those readers who made their own circuit boards, there is troubleshooting assistance available, if needed. Please send a SASE to the supplier address given in the article

GARY McCLELLAN La Habra, CA

R-E



Understanding
Digital
Troubleshooting
Troubles

New "Understanding Digital Troubleshooting" book from TI.

The move is on to digital circuits, increasing the need for expert maintenance and repair troubleshooting. Before trouble finds you, get the new TI Understanding Series Digital Troubleshooting book. The book covers basic concepts and operating principles and leads you through to accurate troubleshooting techniques.

This 264 page book is filled with the latest information, clear illustrations and self-help tests. It's everything you need to find trouble in digital systems.

Order your copy today.

TEXAS NSTRUMENTS

Creating useful products and services for you.

Please send me:	Quantity	Price	Mail to:
Understanding Series " Titles:	and the second		
☐ Understanding Digital Troubleshooting —			Texas Instruments
(LCB8036)		a \$6.95	P.O. Box 3640, M/S 54
☐ Understanding Solid-State Electronics — 3rd		-	Dallas, Texas 75285
edition (LCB3361)	6	2 \$6.95	Dallas, Texas 13203
☐ Understanding Digital Electronics — (LCB3311)		a \$6.95	Add \$1.25 per book for postage and handling. Prices
☐ Understanding Microprocessors — (LCB4023)			subject to change without notice.
☐ Understanding Calculator Math — (LCB3321)		a \$6.95	subject to change without notice.
☐ Understanding Communications Systems —			Enclose check or money order with sales tax (except
(LCB4521)		a \$6.95	AK, DE, NH, OR). Foreign orders must be in U.S.
☐ Understanding Computer Science — (LCB5471)		a \$6.95	
Understanding Optronics — (LCB5472)		a \$6.95	dollars and include shipping charges. No phone
☐ Understanding Automotive Electronics—		40.50	orders, please.
(LCB5771)		a \$6.95	
☐ Understanding Electronic Security		90.50	
Systems —(LCB7201)	-	a \$6.95	Name
Understanding Electronic Control of Energy		u 30.30	
Systems — (LCB6642)		@ \$6.95	
		a 30.30	Address
Understanding Telephone Electronics— (LCB7141)		@ \$6.95	The state of the s
Understanding Electronic Control of Automation		@ 30.90	City
Systems — (LCB6641)		- ee ne	City
		a \$6.95	
Self Study Courses:			StateZip
AC Audio (LCB6651)/AC Text (LCW8168)		@ \$24.95	
DC Audio (LCB5922)/DC Text (LCW8161)		@ \$24.95	
☐ Learning Center Library Catalog (CM-110L)	-	Free	72336 © 1984 TI RE584

EQUIPMENT REPORTS

Kaypro 10 Hard Disk Computer

This portable computer comes complete with a hard disk and bundled software.

CIRCLE 101 ON FREE INFORMATION CARD

FOR JUST A FEW DOLLARS MORE THAN THE cost of adding a separate hard-disk unit to an existing computer system, you can have a full-featured portable computer



with hard-disk mass storage from Kaypro Inc. (533 Stevens Ave., Solona Beach, CA 92075). The computer system, priced at \$2795, features a built-in 10-megabyte

hard disk, a double-density two-sided floppy-disk drive, and most of the software you'll ever need.

Description

Outwardly, the Kaypro 10 closely resembles the well-known Kaypro II in overall size and appearance, though it's slightly heavier at 31 lbs. The computer is housed in a metal cabinet with a carrying handle on the top. When placed flat on a table, two catches release the keyboard unit revealing the front panel of the computer. The typewriter-style keyboard contains four-way directional keys and a separate 14-key calculator-style numeric keypad. The front panel of the computer continued on page 25



MODEL DM-6500 **AUTORANGING DMM**

Priced at only

There's no sacrificing quality, even at this low price. And check out these features:

- Autoranging
- Shock Resistant
- Continuity Buzzer
- Fuse Protection
- Safety Construction RANGES

DC Volts: 200m/2/20/200/1000V

AC Volts: 2/20/200/600V

AC/DC Current 200 mA/10A Resistance:

200/2k/20k/200k/2000kΩ

MODEL DM-6590 ELECTRO-PROBE™ DMM Lowest price available!

Including case

The hottest new instrument to hit the market. Contains features such as:

- Autoranging
- Data Hold Button
- Shock Resistant Housing
- Continuity Buzzer
- 200 hr. Battery Life RANGES

AC/DC Volts: 2/20/200/500V Resistance: 2k/20k/200k/2000kΩ

For more information on the DM-6500 and DM-6590 see your local distributor or contact A.W. Sperry Instruments Inc., P.O. Box 9300, Smithtown, N.Y. 11787. Phone: 800-645-5398 Toll-Free (N.Y., Hawaii, Alaska call collect 516-231-7050).



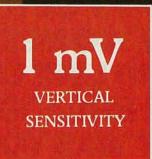
The Measurable Advantage.

CIRCLE 17 ON FREE INFORMATION CARD

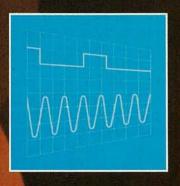


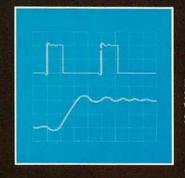
In Europe, contact A P PRODUCTS GmbH • Baeumlesweg 21 • D-7031 Weil 1 • West Germany • Phone: [07157] 62424 • TLX: 841 07 23384

1 mV DIV VERTICAL SENSIVITY



V-MODE DISPLAYS UNRELATED SIGNALS



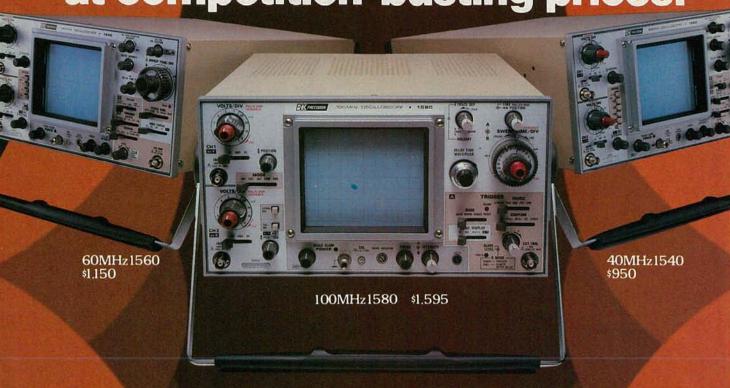


WITH TRACE SEPARATION

> HIGH ACCELERATION VOLTAGE DUAL TRACE ON 1580 TRIPLE TRACE ON 1560 DUAL TRACE ON 1540 X10 SWEEP MAGNIFICATION

DUAL TIME BASE

Three new B&K-PRECISION scopes loaded with features at competition-busting prices.



FOR MORE INFORMATION, see the latest B&K-PRECISION catalog, For your free copy, contact your local distributor or B&K-PRECISION.



6460 West Cortland Street • Chicago, Illinois 60635 • 312/889-9087

International Sales, 6400 W. Cortland St., Chicago, Illinois 60635

• Canadian Sales, Allas Electronics, Ontario
South and Central American Sales, Empire Exporters, Plainview, NY 11803

CIRCLE 16 ON FREE INFORMATION CARD

EQUIPMENT REPORTS

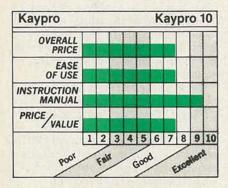
continued from page 22

contains an 80-column × 24-row 9-inch green monochrome anti-glare CRT display. To the right of the display there's a power-indicator lamp, a hard-disk-ready lamp, and a vertically mounted halfheight floppy-disk drive.

A swing-out tilt bracket elevates the front of the computer so that its bottom is level with the top of the keyboard. The tilt bracket allows easy access to the floppydisk drive. It also positions the display screen so that it's tilted directly toward the user's eyes, making it one of the few computer displays that won't give you a stiff neck after extended use. Unfortunately, most computer displays are too high, and you'll really appreciate having the tilt bracket after several hours at the computer punching in data.

In addition, the display is recessed so that it's shielded from overhead lights and its face is etched to sharply reduce the affects of room glare. The screen position and antiglare precautions make that display one of the best we've seen for long-

term viewing.



Turning to the rear of the computer we find a power-cord receptacle along with storage clips for the cord, the power switch, a reset switch, a brightness control, and a parallel-printer output with a Centronics-type connector. The rear panel also contains two standard RS-232 I/O ports-one that can be used for a serial printer and the other for a modem—and a modular telephone connector for an optional light pen. In addition, there is another modular connector for the connecting cable that is used to connect the keyboard to the computer.

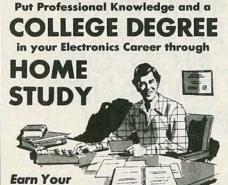
The main features of the Kaypro 10 are the internal 10-megabyte hard-disk, a CP/M operating system, and an extensive bundle of software. (Bundle means software supplied with the computer at no additional cost.) The hard disk has a basic capacity of 10-megabytes and is automatically partitioned to function as drives A and B. Almost all the softwear is duplicated on drives A and B and is so extensive that it uses more than 2.5-megabytes of storage, thus the hard disk comes with almost 6 megabytes already in use.

If the user inadvertently "blows" (erases) a program on, say, drive A; it can recopied on drive A from drive B using the PIP (copy) command. The floppy-disk drive is used as drive C and provides 390K of storage. That drive can be used to make back-up copies. Almost all the software can be transferred to floppy disk, thereby freeing the hard disk for data storage. (As you can see from the preceeding, the system is extremely flexible and easy to handle.)

Software

The list of software provided by Kaypro at the time this report was prepared included: MBASIC, an easy-to-use BASIC language for the beginner and experienced programer; SBASIC, an advanced BASIC language that you can use to write your own programs. There's also Perfect Writer (a word-processor program) and Perfect Speller (a spelling checker), The Word Plus (a highly rated spelling checker), and Perfect Filer (a database program). In addition there's Perfect Calc (a "What If...?" program), Profit Plan ("What If...?" business planning), and a

Where's Your ELECTRONICS CAREER Headed?



No commuting to class. Study at your own pace, while you continue on your present job. Learn from easy-tounderstand lessons, with help from your instructors when you need it.

DEGREE

Grantham has been training students for electronics degrees longer than any other home-study, independent-study, or correspondence institution. Grantham is the only school in the United States offering an accredited B. S. Degree in electronics by home study, independent study, or correspondence.

Our free bulletin gives full details of the home-study program, the degrees awarded, and the requirements for each degree. Write for our free

Bulletin 5-84.

Grantham College of Engineering is a specialized institution catering to mature individuals who are employed in electronics and allied fields such as computers. The field of electronics is so enormous that opportunity for advancement is always present. Promotions and natural turnover make desirable positions available to those who are prepared to move up!

Advancement in electronics is made easier and more certain by (1) superior knowledge, and (2) documentation of that knowledge. Grantham specializes in making both 1 and 2 as listed above available to you.

Grantham's home-study program leading to the

B. S. DEGREE

may fill an important need for you. This is a comprehensive correspondence program in which you first review some things you already know, in preparation for the studies that come later. Some previous knowledge in the field is presumed, but is thoroughly reviewed in depth, so as to give you a thorough foundation for the level of studies you have not previously undertaken. Even though some students hold associate degrees before enrolling, an A. S. Degree is awarded along the way toward the B. S. Degree.

For full information, write for Bulletin 5-84.

Grantham College of Engineering 2500 So. La Cienega Blvd. P. O. Box 35499 Los Angeles, CA 90035

game package. Also included are the usual CP/M utilities such as PIP and SUB-MIT, as well as some unusual but extremely convenient routines. For example, one utility allows the user to instantaneously select the baud rate for the modem RS-232 port, while another utility allows the simultaneous selection of a different baud rate for the second RS-232 port. (Since two serial ports have been provided, you, of course, can have both a modem and a serial printer connected at the same time; the modem does not disable the printer.)

There's also Kaypro's version of the

public-domain utility XDIR that provides an alphabetized directory showing the size of each program and the free space on the disks. Kaypro also provides a dumbterminal program and a utility called SAFETY.

SAFETY is the software that permits the hard disk to be truly portable. As you might have wondered, how does one prevent knocks and jolts from causing the hard disk's heads from crashing into the disk and damaging the magnetic surface? The very last thing the user does before shutting down is to run the short and fast SAFETY program that parks the heads on

a safe area of the disk. With the heads parked, knocking the computer around causes no damage to the surface of the hard disk.

Keep in mind that in the past Kaypro has continuously upgraded and changed the software bundled with their computers, so that by the time you read this report the bundled software that is being provided with the computer might be completely different. There might even be several different packages. In that case, you might even be allowed to choose between different software packages at no extra cost.

Instructions

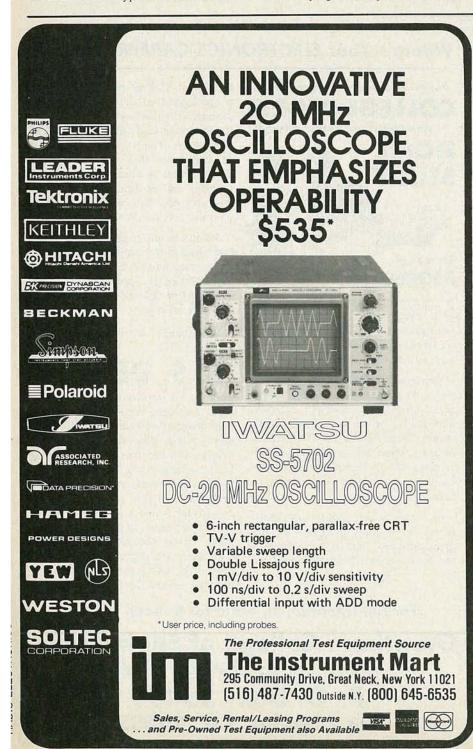
We had the fourth draft of Kaypro's own preliminary operating manual for the computer. It was excellent: notably clear, well organized, with an excellent table of contents (among the best operating manuals we have seen). Unfortunately, the same cannot be said for the other software, whose documentation is the original from the software houses. Except for The Word Plus documentation, the remainder of the software documentation was the usual wordy, dull, tutorial style that has come to characterize personalcomputer manuals. The CP/M documentation that was provided was the version by Digital Research, which is virtually incomprehensible to anyone except a computer specialist or engineer. (We wish that most of the documentation were rewritten by Kaypro!)

There is not much negative to say about the computer itself because it worked flawlessly, even after being subjected to some rather rough handling for two months. However, we must point out that we were extremely careful at all times about always parking the hard disk's heads with the SAFETY program.

The screen display is quite bright and razor sharp, with an outstanding, easily readable font (type style). The display looks as good as what you'd expect from a high performance typewriter or printer. As mentioned, the overall handling of the unit was exceptional, though we're not fond of the locking lever on the half-height floppy-disk drive (most half-height drives have a similar lever).

The only real complaint with the computer is the female Centronics-type socket connector used for the parallel printer output; it's the wrong gender. A socket is generally used on a printer. The computer should have a plug connector so a standard extension or connecting cable can be used. (And anyone who's ever looked knows, it's not easy to locate a male-tomale cable in local computer stores.)

Other than the printer connector there are no complaints, not even nit-picking. The *Kaypro 10* does exactly what it's supposed to do—and it does it remarkably well.



Heath EE-3201 Digital Techniques Course

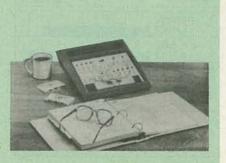
Learn all about digital electronics with this home-study course.

CIRCLE 102 ON FREE INFORMATION CARD

IF THERE IS ONE WORD WHICH TYPIFIES the world of electronics today, the word is digital. There is no escaping it. Everywhere we turn in this electronics world—whether we're involved with it for hobby or business purposes—we encounter the need to be familiar with digital techniques.

It doesn't matter whether we're involved with computers, radio, television, or consumer-electronics repair because they are all using digital circuitry in one way or another. And, since that is the case, it makes sense to learn about digital theory and applications.

But, where do you begin the learning process? If you are in school, then you have no problem because it's what you are studying. Otherwise, you have the alter-



natives of going to the library and trying to teach yourself from the books on the shelf; buying every modern book on the subject and studying them thoroughly; signing up for an evening course at a local school or college, or taking a home-study course.

A home-study course

Some of the best home-study material on the market is provided by the Heath Co. (Benton Harbor, MI 49022) via their series of continuing education courses. Those courses provide the type of training needed for the person who wants some knowledge, but doesn't need the full course provided by a traditional correspondence school. To be sure, you can use the Heath series in such a manner.

But, if you are simply looking for specific training on a specific topic, then Heath's courses provide an ideal program.

The course we will be looking at this month is their EE-3201 Digital Techniques course. Using well-written, highly illustrated textual material, that course takes you through every step you need to become fully familiar and comfortable with digital theory and electronics. The course relies not only on the traditional question-and-answer technique of learning, but also provides positive reinforcement to that learning with short tests at the end of each learning unit and with a final examination at the end of the course. The unit exams allow you to test your knowledge and give you the opportunity of reviewing any material on which you may be a little weak, while the final examination tests your overall learning of the material. It is returned to Heath for grading and, if you pass the course, you can earn continuing education credits.

As with other Heath courses, programmed experiments are used to help you appreciate and gain a better understanding of what you have learned. Like all Heath products, the company supplies you with all the discrete components you will need to complete the experiments.

However, completing those experiments does require that you to invest in



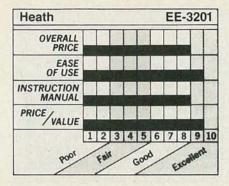


the ET-3200B Trainer, which provides not only three built-in, regulated power-supplies, but also four logic switches, a three-frequency clock, and a solderless breadboard. You can assemble this kit yourself or have it preassembled from the factory. The kit costs \$99.95, while the assembled version costs \$179.95. Either way, it does increase the \$89.95 cost of the course, although you can buy both the course and trainer kit for \$174.90.

That added investment is well justified if you intend to continue with other Heath courses, or if you do breadboard circuits and need a way to test them as part of your hobby or professional work.

Further, the course does require you to have a multimeter and single-trace oscilloscope, which, if you are just purchasing them for the first time, can also raise the cost of this course appreciably. However, once you have that important test equipment, it is always there on your bench for you to use.

As with all Heath courses, Digital Techniques comes with high-quality vinyl binders that hold the course material, and all of the components needed for the experiments. At one time, Heath offered audio learning aides as part of the course, but that policy has now changed and the company makes them available as a \$19.95 option.



What's covered

The purpose of all of that is to make you completely comfortable when working with digital circuitry. By the time you finish the course, you will be able to discuss the advantages and benefits of using digital techniques in electronic equipment. You will also be able to name the major applications of digital techniques in electronics, convert between the binary and decimal number systems, and recognize the most commonly used binary

Further, you will also be able to name the major components used in implementing digital circuits, such as gates and flip-flops, and explain how they operate. You will also be able to identify the more commonly used integrated circuit families used in digital equipment, as well as be able to discuss their operation, characteristics, and features.

Other topics covered in the course include Boolean algebra and how to use it to express logic operations and minimize logic circuits in design. Among the digital circuits examined are binary and BCD counters, shift registers and a variety of other sequential and combinational logic circuits.

Also covered is how to design combinational and sequential logic circuits for a given application, the operation and application of digital counters in time and frequency measurements, and how a digital computer is organized and how it operates. Finally, the course concludes with a thorough discussion of microprocessors, including a look at their operation and applications.

Through all of the lessons in the course you are constantly performing experiments to help increase your knowledge and reinforce what you've already learned. It is a very good teaching method. Overall, we found the Heath EE-3201 Digital Techniques course to be worth the time and effort involved. It was well-written and easy to use. We would have liked to see the audio aids still included as part of the unit as they do help. As such we recommend their purchase.





... ROUT BURGLARS WHILE THEY'RE STILL OUTSIDE . . . PROVIDE SAFETY LIGHTING ON DEMAND — SAVE ENERGY

The Sentrynet Model PD-245 is an easily installed, self-contained field disturbance sensor. Mount anywhere with adhesive backing or screws — plug it in — operate!

The Sentrynet Model PD-245 is not one of those timer systems or simplistic alarms that professional thiefs have gotten used to, or are able to defeat!

The Sentrynet Model PD-245 turns on the light or alarm device of your choice when a protected area (adjustable) has been penetrated, and keeps it on as long as penetration persists, plus a generous delay (adjustable). It "sees" the penetrator even through wooden doors, walls, and windows if desired, unlike ultrasound or infrared systems.

Range is dependably adjustable to tailor sensitivity to precise needs and avoid false activation. You can use as many as needed, even in overlapping zones, without mutual interference. Range 5-25 feet or more. Size 5" x 5" x 1¾". Drives up to 250W A.C.

To order your unit, send \$69.96 (includes shipping) to -

SENTRYNET · P.O. Box 1208 · Evanston, Illinois 60204

Illinois residents add 6% to cover state tax.

MONEY ORDER, VISA OR MASTERCARD ACCEPTED. DEALER INQUIRIES INVITED

The Bearcat DX1000 makes tuning in London as easy as dialing a phone.

Direct access keyboard tuning brings a new level of simplicity to shortwave radio. With the Bearcat® DX 1000, dialing in the BBC in London is as easy as dialing a telephone. And you can switch from the BBC to Peruvian Huavno music from Radio Andina instantly. Without bandswitching.

Featuring the innovative microprocessor digital technology made famous by Bearcat scanner !! radios, the DX 1000 covers 10 kHz to 30 MHz continuously, with PLL synthesized accuracy. But as easy as it is to tune, it has all the features even the most sophisticated "DXer" could want. 10 memory channels let you store favorite stations for instant recall—or for faster "band-

scanning" during key openings.

The digital display measures frequencies to 1 kHz, or at the touch of a button, doubles as

a two time zone, 24-hour digital quartz clock. A built-in timer wakes you to your favorite shortwave station. Or, it can be programmed to activate peripheral equipment like a tape recorder to record up to five different broadcasts-any frequency, any mode-while you are asleep or at work.

The DX 1000 also includes independent selectivity selection to help you separate highpowered stations on adjacent

frequencies. Plus a noise blanking

system that stops Russian pulse radar interference.

There's never been an easier way to hear what the world has to say. With the Bearcat DX 1000 shortwave radio, you have direct access to

the world. For the name of your

nearest retailer dial toll-free... 1-800-SCANNER.

Frequency Range: 10 kHz to 30 MHz continuously. Tuning: Direct keyboard entry, selectable 3 or 24 kHz per revolution knob tuning, or manual step tuning in selectable 1-99 kHz steps. Sensitivity: 1.0 μV AM, 0.5 μV CW/SSB/FM, 1.6-30 MHz. Image and IF Rejection: 70 dB or more. Memory: 10 frequency capacity. Frequency Stability: Better than 100 Hz after warm-up. Modes: AM/LSB/USB/CW/FM. AGC: Selectable Fast/Slow release times. Filter Bandwidths: 2.7 kHz, 6 kHz and 12 kHz. Filter Selection Independent of Mode.

Bearcat DX 10

Direct Access To The World.



RADIO-ELECTRONICS

THE POMONA PROMISE

Our constant goal is to provide the design engineer with the best DIP IC test clips made in this country.

Or anywhere.



The best.

Yes, we know that's a big statement, the kind that puts your reputation on the line.

But that's okay with us because it's what we've been saying ever since we started in business back in 1951. So it's only natural that when we began producing test clips for dual in-line integrated circuit packages we would promise design engineers only one kind of performance. The best.

Well, we've been making the Dip Clip for quite a while now, and the professionals in the electronics industry who have used our products will tell you plainly and simply that we kept our promise.

At ITT Pomona Electronics, we know there is no such thing as standing pat. We also know that your needs change and your expectations become greater as the demands become more severe. To this end we will continue to create a better way. A better product.

That's a promise.

All of our products are described and illustrated in our General Catalog, and it's free. Just call (714) 623-3463 or 623-6751. TWX 910-581-3822. Write to us at ITT Pomona Electronics, a Divi-

CIRCLE 37 ON FREE INFORMATION CARD

sion of ITT Corporation, 1500 E. Ninth St., Pomona, CA 91766.

In Europe: ITT CANNON BELGUIM S.A./N.V. Rue Colonel Bourg Str. 105 Space A (B.3) 1140 Brussels, Belgium. Phone: 02-735-6094.

Our products are available through your favorite electronics parts distributor.

*Dip Clip is a trademark for a Pomona Electronics test clip.

III Pomona Electronics

NEW PRODUCTS

For more details use the free information card inside the back cover.

MOBILE SCANNER, model MX-3000 is a compact-size unit with computer touch-entry programming and six-band coverage, with 30 channels, designed for use at home or on the road. Programming is simple and a "beep" tone verifies entry.

The model *MX-3000* can also search for active channels through as much as an entire

reply; if scan delay is not selected; scanning resumes in about six-tenths of a second. Scanning can be at either 5 or 15 channels per second. A channel-lockout feature excludes selected channels from the scan; that keeps generally busy channels programmed into the scanner, while preventing them from "locking in" on each scan.



CIRCLE 101 ON FREE INFORMATION CARD

band; when one is found, its frequency will appear on the digital display. Search can then resume, or the new frequency can be stored in one of the 30 scan channels. A selected priority frequency can be programmed into Channel 1; if active, it automatically overrides any other signal. A scan-delay feature holds a channel open for approximately two seconds at the end of a transmission to wait for any

The multifunction digital display shows channel numbers when scanning, the channel and frequency when receiving, delay-function and channel-lockout status, and search-mode operation. A brightness switch can be set for day or night operation.

The model MX-3000 is priced at \$299.95.—Regency Electronics, Inc., 7707 Record Street, Indianapolis, IN 46226.

COMPUTER-SECURITY DEVICE, "Gateway," is a stand-alone device for use with asynchronous modems on dial-up or leased lines, connecting to micro's, mini's, or mainframes. It requires entry of both a correct ID code and password before entry is allowed. If the correct codes are not entered within three attempts, Gateway forces the modem to disconnect, defeating everything from the oftenused "Monte Carlo" to the highly-sophisticated "Trojan Horse" style of gaining illegal

entry. There is also a user-definable time limit for the logon attempt. Again, if successful logon is not achieved before time runs out, Gateway breaks the connection.

Gateway allows the use of up to 20 passwords and user ID codes, which can be easily defined and changed by the authorized person. ID codes can be up to 20 characters. Passwords can be any length, with an optional minimum length, and can use not only letters and numbers, but characters such as

Electronic Troubleshooting

WINNER



Hickok's MX333 with VARI-PITCH® and LOGI-TRAK®

Instantaneous VARI-PITCH speeds:

- · Voltage tracing
- Troubleshooting in hard-toreach locations
- Tuning type adjustments
- Resistance checks
- Digital logic troubleshooting

And . . . Detects signal characteristics and abnormalities not possible with digital or analog meters.

LOGI-TRAK replaces the best 100MHz logic probes and offers:

- Eyes on the probe tip, HI/LO indication
- Instant identification of marginal states and fault conditions
- 100MHz response
- 5n sec pulse detection

LISTEN to what the MX333 can do for you. Ask about our NO RISK 30 day Free Trial.



THE HICKOK ELECTRICAL INSTRUMENT CO. 10514 Dupont Avenue • Cleveland, Ohio 44108 [216] 541-8060





Plus FREE Desoldering Wick
with each pound of solder

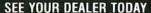
FREE Freight On All Orders Over \$25 der \$25 add \$2.50 per order. Minimum order \$10 Check Money Order Master Charge Visa N.Y. State residents add appropriate sales tax

To place your order call: TOLL FREE 800-645-4808

In NYS (516) 334-2660 No COD's accepted

P.O. Box 668 Jericho, N.Y. 1175.

CIRCLE 58 ON FREE INFORMATION CARD





Firestik'I GOLDEN SERIES

BARE-HANDS TUNABLE 'NO TOOLS NEEDED" HIGH PERFORMANCE ANTENNAS

> ALSO ANTENNAS FOR **CORDLESS TELEPHONES** MONITOR SCANNERS

Dealer & Distributor Inquiries Invited SEND FOR FREE CATALOG

<u> </u>	
	'Firestik' Antenna Company
1 182	2614 East Adams/Phoenix, AZ 85034
Name .	
Street .	TARREST STATE OF THE PARTY OF T
City	
State _	Zip
C	Serving the CB and ommunications Market Since 1962.
5-YEA	R REPLACEMENT WARRANTY

CIRCLE 40 ON FREE INFORMATION CARD

spaces, commas, and control characters for added password security. Since the unit is menu-driven, no programming knowledge is

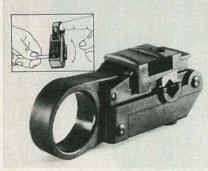


CIRCLE 102 ON FREE INFORMATION CARD

needed to change passwords, ID codes, time limits, or other Gateway features. A record is kept of all logon attempts, both successful and unsuccessful. The authorized person can access that record and spot attempted illegal entries. The record is protected from power failure (as are all other Gateway functions) by a non-volatile memory.

Gateway is priced at \$395.00.-Adalogic, 1522 Wistaria Lane, Los Altos, CA 94022.

COAX STRIPPER, No. 70374, has a holdingring design that allows the user to strip coax cable with minimum effort. With one's finger in the holding ring, one simply inserts the wire and rotates the tool. It is designed to strip cleanly all of the five most popular sizes of



CIRCLE 103 ON FREE INFORMATION CARD

coax cable; RG-6, RG-8, RG-9, RG-174, and RG-182. The stripping blades can be adjusted easily for different cutting depths to meet the user's specifications, and the tool can be set to perform both two- and threelevel strips. A 2-bladed replacement blade cassette for the stripper is available. The No. 70374 is priced at \$45.90 — Vaco Products Company, 1510 Skokie Blvd., Northbrook, IL 60062.

EQUALIZER/ANALYZER, the model dbx 10/20, enables automatic equalization to be achieved individually for left and right channels, or in combination, with the accuracy that only a computer can provide. It can analyze



CIRCLE 104 ON FREE INFORMATION CARD

as many as 10 locations within a room and then automatically adjust equalization for flat response. The proper equalization setting within a room can be accomplished in seccontinued on page 43







performance by design

Folding Meters are Better

Not all multimeters fold. There's a reason. While other manufacturers were busy copying each others designs, BBC looked at where portable meters were used and how they could be improved.

The result is a unique approach. Folding meters with large displays (18 mm LCDs) and adjustable viewing angles. Now you can have high performance in a meter that excels in the field and on the bench.

Hands Free vs Handheld

In multimeters "hands free" is significantly better than "handheld." You need three hands to operate the typical "handheld" meter in the field. One for the meter and two for the probes. BBC's folding design lets you use a neck strap for the meter. This frees your hands for the probes.

On the bench, the large, adjustable displays pay off. It's a sensible design that lets you make measurements faster and more easily.



A Heritage of Precision

BBC's track record of expertise in precision engineering spans eight decades. All our meters are built to tough VDE and DIN safety standards. The 3½-digit DMM's feature 0.1% basic dc accuracy and externally accessible fuses for overload protection.

CIRCLE 72 ON FREE INFORMATION CARD

Compact, Rugged and Affordable

To design the impact resistant case that protects these DMM's, BBC relied on the industrial design skills of the Porsche Design Studios.

When open, the display angle is easily adjustable. When closed, the display and the controls are protected, and the meters turn off automatically. Competitive pricing is another feature of BBC meters. Prices start at \$193.00.

Available Locally

BBC meters are available throughout the U.S. If your instrumentation supplier doesn't carry BBC yet, we'll gladly tell you who does. Call toll free:

1-800-821-6327 (In CO, 303-469-5231)

BBC - METRAWATT/GOERZ 6901 W. 117th Avenue Broomfield, CO 80020, Telex 45-4540

Engineering Excellence in Test and Measurement



At CIE, you get electronics career training from specialists.



If you're interested in learning how to fix air conditioning, service cars or install heating systems— talk to some other school. But if you're serious about electronics... even earning an Associate Degree... come to CIE—The Electronics Specialists.

Why trust your education and career future to anything less than a specialist?

You shouldn't. And you certainly don't have to.

If you talked to some of our graduates, chances are you'd find a lot of them shopped around for their training. They pretty much knew what was available. And they picked CIE as number one.

Be sure to shop around. Because, frankly, CIE isn't for

everyone.

There are other options for the hobbyist. If you're the ambitious type—with serious career goals in electronics—take a close look at what we've planned for you at CIE. What you should look for first.

Part of what makes electronics so interesting is it's based on scientific discoveries—on ideas! So the first thing to look for is a program that starts with ideas and builds on them!

That's what happens with CIE's Auto-Programmed®Lessons. Each lesson takes one or two principles and helps you master them—before you start using them!

How practical is the training?

This is the next big important question. After all, your career will be built on what you can do—and on how well you do it.

Here are ways some of CIE's career courses help you get your "hands-on" training...

With CIE's Personal Training Laboratory...

you learn and review the basics perform dozens of experiments. Plus, you use a 3-in-1 precision Multimeter to learn testing, checking, analyzing!

When you get your own 5MHz, solid-state oscilloscope, you take some real professional steps. You use it as a doctor uses an X-ray machine—to "read" waveform patterns...lock them in...study, understand and interpret them!

When you get your Digital Learning Laboratory, you'll be into digital theory—essential training today for anyone who wants to keep pace with the state of the art of electronics. With CIE's Digital Lab, you'll be applying in dozens of fascinating ways the theory you've learned. For example, you'll compare analog and digital devices. You'll learn to make binary to decimal conversions and to work with semiconductor devices and circuits. You'll see how digital equipment is vital to today's exciting, growing fields such as security... where digital theory provides the brains for space-age alarm and protective devices.

You'll build your Microprocessor Training Laboratory, a working microcomputer—from "scratch." You'll also learn how to program and interface it with displays, memories, switches, and more.

Earn An Associate Degree from CIE.

One of the best credentials you can have in electronics
—or any other career field
—is a college degree. That's why CIE gives you the opportunity to earn an Associate in Applied Science

in Electronics Engineering Technology. Any CIE career course can offer you credit toward the degree...more than half of the number needed in some cases.

You can also prepare for the government-administered FCC (Federal Communications Commission) Radiotelephone License, General Class. It can be a real mark in your favor... government-certified proof of your specific knowledge and skills.

Shop around...but send for CIE's free school catalog first!

Mail the card. If it's gone, cut out and mail the coupon. If you prefer to write, mention the name and date of this magazine. We'll send you a copy of CIE's FREE school catalog—plus a complete package of independent home study information! For your convenience, we'll try to have a representative contact you to

answer your questions.

Mail the card or couponor write: CIE, 1776
East 17th St.,
Cleveland,
OH 44114.

Cleveland Institute of Electronics, Inc.

1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

YES... I'm shopping around for the <u>right</u> kind of career training in electronics—and CIE sounds well worth looking into. Please send me my FREE CIE school catalog—including details about the Associate Degree program—plus my FREE package of home study information!

Address			Apt
City	State		Zip
Age	Area Code/Phone No	1	ur Africa
Check box f	or G.I. Bill information: Veteran		ctive Duty

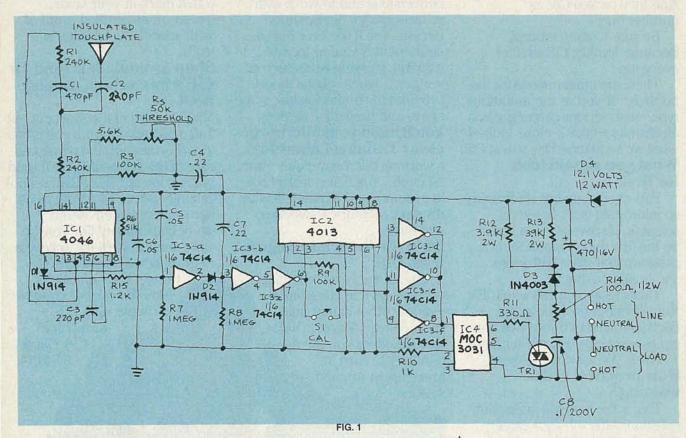
MAIL TODAY!

RE 84

RADIO-ELECTRONICS

NEW IDEAS

Proximity power switch



HOW MANY TIMES HAVE YOU COME YOUR home with your arms loaded down with packages and, after great difficulty, managed to turn on the light? And how often have you wished for an easier way? This month we'll look at a little gadget that allows you to switch an AC device on and off by simply passing a hand (or some other part of the body) near an insulated touchplate.

How it works

The circuit is powered by a 12.1-volt regulated power supply made up of diodes D3 and D4, capacitor C9, and resistors R12 and R13. The AC voltage is picked directly off the AC line and rectified by D3 (half-wave rectifier). The resulting DC voltage is filtered by C9 and regulated by D4, a 12.1-volt Zener.

Turning to the rest of the circuit we have IC1, which is a 4046 PLL (*P*hase-Locked-Loop). That IC contains a VCO (*V*oltage-Controlled-Oscillator), a source follower, and two phase comparators

(which we'll call comparators 1 and 2) with a common input-amplifier. When power is applied to the IC, the VCO outputs a signal at pin 4 that is fed to both comparators via pin 3 for use as a reference. That same signal is also fed to its input at pin 14 through an R-C network consisting of R1, C1, and R2. As long as there's no phase difference detected by the internal phase-comparator between the VCO output and the input signal, the output of IC1 is zero. But when a hand is passed close to the touchplate, body capacitance causes a phase difference. That phase difference is fed to the comparators through the common input amplifier. Comparator I now takes that input signal, compares it to the reference and outputs a squarewave signal at pin 2 that is proportional to the difference between the two input signals.

The output of comparator 1 is then filtered and fed to the VCO as an error signal. The error signal causes the VCO to generate an error-correction signal, which is then fed back to the comparators. Comparator 2 then outputs a train or series of pulses that is fed to a pulse-stretching circuit consisting of three of the op-amps contained in IC3, a 74C14 hex Schmitt trigger. (A pulse stretcher is a shaping circuit whose output pulse duration is greater than its input.) The stretcher circuit also provides for debouncing and noise rejection.

After conditioning, the signal is fed to pin 3 of IC2, a 4013 dual D-type flip-flop that's used as a toggle flip-flop for alternate-action switching. By that we mean that the device is turned on or off alternately by the input signal (push on/push off). To accomplish that action, the output of the flip-flop (pin 2) is fed to its data input (pin 5). The logic level at the pin 5 is transferred to its output at pin 1 during each positive-going transition of the clock pulse.

At this point, the o output of the flipflop is fed to the remaining three inverters continued on page 110

New Dimensions In Time & Frequency

Now a Unique concept in benchtop/portable instruments Global Specialties' New Handheld Model 5000 COUNTER TIMER

Designed for both laboratory and field operation, the Model 5000 is sophisticated enough to handle virtually all your Time and Frequency measurement needs.

BIG ON VALUE... FEATURES & PERFORMANCE. The only things small about the Model 5000 are its SIZE (7.60 x 3.75 x 1.72 inches) and PRICE... at only \$349.95 can you afford not to have one? In stock now and ready for delivery ... call us TOLL FREE to find out how to get your Model 5000 today!

- · Measure Frequency, Period and Pulse Width
- · Full input signal conditioning
- Battery or Charger/Adapter operation
- Unique automatic master reset logic
- High contrast 0.43 inch, 8 digit LCD display
- . LCD indicators: Overflow, Gate Open, Low Battery
- Display storage function maintains last reading

SPECIFICATIONS -

Input: BNC

Impedance: 1M Ω @ 25pF in all modes
Sensitivity: 30 mVRMS — 1 kHz to 30 MHz

50 mVRMS — DC to 50 MHz

Modes:

Power:

Frequency: .1 Hz to 50 MHz (gate times 0.01, 0.1, 1.0, 10 s)

Period: 50 ns to 10 s (1, 10, 100, 1000 cycle averages)

Pulse Width: 25 ns to 10 s (1, 10, 100, 1000 cycle averages)

Full Signal Conditioning:

Coupling: AC or DC switch selectable

Attenuation: x1, x10, x100 switch selectable

Polarity: +/- edge Freq. & Period; >/< trigger

level, Pulse Width

Trigger Level: variable 0 ± 500 mV x attenuator setting
Time Base: 10 MHz crystal oscillator (± 4 ppm,0-40°C.)

Controls: Power/Test/On, Mode, Gate

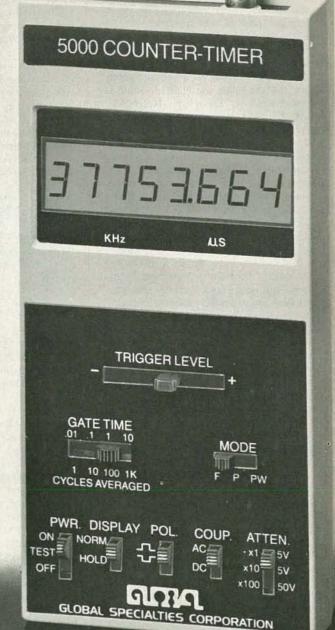
Time/Cycles Averaged, Display-Norm/Hold, Trigger Level,

Polarity, Coupling, Attenuation 6AA Cells (Nicad or Alkaline) 10 hrs continuous operation Optional AC

Charger/Adapter

Dimensions: 7.60 x 3.75 x 1.72 inches,(193 x 95 x 44 mm)

Weight: 14 oz., (397g), without batteries



GLOBAL SPECIALTIES CORPORATION

ดกรด

GLOBAL SPECIALTIES CORPORATION

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

OTHER OFFICES:

San Francisco (415) 648-0611, TWX 910-372-7992,

Europe: Phone Saffron-Walden 0799-21682, TLX 851-817477

CIRCLE 96 ON FREE INFORMATION CARD

5 HADIO-ELECTHUNICS

THE DRAWING BOARD

Bipolar supplies from a single 9-volt battery

ROBERT GROSSBLATT

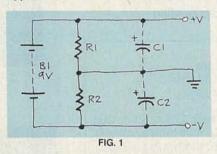
A FEW MONTHS AGO WE ASKED IF ANY OF you out there could come up with a way to generate positive and negative voltages using only one nine-volt battery. To tell you the truth, we expected to get a few answers and then that would be the end of it. Well, as someone once said, the longer you live the more you learn. In the first installment of "Designer's Notebook" (March, 1984) we presented a handy circuit that would produce a bipolar supply from a single battery. Needless to say, that column was written some time before we started this "contest" and in actual fact, the circuit shown and described there is one that we've been using in one variation or another for quite a few years. It fills all the criteria we've talked about for circuit design: simplicity, reliability, and best of all-it's cheap!

The circuits that were sent to us covered the entire spectrum of possible designs from the straightforward to the convoluted, and from the perfectly workable to the absolutely ridiculous. A few of them were absolutely wonderful and we found ourselves really admiring them and wishing that the laws of the universe were changeable so that they could be made to work! In a nutshell, all the designs that were sent in can be grouped into three categories: 1. Simple voltage dividers; 2. Oscillator and charge-pump variations; and 3. Wishful thinking. It's impossible for us to list and mention all the people who sent in answers, so we've had to pick a representative sampling from the three categories. The ones that we'll discuss here are those that we thought would be the most interesting for everyone—not the best or the worst, mind you, but simply the most interesting. (Everyone who sent in an answer and included a return address will get an answer from me. I'm sorry that I've gotten a little behind in answering my mail but I promise that I'll take care of that in the near future.)

We had planned to spend this month discussing our digital sinewave-generator but obviously many of you out there want to know about positive and negative power-supplies. In any event, we'll get back to the sinewave generator next month; remember, any time that you spend learning something is a far cry from being time wasted.

Generating a bipolar supply

The most logical approach to the problem of creating a bipolar supply is to build a simple voltage divider. Now, we know that there are many very obvious disadvantages to doing something like that, but there are also lots of advantages as well. And since the whole purpose of creating a bipolar supply is to save time and money, it stands to reason that you'd want to use the simplest design possible. In fact, the whole problem can be eliminated by the simple expedient of using either a centertapped transformer or two batteries.



A classic voltage divider is shown in Fig. 1. That basic circuit was sent in by Brian Corzilius, Ken Fink, and David Berger among others. For starters, you couldn't ask for anything simpler. Just dive into your junk box, grab a pair of resistors and presto—a bipolar supply. No fancy parts, no silicon, and best of all, no brain damage. So what, you may well ask, is wrong with that? The first problem with the voltage divider is that it should only be used with circuits that have a relatively high input-impedance. Any circuit that draws serious amounts of power is going to drain the battery in record time. Remember: current has to return to ground, therefore the same resistors that are creating the bipolar supply will also act as current limiters. If the supply is to power some device that draws 50 milliamps or more, then the resistor values have to be chosen by the application of Ohm's law, but be careful because it's not quite as straightforward as you might

Let's suppose that you need 30 mA from the positive side, 5 mA on the negative side and the voltages have to be the same (i.e. plus and minus 5 volts). In order to get equal voltages you have to

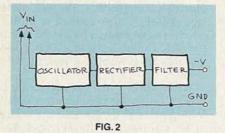
have equal resistors. That means that both R1 and R2 must be able to pass 30 mA. Since those two resistors are in series with each other and in parallel with the battery, that translates into a 15 mA drain-roughly 50% of the needed current. That's quite a price to pay. And if you pick a value for R2 that limits the negative current to 5 mA you're not going to get an equal bipolar supply.

Tom Mosteller has also pointed out another often overlooked drawback to that kind of circuit. Battery impedance isn't constant: it rises with frequency; also resistive voltage dividers can cause problems when used in circuits that have highfrequency signals running through them. Fortunately, that can be overcome by using a pair of capacitors to decouple the power supply from the rest of the circuit. For the capacitors shown with dotted lines in Fig. 1. Tom recommends a value of about 10 µF and we agree with him.

The last awful thing that we have to say about this circuit is that the best voltage you can hope to get from either side of the supply is half the battery voltage (assuming you want an equal bipolar supply). Assuming that we're talking about a ninevolt battery (which is what we were originally talking about) we're only looking at plus and minus 4.5 volts for a new battery-most nine-volt batteries are lower than that right out of the blister pack. That 4.5 volts is a bit low for most applications and the battery is going to start dying at a seemingly incredible rate. In addition, when a nine-volt battery settles into middle age, it usually puts out around 7 volts. That translates into less than 4 volts on either side of the supply, and there's not a whole lot you can do with such small voltages. All in all, the voltage divider approach to a bipolar supply leaves a lot to

Unless your application can tolerate all the restrictions we've just discussed, a much better approach to the problem is to use an oscillator/charge-pump design. That's the kind of circuit that was shown in the first installment of the "Designer's Notebook." Although that circuit is more complex, the basic idea is rather simple and the design is a lot more versatile. Because there's no convenient AC source in a battery-powered circuit, the most direct approach is to manufacture one. That is, put together an oscillator and then rectify the resulting AC to produce a negative DC supply. The amount of current you get from the circuit depends on how much current the oscillator can output. The design of the circuit downstream of the AC is a direct clone of the transformer/rectifier that we're all familiar.

Dick Kaufman, Dale Nassar, David Van Stone, Tom Lewis, and others all used that approach, though their individual circuits differed. Figure 2 is a block diagram of the circuit we're talking about. It's really as simple as it looks and your design can be as simple or sophisticated as you need. The oscillator can be whatever you want and the rectifier can be either half-wave or full-wave-it doesn't really matter. It should be set to trap the negative half of the voltage swing from the oscillator but, other than that, there's nothing new. See the circuit in the March, 1984 "Designers Notebook" for the circuit details. The circuit's output voltage will be unregulated but that can be handled easily enough by hanging a regulator at the output. Since there's a voltage loss when you do that, it might be a good idea to use a voltage doubling rectifier.



The filter shown in Fig. 2 can be as simple as a capacitor or as complex a scheme as you want-again it depends on what you need. Remember that your oscillator is producing a high-frequency signal, and that the high frequency can drive some circuitry around the band. If you have any doubts, make sure that your filter

can take care of it.

The last category we listed was wishful thinking; rather than describing some of the more ridiculous circuits, let's take a look at an idea that is at least theoretically possible-it was certainly the most direct solution that was sent in. Mr. D. L. Bray suggested, more or less as a joke, that we take a 9-volt battery apart and solder a ground connection to the center cell. To save all of you a lot of trouble, let us tell you that we tried it and it works! Now all we need is some advice on how to put the battery back together again.

Before we forget, our special thanks to James Richey for sending us a working model of a charge-pump type of circuit. It's always nice to see an idea on paper, but it's much more satisfying to see it actually turned into hardware.



CIRCLE 59 ON FREE INFORMATION CARD



For non rush service send the Reader Service Card to the magazine.

DESIGNER'S NOTEBOOK

Extending the counting range of the 4017

ROBERT GROSSBLATT

THE 4017 IS ONE OF THE MOST POPULAR OF the CMOS MSI (Medium Scale Integration) counters. Because it sequences its outputs one at a time, it's ideally suited to serve as a frequency divider, pulse delayer, and so on. That IC even has a carry output that allows you to cascade as many 4017's as desired.

There is an application, however, where the use of the 4017 isn't quite as simple and straightforward. We're talking about connecting several of them together so that they will all sequence their outputs one IC after another. The carry output isn't any good here because it goes high for one-half of the IC's full count and low for the other half. That's great if you want a squarewave whose repetition rate is onetenth of the input clock frequency. But it doesn't help at all if you need a simple circuit that will take an input-clock signal and turn on more than ten outputs in sequence. Doing that requires a bit of external gating.

This month we will look at how you can arrange three 4017's to sequence in turn and provide up to twenty-five outputs with a minimum of external gating. We will be using a 4011 quad-NAND gate to achieve

the desired gating arrangement. The same principle can be followed if you need more than twenty-five outputs; just add more 4017's and a few more gates. Since there are four NAND gates in the 4011, it will accommodate two more 4017's to give you a total of 41 outputs. We're losing five possible outputs for a variety of reasons that will become clear shortly.

How it works

In Fig. 1, the clock inputs of all the 4017's are tied together so that they can all be triggered by a common clock pulse, and the same goes for the reset pins. The key to making the circuit work is using the gates to control the enable pins (pin 13) so that the three IC's can be made to count in sequence. Since the enable pins are active high, they have to be brought low. We'll use the NAND gates to control the order in which the 4017's are enabled.

When power is first applied to the circuit, capacitor CI generates a reset pulse that forces all the 4017's to output a "0" at pin 3. One of the unfortunate features of the 4017 is the lack of a convenient inhibit pin that we could use to turn off all the outputs. When the enable pin is brought

high it only disables the clock input—it doesn't do anything to the outputs. That's why we need the external gating and that's also the reason that we can only get 25 outputs from the circuit instead of 30.

When the counting first starts, pin 11 of all the counters is brought low. Because pin 11 of IC1 is connected to its enable pin, the IC is enabled and starts to count. That same low signal is fed to one leg of NAND gate IC4-a at pin 5 to control the enable pin of IC2. The other leg of the NAND gate, pin 6, is connected to IC2 pin 11 through IC4-b, which is used as an inverter. Because IC2 was reset at the start of the counting process, its output at pin 11 is also low. That low output is inverted by IC4-b and the resulting high output is applied to IC3 to disable it. The high output from IC4-b is also applied to IC4-a, which in turn outputs a high to the enable pin of IC2 disabling it too. That means that only IC1 is enabled at the start of the count.

When pin 11 of IC1 goes high, it disables IC1 and at the same time that high is fed to pin 5 of IC4-a. Because both inputs to IC4-a are now high, it's output goes low and that in turn enables IC2. When the output at pin 11 of IC2 goes high, it's inverted by IC4-b and the resulting low enables IC3. The same low is applied to IC4-a causing it to change states (go high), thus disabling IC2. After nine more clock pulses the output of IC3 at pin 11 goes high applying that signal to all of the reset pins simultaneously, causing all the 4017's to reset to zero and start the whole sequence all over again.

Essentially, what we're doing is using pin 11 of each 4017 to control the enable pin of the next IC in line. When the output at pin 11 of the last IC in the sequence goes high, a high is applied to the reset pins of all the IC's causing them to be reset to the beginning. The same principle can be used to extend the sequence. Just remember that you can only use eight of the 4017's ten outputs—pin 3 is needed because there's no inhibit control and pin 11 controls the next 4017.

Let us know if you can figure out a way to use a simple gating arrangement to recover the use of some of the five lost outputs in the circuit. After all, there's always a better way to do something. **R-E**

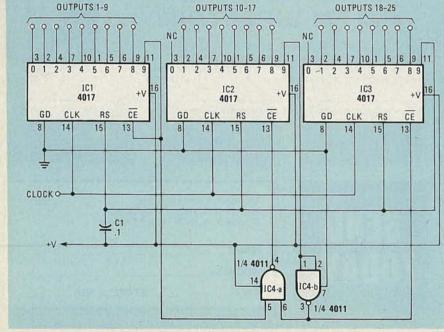


FIG. 1

DON'T FORGET



VSE YOUR READER SERVICE CARD

"Maybe it will go away."

The five most dangerous words in the English language.



NEW PRODUCTS

continued from page 32

onds, automatically and accurately.

Digitally controlled, the model dbx 10/20, with its calibrated microphone and built-in pink-noise generator, can automatically "voice" a room and store as well as recall the equalization settings. Its real-time analyzer function, which also serves as a sound-level meter, provides information on the music energy in each frequency band. A display of 275 LED's shows the functioning of the real-time analyzer by providing an instantaneous readout of musical content in each frequency band. It can also display any equalization curve stored in memory.

The model dbx 10/20 has a suggested retail price of \$1200.00.—dbx Incorporated, 71 Chapel Street, Newton, MA 02195.

FREQUENCY COUNTER, model *LDC-831*, has a 150-MHz range, a 4½ digit green LED display, and is battery operated. An optional AC adapter is available that converts the portable unit to bench use.



CIRCLE 105 ON FREE INFORMATION CARD

For high-frequency operations, the model LDC-831 can provide up to $6\frac{1}{2}$ digits of resolution. The five most significant digits are displayed, using the 0.01-second gate time. By then switching to the 1-second gate, all four digits to the right of the decimal point are displayed. The combination of two readings yields $6\frac{1}{2}$ digits of resolution. The basic accuracy of the LDC-831 is \pm 10 ppm, and it carries a two-year warranty. It sells for \$210.00.—Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, NY 11788.

AC CALIBRATOR, model 4200, is a solidstate high-output instrument featuring performance to 40 ppm on a 6½-digit scale, with



CIRCLE 106 ON FREE INFORMATION CARD

output ranges from 1 nanovolt to 1000 volts all from a single self-contained and transportable package. An optional AC current calibrator is available. It is designed as a prime source for any standards or calibration labo-



AGEMENT MASTER

The growth of NTE quality replacement parts has been nothing short of astronomical. And the proof is in our new 1984 Replacement Master Guide, destined to be the standard directory for technicians across the country. In excess of 3,000 quality NTE types are cross-referenced to more than 220,000 industry part numbers.

YOU'LL FIND ALL THE RIGHT STUFF FOR REPLACEMENT, MAINTENANCE AND REPAIR:

- Transistors
- Thyristors
- Integrated Circuits
- Rectifiers and Diodes
- High Voltage
 Multipliers and
 Dividers
- Optoelectronic Devices
- Zeners
- Microprocessors and Support Chips
- Memory IC's
 Thermal Cut-Offs
- Bridge Rectifiers
- Unijunctions
- RF Transistors
- Microwave Oven Rectifiers
- · Selenium Rectifiers
- NEW! The Protector 6000™ Transient Voltage Protection

Look for our Replacement semiconductors in the bright green polybags and cartons that list rating limits, device type, diagrams and competitive replacement right on the package. NTE quality parts are available from your local NTE distributor and come backed by our exclusive two-year warranty. Ask for your FREE NTE Replacement Master Guide and take off with NTE!



New-Tone Electronics, Inc.
44 FARRAND STREET • BLOOMFIELD, NEW JERSEY 07003
(FORMERLY TCG)

ratory.

Although based on true RMS principles, distortion figures of only 0.04% enable the model 4200 to calibrate the many meansensing instruments still in use. For higher accuracy that may be required in specialist applications, "spot" calibration is optionally available on any five selected and permanently stored frequencies.

The model 4200 is priced at \$17,995. — Datron Instruments Incorporated, 3401 S.W. 42nd Ave., Stuart, FL 33497.

CIRCUIT/COMPONENT COOLANT, Freez-It. makes thermal-intermittent troubleshooting of ciricuit boards and electronics components easy. Applied as an aerosol spray, Freeż-It will freeze to -65°F instantly. Copper circuitry will frost and turn white, exposing hairline cracks in PC boards. Rapid chilling of suspected components allows individual components to be isolated for testing. Defective resistors, transistors, capacitors, and other component parts can be identified quickly and easily.



CIRCLE 107 ON FREE INFORMATION CARD

The coolant can also be used to prevent transformer burnout. If a transformer starts to smoke, spraying it will keep wax, varnish, and shellac from running and causing short circuits. It will also free adhesives for quick removal.

Freez-It is available in two sizes: 15 oz., priced at \$2.95; 22 oz., priced at \$4.50.—Chemtronics, Inc., 681 Old Willets Path, Hauppauge, NY 11788.

POWER SUPPLY, model *PS-101*, is tripleregulated and is designed for the hobbyist, student, and lab technician. It features three completely independent supplies. Those



CIRCLE 108 ON FREE INFORMATION CARD

power supplies can be either positive or negative; they can be stacked in series so that a 5-volt and two 15-volt supplies can total 35volts DC, or any combination of the three, resulting in a fully adjustable 0- to 35-volt DC power supply.

The model *PS-101* has a suggested retail price of \$119.00.—**E.W. Engineering, Inc.,** PO Box 624, Old Lyme, CT 06371.

continued on page 46

Electronics mini-ADS

CALL NOW AND RESERVE YOUR SPACE

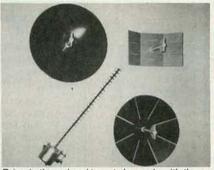
- 6 × rate \$605 per each insertion.
- · Reaches 235,323 readers.
- Fast reader service cycle.
- Short lead time for the placement of ads.
- We typeset and layout the ad at no additional charge.

Call 212-777-6400 to reserve space. Ask for Arline Fishman. Limited number of pages available. Mail materials to: mini-ADS, RADIO-ELECTRONICS, 200 Park Ave. South, New York, NY 10003.



CA28 UNIVERSAL CRT ADAPTER—Now you can use your CRT Tester/Restorer/Rejuvenator on all 2500 Color CRT Types. No need to buy a new tester! Use the functions of your present tester on any Color CRT listed from 9" to 26", including foreign types. Checks: Quintrex, InLine, Trinitrons, Tri-Potential, Pinless, Japanese & European. Replaces over 50 Adapters & guaranteed for all Makes/Models of CRT Testers. Instructions & Obsolescence proof perpetual Set-up Manual included. Check/Money Order/Visa/Mastercard/COD. \$61.95 + \$2.00 P&H. To order call 1-800-331-9658, (OK 918 68 2 4286) DANDY MFG. COMPANY, 1313 N. MAIN ST., MUSKOGEE, OK 74401.

CIRCLE 55 ON FREE INFORMATION CARD



Bring in those hard to get channels with these low priced amateur microwave T.V. receivers. New wide band multi channel reception in the 2.1-2.9 GHZ range. 100% legal for ITFS channels. We stock all types. Complete systems from \$43.95 in quantity. Every item fully guaranteed. Free shipping, Phone or mail order only. C O D's accepted. H.M.R. Sales, 221 East Camelback, Suite 1, Phoenix, Arizona 85012, Phone 602-993-0398.

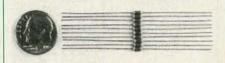
CIRCLE 38 ON FREE INFORMATION CARD



MODERN ELECTRICS. Miniature souvenir of the first publication ever produced by Gernsback Publications. This issue appeared in April 1908—just 75 years ago. You can own your own reprint of this unique first edition for just \$2.50 plus 75¢ P&H. It's available from R-E BOOKSTORE, Radio-Electronics, 200 Park Avenue South, New York, NY 10003



WIRELESS & ELECTRICAL CYCLO-PEDIA. Originally printed in 1918, this 176-page reprint of the complete catalog gives you an accurate look at the state of electronics in 1918. Contains everything from a Zinc Spark Gap to a 1000-Mile Receiving Outfit. You can get your own copy of this modern antique, profusely illustrated, for only \$4.95 plus \$1.00 P&H. Order yours from R-E BOOKSTORE, Radio-Electronics, 200 Park Avenue, South, New York, NY 10003.



MINIATURE 1/4W 5% CARBON FILM RE-SISTORS offer superior overall performance characteristics compared to carbon composition resistors - at significant cost savings! EIA color coding. 1 ohm thru 10 megohm. \$3.75 per hundred per value. Mastercard, Visa, American Express, accepted. Please add \$2.00 for shipping. California residents add 6% Sales Tax. No C.O.D. ACORN INDUSTRIAL ELECTRONICS P.O. Box 10846, SANTA ANA Ca. 92711. 1300-D E. Edinger Ave., Santa Ana, Ca. 92705. (714) 547-8424.

CIRCLE 46 ON FREE INFORMATION CARD

Radio-Electronics mimi-ADS



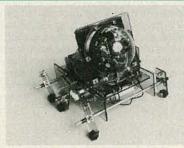
FREE CATALOG OF HARD-TO-FIND TOOLS is packed with more than 2000 quality items. Your single source for precision tools used by electronic technicians, engineers, instrument mechanics, schools, laboratories and government agencies. Also contains Jensen's line of more than 40 tool kits. Send for your free copy today! JENSEN TOOLS INC., 7815 46th St., Phoenix, AZ 85040. (602) 968-6231.

CIRCLE 7 ON FREE INFORMATION CARD



SUBSCRIPTION TV MANUAL. This information packed book details the methods used by subscription TV companies to scramble and descramble video signals. Covers the Sinewave, Gated Pulse, SSAVI system, and the methods used by most cable companies. Includes circuit schematics, theory, and trouble shooting hints. Only \$12.95 plus \$1.50 first class P&H. Info \$2.00, refundable. RANDOM ACCESS, Box 41770-R, Phoenix, AZ 85080.

CIRCLE 31 ON FREE INFORMATION CARD



AMAZING AVOIDER™, the intelligent robot you build yourself. Infra-red Sensors Detect obstacles in its path. The Avoider measures 4½" × 4½" × 5" and walks and turns thanks to electronic controls. Complete kit of quality-made precision parts with easy-to-follow instructions. \$59.95. Ideal starter kit for intelligent machine enthusiasts. Check, money order. (Include \$2.50 handling charge.) 3-4 weeks for delivery. S.M. Robotics, 759 Boylston St., Chestnut Hill, MA 02167.



APPLIANCE REPAIR HANDBOOKS—13 volumes by service experts; easy-to-understand diagrams, illustrations. For major appliances (air conditioners, refrigerators, washers, dryers, microwaves, etc.), elec. housewares, personal-care appliances. Basics of solid state, setting up shop, test instruments. \$2.65 to \$5.90 each. Free brochure. APPLIANCE SERVICE, PO Box 789, Lombard, IL 60148. 1-(312) 932-9550. CIRCLE 84 ON FREE INFORMATION CARD



FREE 1984 ELECTRONIC TOOL & IN-STRUMENT CATALOG is packed with over 5,000 quality technical products for assembling, testing and repairing electronic equipment. All products fully illustrated with photographs, detailed descriptions and pricing to allow for easy ordering by phone or mail. Most orders are shipped within 24 hours. 100% satisfaction guarantee. CON-TACT EAST, 7 Cypress Drive, Burlington, MA 01803. (617)272-5051.

CIRCLE 50 ON FREE INFORMATION CARD



FREE ELECTRONICS TOOL CATALOG. 104 pages packed with customized tool sets for plant and field maintenance, test equipment, soldering stations, plus specialized tools for IC & PCB assembly and telecommunications work. Loaded with great values on over 100 respected name brands. Includes ordering procedures for Tool Sets CUSTOMIZED to meet individual requirements in any quantity. W.S. JENKS & SON, 2024 West Virginia Avenue N.E., Washington, D.C. 20002. 1-800-638-6405.

CIRCLE 57 ON FREE INFORMATION CARD



- 6 × rate \$605 per each insertion.
- Reaches 235,323 readers.
- Fast reader service cycle.
- Short lead time for the placement of ads.
- We typeset and layout the ad at not additional charge.

Call 212-777-6400 to reserve space. Ask for Arline Fishman. Limited number of pages available. Mail materials to: mini-ADS. RADIO-ELECTRONICS. 200 Park Ave. South. New York. NY 10003.

PTS

"PTS rebuilt modules are better than brand



CIRCLE 43 ON FREE INFORMATION CARD

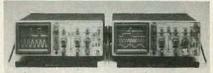
heavy snows, being far from home, and having the USO TO HELP!



Like the mailman, no matter what the weather USO goes on. Orientation tours of new communities, classes, helpful information and more are available come rain or shine. And the famous USO Shows have been known to perform in sleet and hail. Why? "Because life's toughest battles aren't always fought in the field."

Support USO through the United Way, OCFC, or local USO campaign or send a tax-deductible contribution to USO, Box 1982, Washington, D.C. 20013.

PORTABLE OSCILLOSCOPES, model 2213A and model 2215A are upgraded versions of the 60-MHz bandwidth oscilloscopes, models 2213 and 2215. They offer brighter displays, greater accuracy, and more sensitive triggering.



CIRCLE 109 ON FREE INFORMATION CARD

The new "A" versions reflect a composite of suggestions from customers owning the earlier versions. They incorporate such features as a 10-MHz bandwidth-limit switch, a single-sweep mode and power-on light, and separate A/B dual intensity controls.

The model 2213A weighs 12.8 pounds and is priced at \$1200.00; the model 2215A weighs 13.5 pounds and costs \$1450.—
Tektronix, Inc., PO Box 500, Beaverton, OR 97077.

TEMPERATURE INDICATORS offer precise, positive, visual proof that a specific temperature has been exceeded, particularly in inaccessible, hazardous areas. When applied to any piece of equipment, the one-shot, irreversible indicators record and document operating temperatures: The sensitive white triangle turns irreversibly black when the surface temperature reaches the particular triangle's temperature level.



CIRCLE 110 ON FREE INFORMATION CARD

They are available in three configurations: CelsiStrip, 5 or 8 multiple-sequenced temperature increments, printed in C° and F°; CelsiDot labels, single temperature dots in 40 different temperature levels, printed in C° and F°; and CelsiPoint labels, single temperature dots in 40 various temperature levels from 40°C to 260°C (105°F to 500°F).

The labels are self-adhesive and adhere to any dry surface. They measure 0.3 mm thick.

The temperature indicators are available in booklets, each with identical rated labels, and can cost less than 10 cents each in large quantities.—Solder Absorbing Technology, a Spirig Company, South End Bridge Circle, Agawam, MA 01001.

AUTOMOTIVE EXHAUST ANALYZER

Build this useful automotive test instrument and stop guessing about your car's emissions.

PHILIP M. VAN PRAAG

THE GROWING NUMBER OF STATE AND federal auto-emission requirements has added yet another burden on just about every motorist. Not only do you have to worry about monthly payments, insurance, and sufficient maintenance to keep your car running down the road, now you also have to worry about the next emissions test. Will your car pass, or will you have to go through the time and often considerable expense to have it "tuned up" and then retested?

Worse yet, even if you are a do-it-yourselfer with an "army" of tools, timing lights, and dwell meters, you are still at a disadvantage with regard to emissions tuning. Those items alone are not enough to do the job, and doing what we did in the "good old days"—that is, simply replacing the plugs and points, setting timing and dwell, and then "tweeking" the carburetor until the engine runs smoothly and performs well—just won't cut it anymore.

Indeed, often the best low-emission settings for your car will be quite different from those settings that provide the best performance. There is simply no way to optimize those adjustments for, nor adequately predict the results of, an emission test with common service equipment. That's why you need the digital exhaustgas analyzer that will be described in this article.

That device is a small, easy-to-use diagnostic aid. In a general sense, it monitors combustion efficiency of the engine system. That is vitally important as combustion efficiency directly affects exhaust-gas content. More efficient combustion means more complete burning of

the gasoline. That translates to smaller amounts of hydrocarbons and carbon monoxide (CO) in the exhaust. Hydrocarbons and CO are the "polluters" typically

as an ordinary clock or stopwatch when bons and CO are the "polluters" typically not being used to measure exhaust gas. monitored by The unit also contains low-voltage governsensing circuitry to prevent faulty read-DIGITAL EXHAUST GAS ANALYZER ings due to inadequate battery voltage. Theory of operation Figure 1 is a block diagram of the primary circuit functions. Exhaust-gas conversion takes place in a thermalconductivity cell (TCC). The TCC produces an electrical signal that varies with the difference in temperature between a "test" temperature sensor exposed to exhaust gas and a "control" sensor exposed only to ambient changes that affect both sensors. The sensors are self-heated CO : CARBON MONOXIDE% FUNCTION identically, so that they will be at the same A/F: AIR/FUEL RATIO temperature when no exhaust gas is pres-When exhaust gas enters the test-sensor area, the therment test facilities. (More about the relationship between combustion and exhaust makeup later.) Specifically, the unit displays CO in concentrations of less than 1% to about 10%, and air/fuel (A/F) ratios from 14.5 down to about 11.0. The project consists of three parts: an

exhaust-gas probe, which is inserted into the auto tailpipe; a "conversion box",

which transforms part of the exhaust into a proportional electrical signal; and a display unit, which amplifies and digitizes the signal for easy viewing. The unit can be used either while the car is stationary,

allowing you to make adjustments, or while it is in motion, allowing you to verify those adjustments under dynamic

To simplify the circuitry, a commercially-available clock/timer module is used for the display. It contains an LCD

readout, providing easy viewing under al-

most any lighting conditions. The module's crystal-controlled timing is also used by the project's A/D converter to ensure a

stable timebase throughout the system.

An interesting side-benefit to using the

clock module is that the unit can be used

operating conditions.

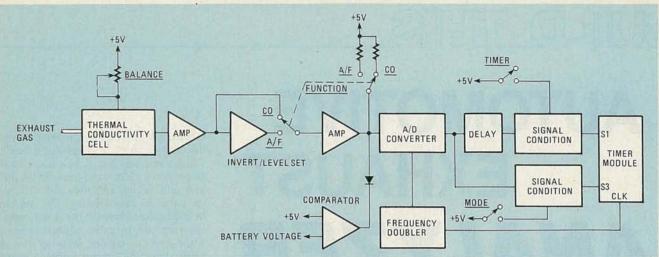


FIG. 1—ALL CRITICAL circuit functions are shown in this block diagram of the exhaust-gas analyzer.

mal conductivity of the air changes. That affects heat dissipation away from the sensor, thus altering the test-sensor temperature. Changes in sensor temperature cause its resistance to change. In this application, sensor temperature never changes more than a few degrees centigrade, but that is sufficient. It produces enough resistance change to unbalance the TCC. Because of the narrow operating-temperature range, sensor resistance changes linearly with changes in temperature.

At first glance, the difference between thermal conductivity and temperature measurement may not seem clear. They both involve electrical-output changes in response to sensor-temperature changes. In a common "thermometer," the change in temperature is due to an ambient-air temperature change. In the TCC, however, the temperature change is due to an ambient-air thermal-conductivity change. That is, the ability of heat to dissipate away from the sensor is a function of heat conductivity through the gas mixture. By the time the exhaust gas gets to the test sensor, it has essentially cooled down to ambient temperature. Thus, it is not the temperature of the gas that affects the sensor, but rather the thermal conductivity of the gas.

Thermal conductivity of exhaust gas differs from that of air. The exhaust consists of water vapor, carbon dioxide, hydrocarbons in various gaseous states, and CO. The exact proportions of the different hydrocarbon gases and CO, and their precise relationship to the thermal conductivity of the mixture, is very complex, beyond the scope of absolute measurement for this unit. Fortunately, there are predictable relationships over the temperature ranges of the exhaust gas commonly emitted from a 4-cycle internalcombustion, gasoline-drive engine; those can be used to help us in performing autoemission adjustments. Over those ranges, reasonable accuracy and (more important) repeatability can be achieved.

The unit's CO and A/F functions bear an inverse display-relationship to each other. Thus, as the TCC output signal is amplified, an inverted version is also made available. The CO and A/F display ranges differ for those functions, so different amplifier output-voltage ranges and levels are also provided.

A digital display was chosen because it is easier to read than an analog meter. That is particularly important if the unit is used while driving. Conversion of the analog sensor-signal to digital form is performed by an A/D converter whose operation is shown in Fig. 2. Clock pulses from the timer module are counted, and the results of that count are used by an adder to generate a ramp. Comparator 1 is then used to compare that ramp with the analog sensor-signal. The output of the comparator is a pulse. The duration of the pulse is determined by the amplitude of the sensor signal; that is, the comparator's output is high as long as the ramp amplitude is greater than the sensor amplitude.

When the ramp amplitude dips below the sensor amplitude, the comparator's output goes low. The duration of the ramp

VARIABLE PULSE WIDTH (DIGITAL) OUTPUT

O.2V COMPARATOR 2

REF COMPARATOR 1

CLK MSB 32R

COUNTER 32R

LSB 64R

ADDER

1.25V REF

FIG. 2—HOW THE A/D CONVERTER works. Note that for simplicity, only 3 of the 7 resistors at the counter's outputs are shown.

(2 seconds), and hence the test-cycle length, is determined by the nature of the counter (divide by 128) and the clock frequency (64 Hz).

The output signal is used as a gate to allow a certain number of timer pulses to be counted by the timer module for each test cycle. That output is used to reset the timer from the previous count and define the start and stop of the current count.

The remaining task of counting and displaying the pulses is accomplished by the clock-timer module. Figure 3 shows the basic timer-module operation. The module is operated in its stopwatch mode, and has a resolution of 10 ms. That means that the display advances by one count every 10 ms. A series of internal counters divide a crystal-controlled 32-kHz oscillator signal down to the desired count rate. The stopwatch START/STOP and RESET switches are operated electrically when power is applied.

The unit uses the three least-significant digits of the display, with an implied decimal point between the two rightmost digits. Thus, a display of 00040 in the CO mode would be a reading of 4.0%, while a 00131 display in the A/F mode would be a reading of 13.1. Note that CO content is expressed as a percentage, while the A/F (air/fuel ratio) is expressed, naturally enough, as a ratio.

Circuit description

Figure 4 is a schematic diagram of the gas-analyzer circuit. The test and control sensors are precision-matched thermistor glass beads. Those beads are extremely tiny, about .014-inch in diameter. The small mass of the glass bead gives the unit a fast response time. The beads are premounted in fixtures, as they would be impossible to handle otherwise. (The bead leads are only .001-inch in diameter!) The fixtures and their housings comprise the TCC within the conversion box. A four-conductor cable routes the sensor signals and ground between the box and the display unit.



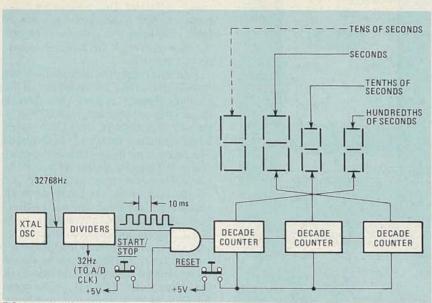


FIG. 3—THE TASK OF COUNTING and displaying the result is handled by a clock/timer module. The basic operation of that module is illustrated here.

tions of IC5, a dual op-amp, are used to amplify the TCC outputs, and inject a fixed bias between them to provide a proper operating point for the next stage.

One section of an LM324 quad opamp, IC3-a, is used to amplify the TCC outputs, and convert them to a singleended signal. Another section, IC3-c inverts that signal and provides level translation for the A/F mode. Resistor R24 is a trimmer used to calibrate for the desired A/F ambient operating point. Final amplification is provided by IC3-b; that device also provides the CO operating-point calibration. The fourth section of IC3, IC3d, functions as a voltage comparator, sensing the battery input-voltage to regulator IC1. If the voltage drops below 7.2 the pin 7 output goes to ground, which loads down the output of IC3-b, causing the device to stop update testing. Then it's time to replace the battery.

Transistor Q1, and IC6 and its associated circuitry, prepare clock pulses for the

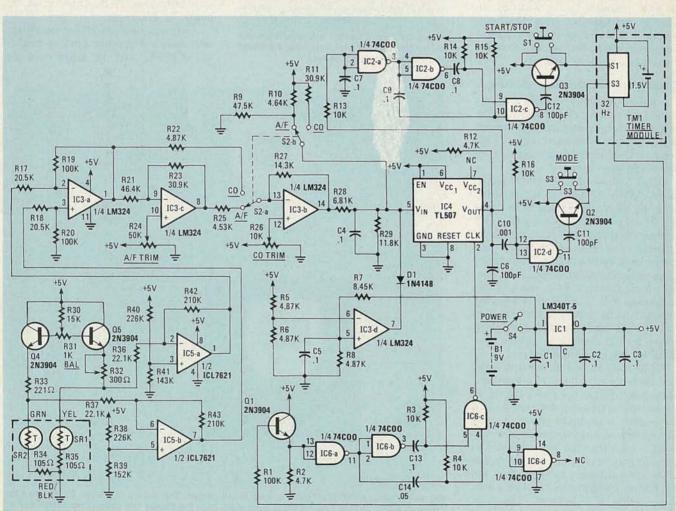


FIG. 4—AN AUTOMOTIVE EXHAUST-GAS ANALYZER. The circuitry enclosed by the dashed box in the lower left-hand corner is located on the TCC PC-board, which is mounted in the conversion box. All remaining circuitry is housed within the display-unit cabinet. Note that many of the resistors have tolerances of 1% (See Parts List).

All other circuitry is housed in the display unit. Transistors Q4 and Q5 translate BALANCE control (R31) changes into the

very subtle bridge adjustments needed to "balance" the currents to the test sensors under ambient conditions. The two sec-

A/D converter (IC4) using a 32-Hz intermediate-countdown signal obtained from the timer module. Transistor Q1 shifts the timer voltage-levels, while IC6 functions as a frequency doubler to provide the 64-Hz signal needed by the A/D converter to

define the two-second test interval.

Resistors R9 and R10 determine the final ambient voltage-level for the A/F mode, while R11 determines the final ambient voltage-level for the CO mode. Those voltage levels define particular A/D pulse durations, which, in turn, define particular display readouts.

The A/D output is conditioned so that it can be used to control the clock module by IC2 and the Q2-Q3 circuit. One section of the IC, IC2-d, along with C10 and R16 are used to differentiate and invert the A/D output's leading edge to form the S3 reset pulse. Another section of the device, IC2-a, delays the A/D output from reaching the stop/start circuitry until the reset pulse has been applied to the timer module. The IC2-b-IC2-c circuit is a "double differentiator that provides short trigger pulses on the delayed leading and trailing edges of the A/D output signal. Those pulses are used to start and stop the timer. By presenting a very high impedance to the timer when the unit is switched off, Q2-C11 and Q3-C12 allow the timer module to be used as an ordinary clock or stopwatch when the unit is not being being used for exhaust analysis.

Display cabinet and timer module

Caution: Before proceeding with any modification to the clock-timer module, be certain that it is functioning correctly in all modes of operation. Once it has been modified the manufacturer will not honor warranty claims.

Figure 5 shows display-cabinet preparation details for the cabinet available from the source mentioned in the parts list. (If you purchase the complete kit, the cabinet will already have been completely prepared.) The cutout for the LCD display can be done by first drilling a number of holes within the cutout border, then carefully filing to eventually produce a clean rectangular hole. The bottom of what was intended to be a battery compartment must be cut out to provide a mounting fixture for the clock/timer module. The detail for that is shown in Figure 5-c.

Figure 6 shows how the timer is modified and mounted in the clock/timer-module cabinet. Figure 6-a shows the ridges on the sides of the timer that must be filed off to allow it to slip-fit into the flanges that are formed when the battery compartment is modified. You will also need to file off a portion of the timer's case rear to allow a 9-volt battery to be inserted into the battery compartment; remove a 11/16inch section to a depth of 3/32-inch as shown. Doing that will disable the S1 and S3 switches on the timer module, but their functions are replaced by the analyzer's switches. Figure 6-b shows the final alignment of the timer in the display cabinet. A tiny amount of contact cement can be used to secure the timer to the cabinet, but it may not be needed if the

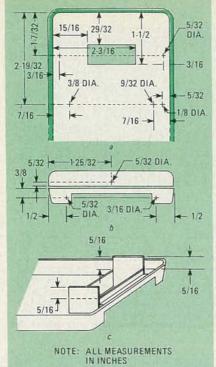


FIG. 5—IF THE CABINET available from the source given in the Parts List is used, it is drilled and modified as shown above.

change the timer battery, although if the bottom battery retaining-clamp screw is left a little loose it is possible to change the battery through the battery-compartment access lid.

Four wires have to be added to the timer module to interface it with the rest of the circuitry. Figure 7-a shows where three of those wires are attached; shown there is the side of timer's PC board that's seen when the timer's back cover is removed. The fourth wire is attached to the other side of that board as shown in Fig. 7-b. To gain access to the timer-circuit board, pry off the back cover, then very carefully remove the four small chrome Phillipshead screws that hold the mechanism in place. Note the locations of the screws as well as the orientation of the battery retaining clamp. You should now be able to lift the molded black plastic lid away from the circuit board. Carefully solder three fine (30-gauge) wires in place, using very little solder and trying to keep the wires and solder close to the edge of the PC board.

Next, very carefully lift out the springsteel switch strip using a pair of needlenosed pliers; note the position of the

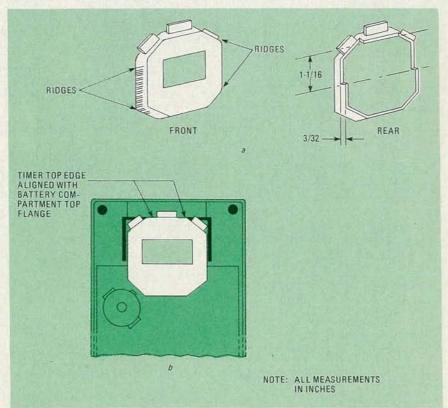
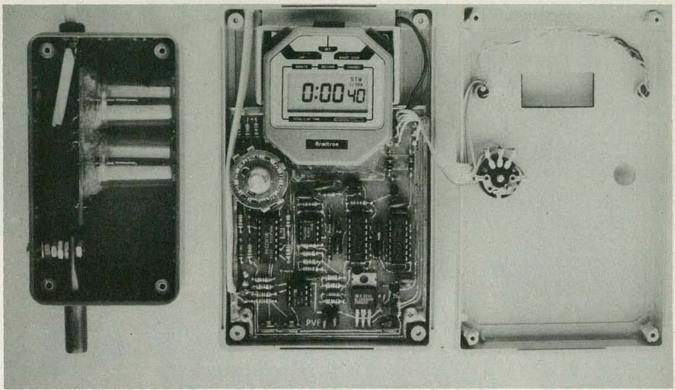


FIG. 6—A POPULAR WATCH/TIMER is used in this project. That timer's case must be modified as shown in a so that both it and a 9-volt battery will fit in the display unit cabinet. How the timer is mounted in the cabinet is shown in b.

side ridges are carefully filed just to the point of allowing a light press fit in the cabinet. In any event, provision must be made to allow the module to be removed, as must be done to insert or remove the PC board. Removal may also be needed to

strip—it is over two small red-plastic studs. Then, remove the circuit board by gently lifting from beneath at various points along the edge of the board. When the PC board is removed, the LCD display will probably stick to it. If it does, care-



A LOOK INSIDE the exhaust-gas analyzer. The completed display unit and conversion box are shown here with their cases open.

All resistors 1%, 1/4-watt unless otherwise noted

R1-100,000 ohms, 5% R2, R12-4700 ohms, 5%

R3, R4, R13-R16-10,000 ohms, 5%

R5, R6, R8, R22-4870 ohms

R7-8450 ohms

R9-47,500 ohms

R10-4640 ohms

R11, R23—30,900 ohms R17, R18—20,500 ohms

R19, R20-100,000 ohms

R21-46,400 ohms

R24-50,000 ohms, miniature potentiometer, linear taper, vertical PC-board mount

R25-4530 ohms

R26-10,000 ohms, miniature potentiometer, linear taper, vertical PC-board mount

R27-14,300 ohms

R28-6810 ohms

R29-11,800 ohms

R31-1000 ohms, miniature potentiometer, linear taper, panel mount, with SPST switch (S4)

R32-300 ohms, miniature potentiometer, linear taper, vertical PC-board mount

R33-221 ohms

R34, R35-105 ohms

R36, R37-22,100 ohms

R38, R40-226,000 ohms

R39-152,000 ohms

R41-143,000 ohms

PARTS LIST

R42, R43-210,000 ohms

Capacitors

C1-C5, C7-C9, C13-0.1 µF, ceramic

C6, C11, C12-100 pF, ceramic disc

C10-.001 µF, mylar

C14-.05 µF. ceramic disc

Semiconductors

IC1-LM340T-5 or 78M05 + 5 volt regula-

IC2, IC6-74C00 CMOS quad NAND

gate IC3-LM324 quad operational amplifier

IC4-TL507C A/D converter IC5—ICL7621DCPA dual operational am-

Q1-Q5-2N3904 NPN silicon transistors D1—1N914 or 1N4148 general purpose diode

SR1, SR2-G126 precision matched thermistor pair (Fenwal Electronics, 63 Fountain St., Framingham, MA 01701)

TM1—timer module, model U01 sport stopwatch (Armitron Corporation, 29-10 Thompson Ave, Long Island City, NY 11101)

S1,S3—SPST momentary normally open pushbutton (C & K 8631 or equivalent) S2-4PDT rotary, panel mount

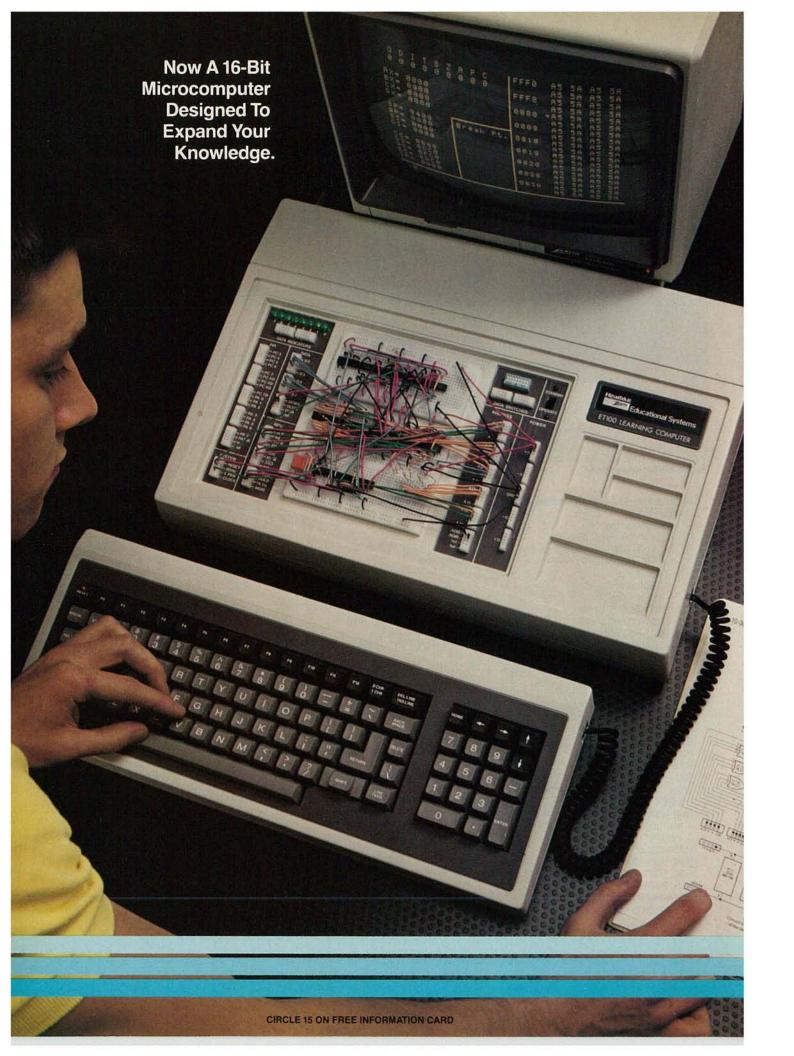
S4-SPST potentiometer switch, part of

B1-9-volt battery

Miscellaneous: PC boards, display and conversion-box cabinets, IC sockets, 9volt battery terminal clip, modular tele-phone extension cord, 25 feet, with plug and receptacle (MCM TA625 or equivalent), vinyl thin-wall tubing (%-inch I.D., ½-inch O.D., 48-inch length), copper tubing (3/8-inch O.D., 1/32-inch wall thickness, 14-inch length), spray bottle caps (see text), alligator clip, cable strain-relief (5/16inch mounting hole), silicone glue, Velcro strip (11/2 inches wide by 3 inches long), double-sided carpet tape, 30 gauge wire, 8-conductor ribbon cable, knobs, hard-

The following are available from PVP Industries, P.O. Box 35667, Tucson, AZ 85740: Etched and drilled epoxy-glass PC boards for display cabinet and conversion box for \$14.95; SR1, SR2 sensor pair for \$22.95; PC board set, both cabinets (not drilled), timer module, front panel decal for display cabinet, and modular extension cord for \$49.95; complete kit of all parts (except glue and battery), including pre-drilled cabinets for \$98.95; completely assembled, calibrated, and tested unit for \$129.95. The above prices are postpaid in the continental U.S. Arizona residents add 5% sales tax. Readers of Radio-Electronics are invited to send a SASE to the above address to receive free updates on this project, along with user tips as they become available.

fully separate it from the board, noting its orientation and setting it back into the case exactly as it was before the board was removed. (That is important because there is usually no pin identifications on those displays.) Using a jeweler's screwdriver, very carefully scrape the green lacquer coating off the PC pattern at the point continued on page 56



Here's How You Can Learn 16-Bit Technology. And Graduate To One Of Today's Most Powerful And Advanced Microcomputers.

Now you can master 16-bit technology with an all-new Advanced Microprocessor course. And build hands-on experience with the only 16-bit microcomputer specifically designed for the hobbyist, working engineer and student.

Advanced Microprocessor Course

This all-new self-study course (EE-8088) provides indepth coverage of 16-bit, state-of-the-art technology.

You will gain a thorough understanding of microprocessors from this 1200 page course. In 10 easy-to-

all advanced a line microprocedsors

understand units, starting with microcomputer basics, you'll cover all phases of 16-bit microprocessing. Assembly language. Program writing. Addressing modes. Dynamic and static RAM. And hardware interfacing.

And by using your 16-bit Trainer/Learning Computer for hands-on experiments (over 60 included), you'll gain actual circuit interface and soft-

ware programming experience with an

8088 microprocessor system.

Trainer/Learning Computer

A unique combination of design features makes this versatile microprocessor system much more than a "teaching machine." Use it as a trainer with the Advanced Microprocessor course. Use it as an experimental design computer. And use it to run a wide variety of

16-bit software – including Z-Dos, Multiplan, Z-Basic, Condor File Manager, and much more.

> In its most basic form, the Trainer/ Learning Computer is a 16-bit,

cassette-based microcomputer.

Its unique design features access ports and solderless breadboards to allow you to build interfaces, design and modify circuits, or simply experiment with the inner workings of the microprocessor system.

The basic system has an 8088 processor, 32K ROM (including assembler, editor and debugger) and 16K RAM.

The unit also features a serial I/O printer port, cassette interface and a detached 95-key keyboard (including 16 function keys and a numeric keypad) which generates a full ASCII character set. It's available either in kit form or factory assembled.

And you can take advantage of the system's H/Z-100 computer design heritage by easily upgrading it to a disk-based, 16-bit microcomputer that will run H/Z-100

series software and many other forthcoming programs.

Fully Upgradeable

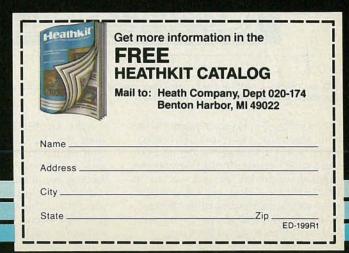
The powerful upgrade package and variety of accessories allow you to make the basic 16-bit system more powerful and versatile. You can add 128K or 192K bytes

of RAM. Floppy disk controller. 48TPI double-sided, double-density, single or dual floppy disk drive. Bitmapped video graphics or full-color graphics. Two RS-232 ports. Programmable timer. And a Centronics-compatible printer port.

Learn on it. Design with it. Use it as a 16-bit computer.

It's the only 16-bit microprocessor system specifically designed to integrate theory with a hands-on understanding of how 16-bit computers work. And it's from Heathkit/Zenith Educational Systems, the world-leader in problem-solving courses, trainers and accessories to help you learn state-of-the-art technology.





Heathkiti

Heath

A subsidiary of Zenith Radio Corporation

Company

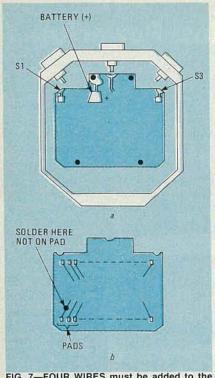


FIG. 7—FOUR WIRES must be added to the timer's PC board as shown above.

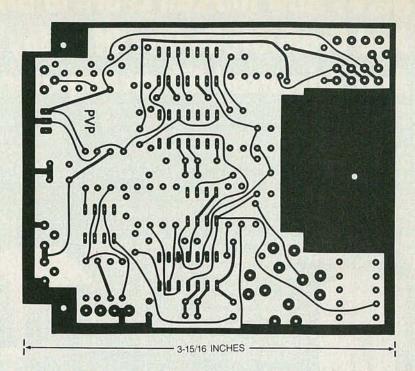


FIG. 9—THE COMPONENT SIDE of the double-sided display PC board. It, too, is shown full sized.

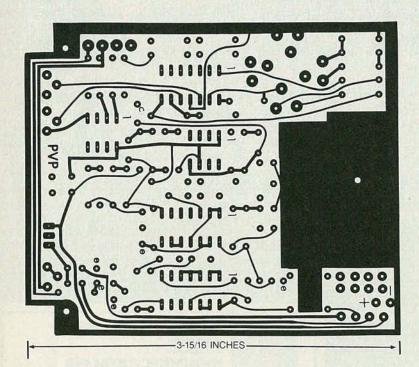


FIG. 8—THE FOIL SIDE of the double-sided display PC board is shown here full sized. It's partsplacement diagram will be shown next month.

shown in Fig. 7-b. Do not touch any of the pads that mate with the LCD display. Using a very fine-tipped soldering iron, and a small amount of solder, tin both the exposed copper foil and the wire to be attached. Do not allow any solder or flux to contact the pad located below the trace. Touch the wire and the iron to the point that was tinned to attach the wire.

Next, set the PC board into the case along with the switch-contact strip. Reinsert the molded black plastic lid and and the screws (do not over tighten), dress the wires up out of the way, and make a note of the wire colors for later identification when connecting them up to the gas analyzer's PC board. The timer's back cover will not be used in the cabinet.

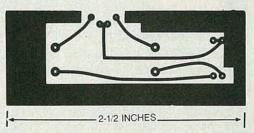


FIG. 10—FULL-SIZED FOIL PATTERN for the TCC board. That board mounts in the conversion box.

Display-electronics construction

Full-size PC-board patterns are shown in Figs. 8, 9, and 10. We recommend using PC boards, as that will considerably reduce construction and debugging time. It will also help eliminate the possibility of any high-impedance-leakage paths or spurious-signal pickup. The use of IC sockets is recommended as those allow easy IC removal/replacement should servicing ever be required.

Full-size foil patterns for the double-sided display PC board are shown in Figs. 8 and 9. If you choose to etch your own board, and cannot provide plated-through holes, you will have to solder all component leads on both sides of the board. In addition, you will have to insert a wire into all pads that do not contain component leads, then solder those feed through wires on both sides of the board.

Unfortunately, that's all we have room for now. Next time, we will take a look at the parts-placement diagrams, and show you how to complete the electronics part of the project.

R-E



What's New in 3-10 TV

IF YOU ARE LIKE MOST PEOPLE, WHEN YOU think of "3-D", you think of bad movies, eye strain, and often unsuccessful special effects. Yet 3-D TV remains one of the "holy grails" of the video industry. But that should come as no surprise considering the enormous popularity such a system would have for not only everyday viewing, but also for such things as videogames. In addition, 3-D TV has many important applications in science, medicine, and industry.

The key to the success or failure of a 3-D system is the quality of the effect. Also, only slightly less important is the degree of inconvenience and/or cost imposed on the viewer.

In this report we are going to look at three 3-D TV systems currently under development, and examine their strengths and weaknesses. Each, from different manufacturers, takes a completely different approach as to how the 3-D image is produced. Finally, these systems are not all dreams and promises. All have reached the stage where at least working prototypes have been produced, and all could be introduced commercially in the near future.

No glasses

The first system we'll be looking at is also the only one that is "autostereoscopic;" that means that it does not require some sort of viewer-worn glasses to create its 3-D effect. Developed by a small California toy manufacturer, The Bright and Morning Star Company (5319 West 146th St., Lawndale, CA 90260), and called the *Autostereoscopic Image Display System*, it uses plastic Fresnel lenses instead.

Let's see how it works. First of all, two images, one of which must be reversed, are required for the system. That means that two monitors, with one displaying a reversed image, are needed for TV viewing; as we'll soon see, other applications are possible.

The heart of the system is a sandwich made up of prismatic Fresnel lenses. In use, the monitors are placed at right angles to each other and the Fresnel "sandwich" is placed diagonally between them as shown in Fig. 1.

When the viewer sits as shown in the figure, his converging sight paths are separated. One of the sight paths strikes the Fresnel sandwich at such an angle as to be

totally reflected. That eye "sees" lefthand monitor, which is displaying the reversed image. The reason that the image on that monitor must be reversed is that, due to the total reflection of the sight path, we are essentially viewing it in a mirror. If it were displayed normally, the images seen would be reversed. Thus, by reversing the image, a normal image is seen. (That can get a bit confusing, so reread the last few lines, if needed, to be sure you understand them. Also, as an experiment, you might want to try watching TV in a mirror to see the effect.)

The other sight path is not reflected, but some slight refraction does occur. That eye sees the right-hand monitor, which is showing the normal image. Thus, since each eye is seeing the same image, although from a slightly different perspective, the viewer's brain is able to derive the 3-D image. In fact, that is how the brain normally provides us with three dimensional information.

Of course, the chief advantage of the system is that it requires no glasses. The other important advantage is that, because of the nature of the viewing system, its use is not limited to video. Indeed, it will

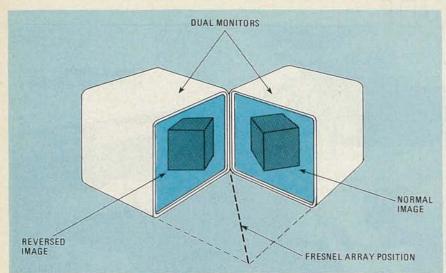


FIG. 1—THIS AUTOSTEREOSCOPIC 3-D TV system requires two monitors; those monitors are placed at right angles to each other.

work with photographic prints and transparancies (both still and moving), or with any other image source such as X-rays, radar, electron microscopes, and computer displays.

On the negative side, there are disadvantages, especially for home-video applications. For one thing, there's the cost associated with providing the two monitors required. Secondly, ideal viewing occurs only at one point, about 12 to 24 inches away from the unit; the exact point varies from individual to individual. That fact limits ideal viewing to just one person. A second person could also view the picture as shown in Fig. 2, but that second person would see a reversed image. The third disadvantage lies in the nature of the Fresnel lens. Those familiar with that type of lens know that the image rendered by them is unacceptable unless the lens is of the highest quality.

That is not to say, however, that that system does not have great potential, especially in areas outside of home video. For instance, the cost of a second monitor would not be too great a concern in a stand-alone arcade videogame. Another possible consumer application would be as a stereoscopic photographic viewer. The cost of the optics (only) for a snapshot viewer could be as low as one dollar; the optics for larger viewers would, of course, cost more.

Red and blue

The second system we'll be looking at uses a technique that should be familiar to anyone who has ever seen one of Hollywood's 3-D efforts. Those films were made using two cameras with different colored filters—one red, the other blue. The result was a film with two images slightly out of register. If the film were viewed directly, it would appear as if everything had a red outline.

But those films were not meant to be

viewed directly. Instead, glasses with one red lens and one blue lens are used. Those lenses direct the appropriate image to each eye, and because the images are offset, the viewer sees the scene in three dimensions.

A German company, ABDY AG, is marketing a system that converts a standard TV so that it can create the same effect using standard TV signals. The system is also called ABDY, and its secret lies in its name, which is an anagram for Anaglyphic By DelaY.

The nice thing about this system is that it does not require special signals. In-

stead, it electronically alters a standard two-dimensional TV picture so that the illusion of 3-D is created. It does that by splitting off the red signal and delaying its viewing until a small fraction of a second after the blue signal has been displayed. That small time-delay creates an effect that is nearly identical to that of the 3-D movies so that when the image is viewed through special glasses, a three-dimensional image is seen.

The key to the success or failure of the system may very well lie in the glasses used. According to Garry D. Silivanch, President of 3DS Systems, Ltd. (Crescent Office Park 1, Hempstead Turnpike, Levittown, NY 11756), the U.S. distributor of the system, earlier efforts (such as the 3-D movies that were shown on TV in various parts of the country a few years back) failed mainly because of the poor quality of the glasses used. Those glasses were typically made of cardboard and used colored cellophane for the the lenses. On the other hand, the glasses that will be provided for the system, dubbed Tri-Dimensional Television for U.S sales, are comparable in quality to expensive sunglasses. Even viewers who wear prescription glasses have been considered: A clipon version for wearing over regular glasses will be available.

Another strong point in favor of the system is that it can be added to any standard TV set at a relatively low cost. It is expected that the modification, complete with installation and two pairs of glasses, will sell for about \$100. Once installed, 3-

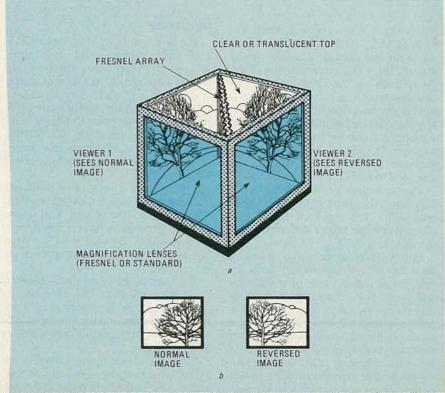


FIG. 2—A LOW-COST TWO-PERSON VIEWER is shown in a. Note that while one viewer will see a normal 3-D picture, the second will see a reversed image as shown in b.

D viewing is available at a flip of a switch; when the device is turned off, regular viewing is unaffected.

On the negative side, glasses, which are a viewer inconvenience, are required. Also, because colored lenses are being used to create the effect, at least some distortion of the colors displayed on the set will take place.

What about availability? The system has been sold in Germany for well over a year now. In the U.S., production in now underway, with testing scheduled to begin in July of this year in an area of suburban New York City.

Interlacing images

The third system we'll look at seems to be the one that is generating the most interest in the industry. Dubbed *StereoDimensional*, it was developed by Stereographics (Box 2309, San Rafael, CA 94912).

The StereoDimensional system consists of the electro-optical shuttering glasses, a video monitor, an imaging source such as stereoscopic cameras or a stereoscopic microscope (see Fig. 3), and a "black box" (see Fig. 4) that contains the propriatary electronics that keep the entire system synchronized.

Figure 5 shows how the system works. In it, a special pair of video cameras is used to photograph the scene. The images from the cameras are then presented sequentially on a monitor using the odd and even fields of the television interlace. The monitor is viewed using special glasses that first obscure one eye and then the other. The glasses are wired to the system and synchronized to the transmission so that the right eye sees only what the right

camera photographed and the left eye sees only what the left camera photographed. (Research is also under way to develop some form of wireless glasses, perhaps using ultrasonic or infrared transmission techniques.) The brain, once again, sees the image from two different viewpoints and thus can reconstruct the three-dimensional scene.

If successful, such a system has distinct advantages over several other approaches currently being explored. For instance, in an anaglyphic system, the use of colored glasses prevents the image from being seen in its normal colors. Another problem often associated with those systems is eyestrain. Polarizing systems, on the other hand, allow the image to be seen in full color, but require that the viewer keep his head perfectly vertical to prevent ghosting or loss of depth. The StereoDimensional system overcomes those problems and allows the image to be seen in full, normal color, and allows the viewer complete freedom of head, neck, and body movement.

Using the odd and even fields of the television interlace to present sequential right and left images is not a new idea, but it only became practical because of recent developments in electro-optical technology. Also, previous systems using that technique suffered from bad flicker. That was caused by the fact that the normal field rate of a television raster is 60 Hz. Thus, when alternating fields are used, only 30 fields per second are devoted to the right eye and 30 fields per second to the left one.

That is just too few; according to Stereographics, the minimum number of frames per second required to produce



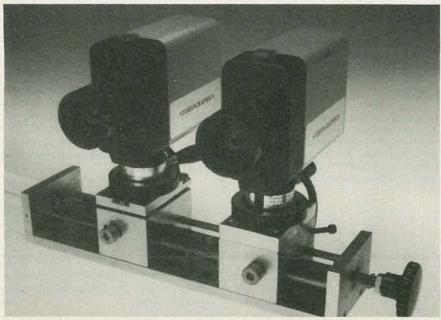
FIG. 3—ANOTHER 3-D IMAGE SOURCE. Here, twin video-cameras are mounted on a ster-eoscopic zoom-microscope to create a "3-D microscope."

satisfactory results under most circumstances is 50. In the *StereoDimensional* system, several techniques are used to increase the number of fields displayed each second. In one of those, the vertical scanning rate is doubled, thus producing 120 fields per second as opposed to the usual 60. When such a signal is displayed on a standard monitor, however, it is vertically compressed and two images appear one over the other.

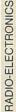
To see the image in proper sequence, the field rate of the monitor must be increased to 120-Hz. In addition, suitable circuitry must be provided to double the sync frequency so that the fields will be decompressed and the images displayed in their proper proportions.

To keep costs down (it is hoped that eventually the cost of adding the system to a set during its manufacturing will increase the cost of the set by only 10%) the system was designed to be compatible with existing video systems. The first system manufactured (which, incidently, was delivered to Lockheed this past November) was designed around the NTSC system, but there is nothing inherent in the technique that would prevent its use in areas of the world that have adopted either the PAL or SECAM formats. Of course those formats use different field rates, and different numbers of total lines per field, but the StereoDimensional system can be adapted to them.

By the same token, that 3-D system can be adapted for use with a high-resolution video system, one with many more horizontal lines. The system can also be used



THREE-DIMENSIONAL TV CAMERAS. Signals from the cameras are routed to the control box, where they are processed and sent to a video monitor.



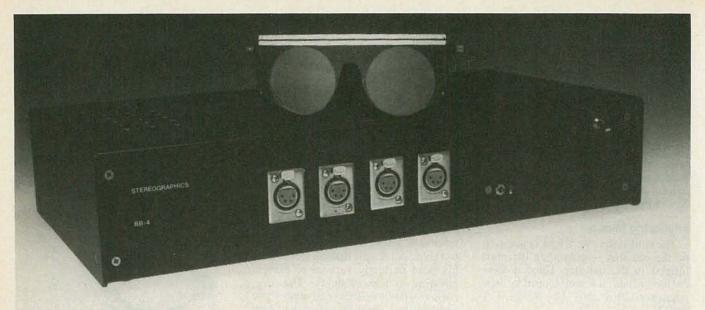


FIG. 4—THE EXTERNAL SYNC GENERATOR, the heart of the *StereoDimensional* system, is shown here with a pair of their electro-optical glasses.

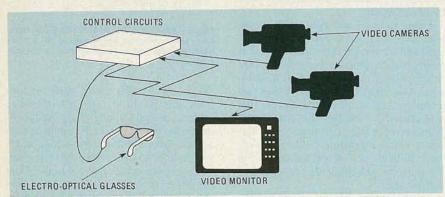


FIG. 5—PUTTING IT ALL TOGETHER. This diagram shows how the basic elements in the StereoDimensional system are connected together.

in just about any application that uses a CRT for display. Those applications include ultrasonics, radar, flouroscopy, and, of course, videogames.

Changing the number of fields per second does not effect such signal factors as bandwidth. Thus the altered signals could be broadcast over the air, used in a closedcircuit system, or distributed via cable without any problems. Existing videotape and videodisc formats could also be used to record the signals without any modifications.

That is not to say that there are not some serious drawbacks to the system. Glasses are, of course, still required. More importantly, the image must be photographed and transmitted using the *StereoDimensional* process, and the resulting signal can not be viewed satisfactorily on a "standard" TV set.

That, of course, means that it is unlikely that you will be seeing your favorite over-the-air TV show in 3-D using that system in the near future. Instead, the future of this system seems to lie in industrial applications such as computer-aided design and manufacture, cartography, flight simulation, IC inspection, microsurgery, mechanical training, and even air-flight control.

On the entertainment front, as previously mentioned, cable or videotape/videodisc distribution of programming using the process is certainly possible. Even more interesting are the possibilities offered by DBS. High-definition TV has received a great deal of attention in connection with DBS, and its use by one or more of that service's prospective programmers has been considered. Needless to say, a service that combines high-definition TV with 3-D TV could create quite a bit of excitement.

In this article, we've looked at three 3-D systems that have drawn a bit of interest. That is not to say, however, that those are the only systems under development. Indeed, because of the wide range of lucrative consumer and industrial applications, we expect that 3-D TV will be one of the hottest and most interesting areas of video research and development for many years to come.

WHAT DO YOU THINK?

In this article we have presented an overview of three 3-D TV systems that have attracted a great deal of interest. We would like to know what our readers think of them. Which system do you think shows the greatest potential? If you had the opportunity, which one would you like to use to view 3-D programming? We invite you to vote below, and add any comments that you might have. We will let you, and the developers, know how the systems fared in a future issue of **Radio-Electronics**. Mail your ballots to: Radio-Electronics, 3-D TV, 45 East 17th St., New York, NY 10003.

1	Autostereoscopic	Image	Display	System
31	Tri-dimensional TI			

StereoDimensional

Comments:_

Telephone Add-On NO MORE WRONG

NUMBERS!

Receive only the calls you want to receive with this inexpensive and easy-to-build telephone accessory.

GARY McCLELLAN

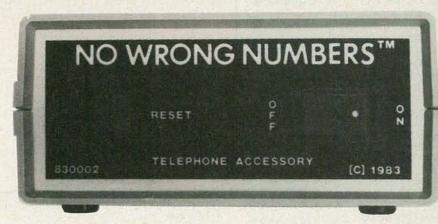


Putting it together

Start by referring to the Parts List for the materials you'll need and obtain them. Here are a few suggestions on the parts that might make shopping easier:

The switches may be any SPST types. We give the supplier and part numbers for switches that looked especially attractive, however you are welcome to use others. Just be sure to get a momentary type pushbutton switch for S1 and not an alternate action type. Using the wrong switch will cause problems!

The piezoelectric buzzer may be any similar device but don't substitute a mechanical type; the current draw is too high. Note that if you substitute for that device, be sure to get a surface-mounted buzzer. That is necessary because there isn't enough room inside of the cabinet for a different type.



A different cabinet may be substituted if the one specified is not readily available. Simply use any cabinet greater than $2 \times 5 \times 5$ inches. But note that if you substitute the cabinet, you'll probably have to label your own front panel. That's because the front-panel board used in the project (see Fig. 9) is sized for the cabinet that was specified.

And finally, a few words about the hardware. All items are standard and should be available through most electronics supply houses. The spacers may seem unusual, though. We want four 1.125-inch threaded spacers, but that size must normally be custom made. Instead, four one-inch threaded spacers are used, plus four more 0.125-inch unthreaded spacers. That way, we get what we want by using standard parts.

Start assembly by drilling the frontpanel board and mounting the switches. Start with a small drill bit, then use several larger bits and a round file to enlarge the holes to prevent damage. Then install the switches in the proper places and set the panel board aside for a moment.

Next, drill the rear panel, using the

template shown in Fig 10 as a guide. Drill the small holes with a 0.125-inch bit and use a 0.25-inch bit on the large holes. When done, mount the buzzer using 4-40×0.5-inch screws and hardware.

Cut the telephone cord to about 6 feet and thread it and the 12-volt leads from the transformer through the large hole at the left edge. Pull about 7 inches of wire through, then install a cable clamp in the remaining small hole and thread the wires through it.

Turn to the main board and install the spacers. Note that each spacer mounts in the corners of the board—do not mount spacers in the holes located closer to the center of the board. Refer to Fig. 11 for details and install the spacers as shown. Place a lockwasher on a 4-40 × 0.5-inch screw, then pass it through the board. Place the 0.125-inch spacer and then the 1-inch spacer on the screw and tighten. Install the other spacers in the same way.

Now it is time to connect some wires to the main board—refer to Fig. 12 for details. Strip the telephone cable back about a half-inch. Then strip and tin the red and green wires; cut any others off.

PARTS LIST-MAIN BOARD

All resistors 1/4-watt, 5% unless otherwise noted

R1, R3-1000 ohms

R2, R7, R11, R13-10,000 ohms

R4-4700 ohms

R5-270,000 ohms

R6, R16-100,000 ohms

R8-33,000 ohms

R9—22,000 ohms

R10, R14, R15, R19-10 megohms

R12—10,000 ohms, potentiometer, linear taper, PC-board mount (Radio Shack 271-218)

R17-330 ohms

R18-470 ohms

R20-2200 ohms

Capacitors

C1-0.22 µF, 250 volts, metal film

C2, C13, C14—0.01 μF, 50 volts, ceramic disc

C3-47 μF, 16 volts, radial leads, electrolytic

C4, C6, C7, C10—1 μF, 16 volts, radial leads, tantalum

C5, C9, C11, C12-0.1 µF, 50 volts, polyester

C8, C16, C17—0.1 μF, 16 volts, ceramic disc

C15—470 µF, 25 volts, radial leads, electrolytic

Semiconductors

IC1—TIL-119 optoisolator (Texas Instruments)

IC2—M290 ring-detector subsystem (Mendakota—see below)

IC3—CD4538 CMOS one-shot (RCA) IC4—CD4093BE CMOS Schmitt trigger

NAND gates IC5—MOC-5010 optoisolator (Motorola) IC6, IC7—78L05ACP 5-volt, I00-mA reg-

ulator (Motorola)

Q1, Q2-2N2222 NPN transistor

D1-D6, D8-D11-1N4002 diodes

D7-1N4148 diode

F1-0.25 amp, 3AG fuse

PL1—6 pin male PC-header (GC Electronics 41-046 or similar)

RY1—DPDT relay, 12-volt DC coil (Radio Shack 275-213 or equivalent)

PB1—Piezoelectric buzzer (Radio Shack 273-060 or equivalent)

S1—SPST momentary pushbutton switch (Radio Shack 275-618 or equivalent)

Miscellaneous: PC board, solder, wire, 2 PC-mount fuse clips (Littlefuse

122087), IC sockets, etc.

The following is available from Mendakota Products, Ltd., PO Box 20HC, 1920 W. Commonwealth Ave., Fullerton, CA 92633: A set of three PC boards and the M290 ring detector IC (order part No. NWR). The cost is \$26.00 postpaid in the U.S. and Canada. The M290 is available for \$12. California residents please add 6% sales tax. Sorry, no C.O.D's or credit-card orders.

Here is a useful hint: Before connecting the wires, cut six 3/8-inch pieces of lead from some half-watt resistors. Insert the pieces into the main-board locations for the off-board connections so that they protrude from the component side and solder.

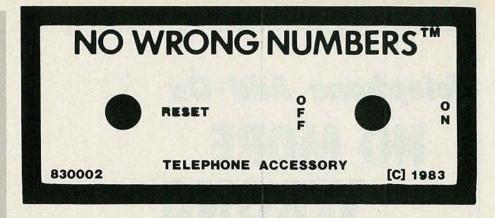


FIG. 9—FOR SIMPLICITY, a PC board is used for the front panel. The foil pattern for that board is shown here.

4-3/4-INCHES

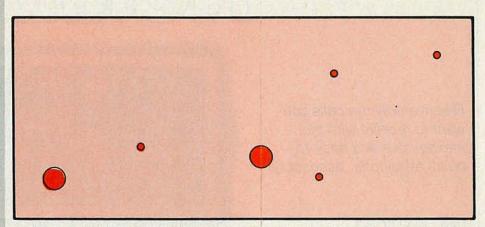


FIG. 10—IF YOU USE THE CABINET specified in the Parts List, using this template will simplify drilling the rear panel.

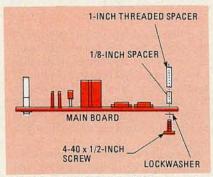


FIG. 11—HOW THE ONE-INCH and 1/6-inch spacers are mounted on the main board.

Then, make the off-board connections to those leads. Doing that will allow you to repair any broken wires once the main board is installed in the cabinet. Otherwise such repairs would require removing the board.

Wire the main board and rear-panel as shown in Fig. 12. Place the rear panel into the slot cut in the cabinet and place the main board inside. Note that connector PL1 must point toward the front of the cabinet. Secure the main board with the screws supplied with the cabinet.

Next, slide the front-panel board in the

slot and wire the switches as shown in Fig.

The decoder board is installed next. Connect SO1 to PL1 on the main board. Then position the board over the stand-offs and secure with $4-40 \times 0.25$ -inch screws and lockwashers. Check to be sure that filter capacitor C15 does not short any traces on the decoder board.

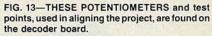
That takes care of the assembly so let's move on to the adjustments!

Adjustments

Basically, there are three adjustments. One sets the volume of the buzzer and the others set the pushbutton tone-pairs that the decoder board will respond to.

There are two methods you can use to set the pushbutton tone-pairs that the project will respond to, and the method chosen depends upon your test equipment. The first method is the best and the easiest, but requires the use of a frequency counter. The second method requires no test equipment. Instead, you'll need the assistance of a friend with a pushbutton phone. That method works well enough, but is time-consuming.

Note that the volume adjustment is done by ear and will be saved for last.



REAR FRONT PANEL MAIN BOARD PIEZO BUZZER RED GREEN - O PIEZO BUZZER RED BLACK - 0 RESET PL1 WIRES CABLE TRANSFORMER WIRES POWER WIRES TO MODULAR PLUG AND T1

FIG. 12—THE WIRING BETWEEN the main board and the front and rear panels is done as shown here.

PARTS LIST-DECODER BOARD

All resistors 5%, 1/4 watt unless otherwise noted

R1, R13, R16-2200 ohms

R2-22 ohms

R3, R5, R11, R12-100,000 ohms

R4, 46, R8-4700 ohms

R7-100 ohms

R9-10 megohms

R10-47,000 ohms

R14, R17-20,000 ohms, 15-turn potentiometer, PC-mount (Radio Shack

271-340 or equivalent)

R15, R18-6200 ohms R19, R20-180,000 ohms

R21-1 megohm

Capacitors

C1, C6, C13-1µF, 16V, electrolytic, radial leads

C2-0.001 µF, 50V, polyester

C3, C7-47µF, 16V, electrolytic, radial leads

C4, C8, C9, C10, C11, C15-0.1µF, 50V, polyester

C5, C12-2.2 µF, 16V, electrolytic, radial

C14, C16-0.1µF, 16V, ceramic disc

C17-1µF, 16V, tantalum

Semiconductors

IC1-LM339 linear quad comparators (National)

IC2-CD4017 CMOS counter (RCA) IC3, IC4-LM567 linear tone decoders (National)

IC5-CD4001 CMOS quad Non gates (RCA)

D1-D6-1N4148 silicon switching diodes LED1, LED2-jumbo red LED's (Radio Shack 276-041 or equivalent)

SO1-6-pin female plug (Calectro 41-126 or equivalent)

S2-SPST rocker switch (Radio Shack 275-690)

T1-12 VAC, 250mA, plug-in transformer (Jameco AC-250 or equivalent)

Miscellaneous: PC board, front-panel board, 2×5×5-inch cabinet (CM5-200, Pac Tec, Inc., Enterprise and Executive Aves., Philadelphia, PA 19153)(Radio Shack 270-218), 12-foot modular telephone cord (Radio Shack 279-374 or equivalent), IC sockets, 4 1-inch threaded spacers for 4-40 screws, 4 0.125-inch unthreaded spacers, 4 4-40 × 0.25 inch screws, 7 4-40 × 0.5 screws, 11 No. 4 lockwashers, 3 4-40 nuts, 0.25-inch cable clamp, etc.

Also note that the procedures outlined below assume that the code number selected will be 7

Use this procedure if you have a frequency counter: Plug in the transformer and set the project's power switch to the ON position. Observe that the LED's on the decoder board blink when power is applied. That tells us that the decoders are working. Next, set up your counter and connect the ground lead of its probe to TP3, the ground test point on the decoder board (see Fig. 13).

Adjust the decoders by measuring the frequency at the testpoints and by adjusting the potentiometers for the right values. Connect the counter to TP1 and adjust R17 until the counter reads 1209 Hz. Next, connect the counter to TP2 and adjust R14 until the counter reads 852 Hz. Finish by dabbing nail polish on the potentiometers to lock the settings.

Use this procedure if you do not have a counter: Temporarily remove the decoder board and unplug it. Remove IC3, the MC14538, from its socket and place a wire jumper into the socket between pins 10 and 16. That causes the relay to close when power is applied. That way, incoming tones will be received by the decoder

Preset the potentiometers on the decoder board-turn R17 fully clockwise and R14 fully counterclockwise. You'll know when the end is reached when the potentiometers start to turn hard.

Plug in the transformer and plug the phone connector into your phone jack. Do not turn on the power switch yet. Then call your friend.

When your friend answers, tell him to press and hold down number 7. Turn R17 until LED2 lights. Likewise, turn R14 until LEDI comes on. At the same time the beeper will sound; that is normal. Finish up by having your friend press number 7 several times. Both LED's must light. If not, touch up the adjustment for the one that doesn't.

Finish the adjustments by dabbing nail polish on the potentiometers to lock the settings then remove the jumper from the IC3 socket on the main board and replace the MC14538.

Adjust the volume control by setting it to midposition through the hole in the rear panel. Later on, if you find that the buzzer is too loud or too soft, adjust the volume as required.

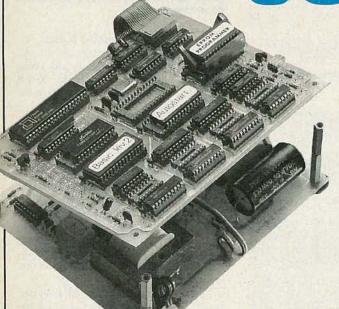
Using the project

Using the project is simplicity in itself. and the hardest part will be to get other people to remember to dial your access code.

To use the project, connect the transformer to a nearby outlet. Also, using a Tconnector, connect both the project and your phone to your modular phone jack. Then set the power switch to the on position to prevent undesired phone calls.

Tell those who you want to be able to reach you about the project and the procedure that must be followed to call you. That is, they dial your phone number as usual, hear one ring, and then have 10 seconds to dial "7". If they don't dial the code number, your phone won't ring and they can't reach you.

There may be times when you want to receive calls from people who shouldn't continued on page 107



One of the best things about this control computer is that it can operate BSR-type remote controllers. Let's see how, as we look at the power-supply, the wireless remote controller, and the computer's I/O system.

STEVEN E. SARNS

Part 2 WHEN WE LEFT OFF last time, we had just set up the computer. We said that if the BASIC prompt (>) appeared on your terminal, you could assume that things are working properly. If you do not get the prompt, turn off the power and disconnect the board. If you are using a wire-wrap or other prototype system, check every line with an ohmmeter. If you use a printedcircuit board, examine the board closely (with a magnifying glass) for solder bridges or splats, cold solder joints, solder-flux residue, or "whiskers" of PC material under the solder mask. Use an ohmmeter to check adjacent pins and lines for whisker shorts. Check every IC to insure that no pin has been folded under during insertion. Use an ohmmeter to check the orientation of every diode. It is unfortunately not uncommon to find the markings reversed. If those basic troubleshooting steps don't work, reapply +5 volts DC and check the state of the pins on

the microprocessor according to Table 2. Reset the board and observe the RS-232 output pin. If there is any activity on this pin shortly after reset, then the prompt is being sent, but the terminal is not responding correctly. Check the communications settings on the terminal. (Although we said last month that the terminal should be set to 4800 baud, that's not essential. Simply type a space within 8 seconds after reset, and the computer will adapt.) Examine the input of the RS-232 port; this line should be at a TTL low level. Typing any character on the terminal should produce a short series of positive-going pulses.

When you get the BASIC prompt, and your terminal and the control computer are communicating properly, you are ready to enter your first program:

OK >NEW

OK

>1 PRINT "HELLO",

>2 GOTO 1

>RUN

We hope that everything worked as it should have, and your screen is now full of "HELLO's." We'll now leave our discussion of the computer board and begin our discussion about the computer's power supply and wireless remote control that we promised last month.

You may think we're getting ahead of

TABLE 2-8088 PIN STATES

Pin	Function	State
1,20	GROUND	ground
21	RESET	low
23	TEST	high
31	HOLD	low
19	CLOCK	4 MHz
17	NMI	low
40	Vcc	+5 VDC
22	READY	high
24	INTA	high
33	MN/MX	high
18	INTR	low

ourselves because we haven't finished discussing the computer circuitry yet—specifically, the I/O system. But some people will not be able to test out the basic system until they build a power supply. So now we'll discuss the power-supply board. After we've done that, we'll return to the computer board with a look at its I/O capabilities.

The second board

As we mentioned last time, we know that the computer board requires a supply of +5 volts DC at less than 1 amp. If you plan to use an RS-232 cable longer than 10 feet, then you'll also need a -5-volt supply to establish the RS-232 "mark" level. And if you'll want to program EPROM's, you'll need a higher-voltage



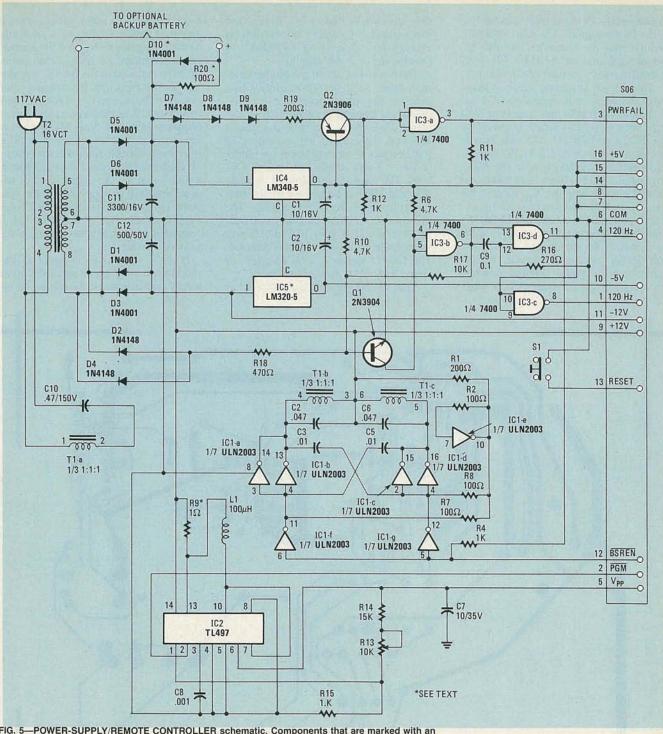


FIG. 5—POWER-SUPPLY/REMOTE CONTROLLER schematic. Components that are marked with an asterisk are optional. Note that some component values do not agree with the Parts List that appeared last month. Those have been corrected in the Parts List on page 69.

supply—the 2716 EPROM requires a 25-volt DC supply at 30 mA.

Other EPROM's require other supplies. For example, the 2732 requires a 21-volt switched supply at 20 mA, while the 2764 requires a 21-volt supply at 30 mA. We mention the requirements for other EPROM's because, as you may remember, the first installment of this article made note of some "unused pads" on the board, some of which are for jumpers to select various options (including the option to program EPROM's other than the 2716). Unfortunately we cannot go into

detail on all the possible options—we'll discuss a basic configuration and leave the experimenting up to you. We strongly recommend that you have the board working correctly using 2K×8 RAM's like the TMM 2016P and 2K×8 EPROM's like the 2716 before you start making changes.

Presuming that everything is working correctly, then you can begin to change the board configuration. Let's say, for example, that you want to program a 2732 or 2764 EPROM. You will have to connect pin 23 of the socket (remember—we're using 28-pin sockets even though the 2716

and 2732 have 24 pins) to A11. And you'll have to cut the trace that now brings V_{pp} there. Pin 20 of the socket should be connected to IC16, pin 7 instead of IC20 pin 13. Study the data sheets and pin functions carefully so that you understand why those changes have to be made—before you make any changes.

A look at the power supply

The schematic of the power supply we'll use is shown in Fig. 5. It can supply all of the V_{pp} options. (The level of V_{pp} can be varied by trimmer potentiometer R13.) The power-supply board also provides some signals that are used—but

RADIO-ELECTRONICS

not required-by the control computer itself. Those signals include: PWRFAIL (which tells the computer that the AC power has failed) and a 120-Hz TTL-level pulse that is used for time-of-day routines.

The \pm 5-volt DC power supply is made up of simple linear-IC regulators (IC4 and IC5). The V_{pp} supply must supply only 30 mA, but it must be switched on and off for the 2732 type EPROM. The switching is accomplished with IC2, a TL397 switching regulator. Besides giving us the ability to program 2732's, there is an additional benefit to switching the V_{pp} supply: We can control its turn-on characteristics. That's important because most EPROM's specify the programming voltage to within .5 volt. If the supply goes any higher, the device can be destroyed. Unfortunately, many power supplies generate an overshoot greater than .5 volt when they are switched on or off. Even a few nanoseconds of ringing on the line is enough to cause some EPROM's to crowbar the +5-volt supply.

The power-fail circuit is a simple common-base, level-detection circuit that monitors the voltage across the +5VDC regulator. When that voltage falls to less than 4 diode drops, the PWRFAIL signal is activated. That allows approximately 30 milliseconds of warning before the output of the +5-volt supply falls below 4.75 volts. The PWRFAIL signal is fed (through SO6 and SO5) to the non-maskable interrupt (pin 17) of the microprocessor. The microprocessor will enter a wait state until its TEST pin (23) goes low, which will happen when a 120-Hz signal is detected. The 120-Hz signal will be detected, of course, when AC power is restored.

That 120-Hz signal is a positive-going

pulse at AC zero cross. That signal is important for several reasons. It allows the control computer to be used for time-ofday applications. (A time-of-day routine has been included in the BASIC interpreter. See the Parts List for ordering information.) The second use of the AC zerocross signal is to synchronize the control computer to the AC line. Many types of machinery require switching on or off at AC zero-crossing to minimize the amount of interference generated. More important for us is that the the remote-control link requires that transmissions be synchronized to AC zero crossing. We'll discuss that shortly. Transistor Q1 is connected in a common-emitter configuration, driving IC3.

If you're worried about power failures and brownouts, you can make the power supply uninterruptable by adding an op-

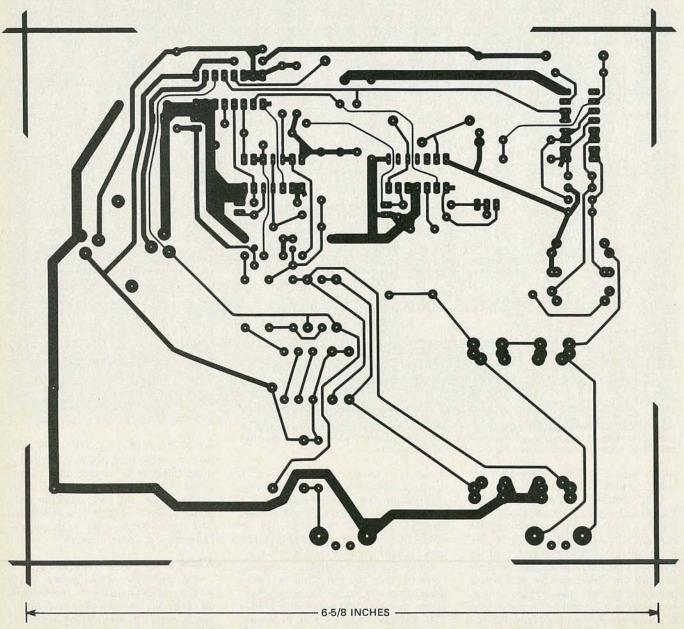


FIG. 6—FOIL PATTERN for the power supply/remote controller. The single-sided board is the same size as the computer board that we showed last month.

tional backup battery, D10, and R20. That approach is simple and effective for small systems such as this, where an 8-volt, 4 amp-hour *Gel-Cell* will give you about 6 hours of backup operation. Unfortunately, while a battery-backup system will protect the contents of RAM, it will not protect the time-keeping function, which relies on the 60-Hz line frequency.

The foil pattern for the single-sided power-supply/remote-control board is shown in Fig. 6. Note that it's the same size as the computer board that we showed you last month. The parts-placement diagram for the board is shown in Fig. 7.

Building the power supply is simply a matter of "stuffing the board." There are a few points that we should mention, though. Figure 8 shows the assembled board of the author's prototype. Note that only one regulator is installed. That's because the —5-volt supply is necessary only for RS-232 cables longer than 10 feet. Up at the top of the board is SO6—a standard 16-pin IC socket. A 16-conductor cable that leads to the computer board is simply plugged in there.

The flat PC-mounted transformer and the heatsink for the regulators bring the overall height of the power supply to less than 1.5 inches. That means that even with the computer board mounted directly on top of the power supply, the total height can be kept well below three inches.

The remote-control link

The greatest feature of the power-supply board is the wireless remote-control link that allows the computer to control instruments and appliances without the hassles of stringing wires to the control point. Signals are sent via the power lines and are decoded at the control site so that remote control is simply a matter of plugging the unit that you want to control into a remote module, and transmitting the appropriate codes to the module under control of a BASIC program. (We're getting a little ahead of ourselves here; we haven't yet discussed the computer's I/O system that enables us to do that. But we'll get to the details on that shortly.)

The best way to familiarize you with the remote-control system is to compare it to the BSR model X-10—a remote-control system based on the carrier-current method. A transmitter superimposes a highfrequency signal onto the AC power lines. That signal contains information that is decoded by the receiver module. There are many advantages to using carrier-current communications. First, the wires are already there—there is no need to drill, cover, or hide the wires around the home. Second, the system is highly portablebecause there are no wires, it is not built into your existing location. Another advantage is that the system is popular-Radio Shack, Heath, Sears Roebuck, and Advance Electronics are among the

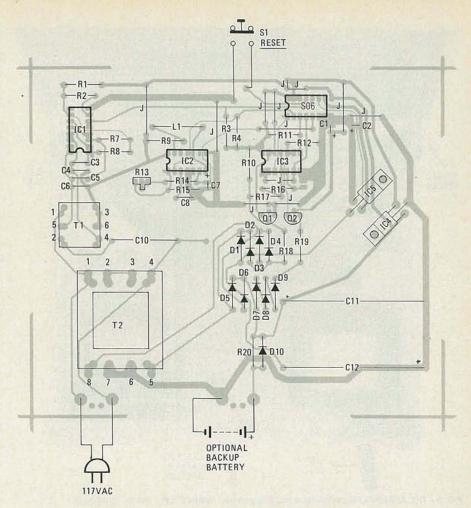


FIG. 7—PARTS-PLACEMENT diagram for power supply/remote controller.

largest suppliers. The receiver modules are inexpensive (\$8–\$17) and are available for a wide variety of functions. Plugin modules (see Fig. 9), wall-mounted switches, and dual outlets are the most common.

There are two basic types of receivers. The lamp controller uses a Triac as the control element and can regulate the AC power into resistive loads up to 300 watts. The appliance modules contain a relay that can be used to switch loads that draw up to 15 amps.

It should be noted that this system does not include "handshaking." No response from the receiver is expected; it cannot indicate that the message was received or that the command was executed. The transmitter simply transmits and assumes that everything is all right. Because of that, you should be very careful if you plan to use this system in any application that requires high reliability. However, in the home environment where the system was designed to operate, it is as secure and reliable as possible for the low module cost.

There are several possible problems with transmitting information over the AC power lines. First, if you live in an apartment complex, you may find that your transmissions control your neighbor's

units as well as your own. But because there are 256 unit codes available, a bit of coordination will easily solve that problem. The second problem occurs when attempting to transmit from one branch of the AC line to the other. When 230 volts AC is brought into the home at the service entrance, the home circuits are shared between the two phases. A transmitter on one leg may not be able to communicate with a receiver on the other. Many times, however, appliances that are connected between the 230-volt phases will serve as a high-frequency bypass path between the legs. If a problem is encountered, a 0.1 µF capacitor connected across the legs should solve it. (The capacitor provides a high-frequency bypass path around the transformer to the other leg.)

We mentioned that the remote-control system requires that the code transmission be synchronized to AC zero crossing—the transmission must begin within 100 microseconds of zero cross. A data "one" bit is defined as 3 bursts of 120 kHz starting immediately after zero cross, lasting 1.0 milliseconds, and spaced 1.6 ms apart. A data "zero" bit is defined as no transmission of 120 kHz after zero cross. Fig. 10 shows one cycle of 117-volts AC, over which is superimposed first a one and then a zero. Notice that each bit of data is

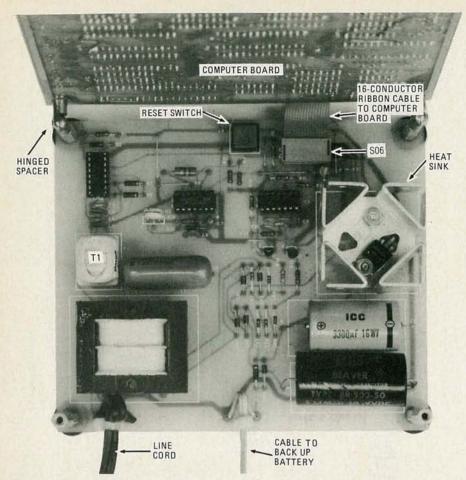


FIG. 8—THE ASSEMBLED board. Note that IC5 was not installed in the author's prototype.



FIG. 9—THE BSR LAMP-CONTROL MODULE. The house and unit codes are easily set using thumbwheel switches.

sent during one-half AC cycle. Therefore, the data-transmission rate is 120 Hz.

Each message sent to the control module is made up of 22 bits of data as shown in Fig. 11. That data is organized as follows: First a start sequence of 1,1,1,0 is transmitted. (That takes two full cycles.) Next the 9-bit address/command code is transmitted. Following each transmitted data bit, the compliment of that bit is transmitted on the next AC zero cross. The complete message, including the start

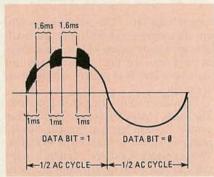


FIG. 10—ONE CYCLE of a 60-Hz waveform showing a superimposed control signal.

sequence, takes 11 full AC cycles.

The 9-bit (18 bits if you include the complements) data packet consists of 4 bits that determine the "house code" (A-P) followed by 5 bits that contain either the command or unit code. A typical control-command sequence consists of two transmissions. First, for example, house code M, unit 3 is transmitted. That causes all modules that are set to code M-except for any modules set to unit 3-to ignore the next transmission. (Of course, any modules that are not set to house-code M will also ignore the next transmission.) That next transmission would be, for example, house-code M, ON. And module 3—which is the only module "paying attention" responds by turning on.

Table 3 lists the house codes and Table 4 lists the command codes that are available in the system. Notice that if you select house code M, the upper 4 bits are always zero. The data word transmitted then consists of only the following 5-bit word—the decimal value shown in Table 4. If you wish to use other house codes, simply form the 9-bit word by placing the house code bits in front of the command bits. We'll look at an example shortly.

The hardware required to transmit the commands is surprisingly simple. The AC zero-cross detector is already a part of our system. The 120-kHz transmitter is an inductive multivibrator that can be enabled with a TTL signal (BSREN from pin 11 of SO5). This multivibrator consists of 4 open-collector inverters (IC1) connected in an astable configuration. Each stage is formed by paralleling two gates for increased reliability. A fifth IC inverter is connected in a negative-feedback configuration, biased at the same level as the multivibrator stages to provide a stable bias source. The multivibrator is controlled through two additional (open-collector) gates connected to the inputs of the astable gates. Those will clamp the astable inputs to ground in order to disable the oscillator.

The software required to drive the BSR remote-control link is, unfortunately, not as simple as the hardware. Because of the submillisecond timing requirements, BASIC cannot be used. However, the transmitter driver routine has been incorporated into the BASIC interpreter. (See the Parts List for information on availability of the interpreter.) The command "XMIT" eliminates all of the inconvenience of developing and debugging a machine-code routine. For example, to turn on unit 6, house code M, the proper sequence of commands is:

XMIT(18) XMIT(5)

The first command alerts any units that are set to house code M, unit 6. The second command turns those units on. Just to make sure you understand how to use the

	TABLE	3		
House Code	D8	D7	D6	D5
A	0	1	1	0
В	1	1	1	0
C	0	0	1	0
D	1	0	1	Ø
E	0	Ø	0	1
F	1	0	0	1
G	0	1	0	1
H	1	1	Ø	1
in the second	0	1	1	1
J	1	1	1	1
K	0	0	1	1
	1	0	1	1
M	0	0	Ø	0
N	1	Ø	0	0
0	0	1	0	0
P	1	1	Ø	Ø

PARTS LIST—COMPUTER BOARD

All resistors 1/4-watt, 5% unless otherwise noted

R1,R4,R14-R18-1000 ohms R2,R5,R6-user-determined. To be discussed next month H3,R11,R12-10,000 ohms

R7-680 ohms

R8-390 ohms

R9-12,000 ohms

R10-2,000 ohms

RN1-4.7K×9 resistor network

Capacitors

C1—user-determined. To be discussed next month

C2—150 pF, ceramic disc

C3-C8,C11-C13,C16-C20-0.1 µF, ceramic disc

C9-0.001 µF C10-27 pF

C14,C15-10µF, 16 volts, electrolytic

Semiconductors

IC1—ADC0804 A/D converter (National) IC2,IC3-74LS541 octal buffer and line

IC4—SN75478 seven high-current darlington drivers (TI, also Sprague ULN-2003, Motorola MC1413)

IC5-4051 8-input analog multiplexer IC6,IC7—74LS377 octal latch

IC8-74LS251 8-input digital multiplexer IC9-System ROM. 2716, 2732, or 2764.

450 ns maximum access time. IC10,IC12-TMM 2016P-2 (Toshiba or similar) 2K × 8 static RAM, 450 ns. IC13—Programmed EPROM (2716)

IC14-EPROM to be programmed

IC11-74LS259 8-bit addressable latch

IC15-74LS373 octal latch

IC16-74LS139 dual 2-to-4 line decoder/ multiplexer

IC17-74LS32 quad on gate

IC18-8088 microprocessor

IC19-74LS04 hex inverter

IC20-74LS123 dual one-shot

Q1,Q2-2N3904

Q3-2N3906

D1.D2, D4-D8-1N4148

D3-1N4001

Miscellaneous: IC sockets, PC board, mounting hardware, etc.

The following are available from Vesta Technology, Inc., 2849 W. 35th Ave., Denver, CO 80211: KIT 1—Kit of all parts needed to control 7 LS-TTL outputs, monitor 7 inputs, program EPROM's, RS-232 serial port, and 2K RAM (does not include operating system—see below), \$99.95; KIT 2—Kit of all parts for full-capacity I/O and 4K RAM (does not include operating system-see below), 169.95; Operating systems contained in ROM: BASIC I operating system, \$12.95; BASIC II operating system, \$29.95; Forth operating system, \$79.95; Assembled, tested, and burned-in control computer with BASIC II operating system, \$279; RS-232 cable, \$24.95; 2716 EPROM, \$6.95. Add \$6 for shipping, handling, and insurance.

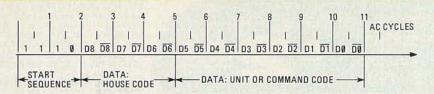


FIG 11—ONE TRANSMISSION consists of a start sequence, a house code, and a unit or command code. (Remember-the complete command transmission consists of two separate transmissions; the first ends with the unit code, and the second ends with the command code.)

TABLE 4

ADDRESS/COMMAND	D4	D3	D2	D1	DØ	DECIMAL VALUE
Unit 1	Ø	1	1	Ø	0	12
Unit 2	1	1	1	0	0	28
Unit 3	0	0	1	0	0	4
Unit 4	1	Ø	1	0	Ø	20
Unit 5	0	0	Ø	1	0	2
Unit 6	1	0	0	1	0	18
Unit 7	0	1	0	1	Ø	10
Unit 8	1	1	0	1	0	26
Unit 9	0	1	1	1	0	14
Unit 10	1	1	- 1	1	0	30
Unit 11	0	Ø	1	1	Ø	6
Unit 12	1	Ø	1	1	Ø	22
Unit 13	Ø	Ø	0	Ø	Ø	0
Unit 14	1	0	Ø	0	0	16
Unit 15	Ø	1	0	Ø	0	8
Unit 16	1	1	Ø	0	Ø	24
CLEAR	0	0	0	0	1	1
ALL UNITS ON	Ø	0	0	1	1	3
ON	0	0	1	0	1	5
OFF	0	0	1	1	1	7
DIM	0	1	Ø	0	1	9
BRIGHTEN	0	1	0	1	1	11

PARTS LIST—POWER-SUPPLY/ **BSR LINK BOARD**

All resistors 1/4 watt, 5% unless otherwise noted

R1,R19-200 ohms

R2,R7,R8,R20—100 ohms

R3,R4,R11,R12,R15-1000 ohms

R6,R10-4700 ohms

R9-1 ohm (a jumper works fine)

R13-10,000 ohms trimmer potentiometer

R14-15,000 ohms

R16-270 ohms

R17-10,000 ohms

R18-470 ohms

Capacitors

C1,C2-10 µF, 16 volts, electrolytic

C3,C5—0.01 μ F, ceramic disc C4,C6—0.047 μ F, ceramic disc

C7-10 µF, 35 volts, tantalum

C8-.001 µF, ceramic disc

C9-0.1 μF, ceramic disc

C10-0.14 to 0.47 µF, 150 volts, electroly-

C11—3300 μ F, 16 volts, electrolytic C12—500 μ F, 50 volts, electrolytic

Semiconductors

IC1-ULN2003 darlington array (Sprague)

IC2—TL497 switching regulator

IC3-74LS00 quad NAND gate

IC4—LM340-5 +5-volt regulator IC5—LM320-5 -5-volt regulator

Q1-2N3904

Q2-2N3906

D1,D3,D5,D6,D10-1N4001

D2,D4,D7-D9-1N4148

T1-11Z2100 1:1:1 pulse transformer (Sprague)

T2-16 volts, center tapped, 0.4 amps. (Signal ST-4-16 or similar)

S1-normally open momentary pushbutton switch

Miscellaneous:line cord, printed-circuit board, IC sockets, heat sink for regulator, mounting hardware, etc.

The following are available from Vesta Technology, Inc., 2849 W. 35th Ave., Denver, CO 80211: Power-supply/BSRlink kit, including all components, \$59.95; Assembled, tested, and burned in power supply, \$109. Add \$6 for shipping, handling and insurance.

command/address codes, how would you turn off house-code N, unit 6? If you study Tables 3 and 4 and our discussion, you should see that the commands

XMIT(151)

XMIT(135)

would do it. The first command sends the house/address code 0100/10010 (151 decimal) and the second command sends the house/command code 0100/00111. (135 decimal).

One final point that we should make about the remote-control system is that it is a low-power communications device operating between 10 kHz and 490 kHz and is therefore subject to FCC regulation part 15, paragraph 15.111 (Operation below 1600 kHz) and 15.102 (Interference) which states: "Notwithstanding the other

RADIO-ELECTRONICS

Professional Books That Help You Get Ahead-And Stay Ahead!

Join the Electronics and Control Engineers' Book Club® and...

THE McGRAW-HILL COMPUTER HANDBOOK: Applications, Concepts, Hardware, Software, Edited by H. Helms. 992 pp., 475 illus. Everything you need to know about today's computer science and engineering is here in this massive treasure trove of information. Covers everything from Boolean algebra to hardware selection techniques to artificial intelligence. A handy reference work that brings you right up to the minute!

279/721 Pub. Pr., \$79.50 Club Pr., \$49.95

INTUITIVE IC ELECTRONICS: A Sophisticated Primer for Engineers and Technicians. By T. M. Frederiksen. 208 pp., illus. Covering both the simplest and the most complicated IC designs, this lively, easy-to-read volume provides a sophisticated, nonmathematical explanation of the basic internal mechanisms common to all semi-conductor devices. conductor devices.

219/230 Pub. Pr., \$24.95 Club Pr., \$18.95

SIGNALS AND SYSTEMS. By A. Oppenheim, A. Willsky, and I. Young. 869 pp., more than 350 illus. Presenting a comprehensive discussion of methods for analyzing discrete-time systems, this book thoroughly integrates discrete- and continuous-time concepts, covers underlying theories, and explores real-world applications. Includes a look at feedback, convolution, and other concepts not treated in depth elsewhere.

582674-7 Pub. Pr., \$32.50 Club Pr., \$25.95

RADIO HANDBOOK, 22/e. By W. Orr. 1,136 pp., more than 1,300 illus. Here's the latest edition of what is universally regarded as the most useful reference in the industry. It's a "course" in communications, a fact-packed reference, and a how-to guide-all in a single book!

582442-6 Pub. Pr., \$39.95 Club Pr., \$33.95

MICROPROCESSOR APPLICATIONS HANDBOOK. Editor-in Chief, D. F. Stout. 472 pp., 284 illus. At last—a reference guide to microprocessor applications to help you make your systems timely, versatile, and

617/988 Pub. Pr., \$39.95 Club Pr., \$31.45

MICROPROCESSOR AND MICRO-COMPUTER DATA DIGEST. By W. H. Buchsbaum and G. Weissenberg. 336 pp., 93 block diagrams, 106 pin con-figurations. If you work with electronic devices that use microprocessor or mi-crocomputer integrated circuits, this much-needed book contains all the detailed technical data for every micro-processor IC that is currently listed as a "standard," off-the-shelf item.

582835-9 Pub. Pr., \$29.95 Club Pr., \$22.50

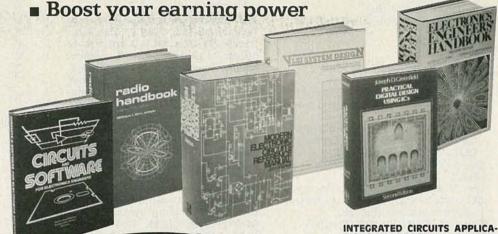
VLSI SYSTEM DESIGN: When and How to Design Very-Large-Scale Integrated Circuits. By S. Muroga. 496 pp., illus., includes self-test prob-lems. This book provides a straight-forward explanation of how to design the integrated circuit chips that are causing this electronics revolution. It focuses on every significant aspect of LSI/VLSI

582823-5 Pub. Pr., \$34.95 Club Pr., \$26.50

Keep up with current technology

Sharpen your professional skills

Be ready for new career opportunities



New members! Any one of these great professional books for only ... as a premium with your 1st selection!

Spectacular values up to \$79.90

PRACTICAL DIGITAL DESIGN US-ING ICS, 2/e. By J. D. Greenfield. 717 pp., illus. This revised and expanded pp., illus. This revised and expunded Second Edition of a popular guide shows how to get the most out of a wide range of popular integrated circuits. What's it contains the specialized knowhow today's designer needs to interface ICs with microprocessors.

582853-7 Pub. Pr., \$25.95 Club Pr., \$19.95

ELECTRONIC COMMUNICATIONS SYSTEMS. By W. D. Stanley. 566 pp., illus. Emphasizing the signal-processing functions of modulation and demodulation operation, this book pre-sents the essentials of electronic communications in a logical, step-by-

582834-0 Pub. Pr., \$24.95 Club Pr., \$19.95

ANALYSIS AND DESIGN OF DIGI-TAL INTEGRATED CIRCUITS. By D. A. Hodges and H. G. Jackson. 448 pp., illus. One of the most comprehensive books in this field, this is a valuable working tool for those who design ICs as well as those who use them. It is the only book now available that covers its subject from a quantitative viewpoint. 291/535 Pub. Pr., \$31.00 Club Pr., \$23.95

MODERN ELECTRONIC CIRCUITS REFERENCE MANUAL. By J. Markus. 1,264 pp., 3,666 circuit diagrams. Complete with values of components and suggestions for revisions—plus the original source of each circuit in case want additional performance or construction details.

404/461 Pub. Pr., \$74.95 Club Pr., \$57.95

ELECTRONICS ENGINEERS' HAND-BOOK, 2/e. Edited by D. G. Fink & D. Christiansen. 2,272 pp., 2,189 illus. This updated and enlarged edition covers all the latest knowledge in the field, including new advances in integrated circuits, pulsed and logic circuits, laser technology, telecommunications, and much more

209/812 Pub. Pr., \$79.90 Club Pr., \$57.50

DIGITAL CIRCUITS AND MICRO-PROCESSORS. By H. Taub. 608 pp., heavily illus. This fast-paced, carefully written guide gives you thorough explanations of all the basic principles of digital systems and logic design — plus a solid introduction to microprocessors and microprocessor-based designs.

629/455 Pub. Pr., \$33.95 Club Pr., \$25.50

TIONS HANDBOOK. By A. H. Seidman. 673 pp., illus. This Handbook presents information on everything from TTL, ECL, MOS, and CMOS logic families to semiconductor and bubble memories. The emphasis is on applications, with a minimum of theory. The math used is essentially limited to simple arithmetic and elementary algebra 582860-X Pub. Pr., \$39.95 Club Pr., \$29.95

INTRODUCTION TO RADAR SYSTEMS, 2/e. By M. I. Skolnik. 698 pp., 244 illus. This new edition of a widely used text on radar from the systems engineer's point of view brings you full discussions of the many major changes that have oc-curred in the field recently.

579/091 Pub. Pr., \$40.95 Club Pr., \$31.00

CIRCUITS AND SOFTWARE FOR ELECTRONICS ENGINEERS. By H. Bierman. 352 pp., 200 illus., outsized 8½ x 11 format. This collection of over 340 proven-reliable circuits, computer programs, test methods, and design tools have been selected because of the ingenious ways they adapt devices to other uses.

052/433 Pub. Pr., \$35.00 Club Pr., \$27.95

HANDBOOK OF ELECTRIC POWER CALCULATIONS. Edited by A. Seidman, H. Mahrous and T. G. Hicks. 448 pp., 300 illus. Here are 285 tested and proven procedures for handling the electric power problems most frequently encountered in actual practice. You'll find ingenious, time-saving ways to calculate fuel costs, motor efficiency, and power output. 560/617 Pub. Pr., \$39.50 Club Pr., \$29.95

STANDARD HANDBOOK FOR ELECTRICAL ENGINEERS, 11/e. By D. G. Fink and H. Beaty. 2, 448 pp., 1,414 illus. Today's most widely used source of electrical engineering information and data serves you as no other single work when you need detailed, timely, and reliable facts . 209/74X Pub. Pr., \$74.95 Club Pr., \$53.95

HANDBOOK OF PRACTICAL ELECTRICAL DESIGN. By J. F. McPartland. 416 pp., 300 illus. This volume provides a step-by-step explanation of designing electrical systems for industrial, commercial, and residential applications. Packed with helpful tips for explain time and complying with cere for saving time and complying with code requirements from branch circuits to

456/95X Pub. Pr., \$39.50 Club Pr., \$27.50

DIGITAL LOGIC DESIGN. By B. Holdsworth. 338 pp., 192 illus. All of the recent advances in digital design techniques are presented here in depth. It's both a text covering basic concepts and a practical guide to design techniques for combinational, clock-driven, and event-driven circuits.

582852-9 Pub. Pr., \$39.95 Club Pr., \$27.50

ELECTRONICS

PROFESSIONAL

XAMINATIONS

CHARLES R. HAFER

GINEERS

Digital

OPTICAL FIBER SYSTEMS: Technology, Design, and Applications. By C. K. Kao. 197 pp., illus. From a basic explanation of optical fiber systems to the economic ramifications of their use, this volume provides full coverage of a rapidly changing field. rapidly changing field.

332/770 Pub. Pr., \$29.50 Club Pr., \$23.95

ELECTRONICS ENGINEERING FOR PROFESSIONAL ENGINEERS' EX-AMINATIONS. By C. R. Hafer. 336 pp., more than 200 illus. Actually two books in one—a quick preparation manual to help you pass your P.E. exams on the first try and a rich source of practical electronics engineering information and know-how.

254/303 Pub. Pr., \$29.95 Club Pr., \$21.50

DBOOK

) f.STOUT

computer

methods for

and design

circuit analysis

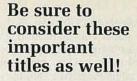
ELECTRONIC COMMUNICATION, **4/e**. By R. L. Shrader. 801 pp., 870 illus. This thoroughly updated edition offers all the theory and fundamentals you need to prepare yourself for the FCC commercial and amateur grade license examinations—and pass them the first time!

571/503 Pub. Pr., \$28.50 Club Pr., \$20.95

HANDBOOK OF MICROCOMPUTER-BASED INSTRUMENTATION AND CONTROLS. By J. D. Lenk. 307 pp., 227 illus. Digital or microcomputer-based instrumentation and control systems can be very complicated—or relatively simple—depending on the application. In this book both systems are described and illustrated—and many examples of actual systems now in use in industry are included throughout. 582866-9 Pub. Pr., \$22.95 Club Pr., \$18.95

COMPUTER METHODS FOR CIR-CUIT ANALYSIS AND DESIGN. By J. Vlach and K. Singhal. 656 pp., 148 il-lus. Computational methods have become an integral part of circuit analysis and design. And a solid understanding of the basics of computer-aided design is a must for engineers who want to achieve their career objectives. This selfteaching book provides that know-how in a logical, easy-to-follow presenta-

582855-3 Pub. Pr., \$42.50 Club Pr., \$33.95



LARGE SCALE INTEGRATION: De-vices, Circuits, and Systems. By M. J. Howes & D. V. Morgan 582851-0 Pub. Pr., \$35.95 Club Pr., \$29.95

MICROWAVE SEMICONDUCTOR ENGINEERING. By J. F. White. 582553-8 Pub. Pr., \$28.50 Club Pr., \$23.50

MICROPROCESSOR SUPPORT CHIPS: Theory, Design, and Applica-tions. By T. J. Byers.

095/183 Pub. Pr., \$39.50 Club Pr., \$31.00

ENGINEERING FORMULAS, 4/e. By 232/199 Pub. Pr., \$16.95 Club Pr., \$13.50

ELECTRONICS CIRCUITS NOTE-BOOK. Edited by S. Weber. 192/448 Pub. Pr., \$35.50 Club Pr., \$27.50

INTRODUCTION TO THE THEORY AND DESIGN OF ACTIVE FILTERS. By L. P. Huelsman & P. E. Allen.

308/543 Pub. Pr., \$35.50 Club Pr., \$27.00

HANDBOOK OF OPERATIONAL AMPLIFIER CIRCUIT DESIGN. By D. E. Stout & M. Kaufman. 617/97X Pub. Pr., \$39.50 Club Pr., \$29.00

ENGINEERING MATHEMATICS HANDBOOK, 2/e. By J. J. Tuma. 654/298 Pub. Pr., \$34.50 Club Pr., \$26.95

PCM & DIGITAL TRANSMISSION **SYSTEMS.** By F. F. Owen. 479/542 Pub. Pr., \$34.95 Club Pr., \$25.95

ANTENNA THEORY: Analysis and **Design.** By C. A. Balanis 582493-1 Pub. Pr., \$41.95 Club Pr., \$31.95

DIGITAL COMMUNICATIONS. By J.

509/271 Pub. Pr., \$37.50 Club Pr., \$29.50



Standard Handbook

Electrical

Engineers

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

Why YOU should join now!

■ BIG SAVINGS — Build your library and save money too! Savings ranging up to 30% or more off publishers' list prices - usually 20% to 25%

BONUS BOOKS—You will immediately begin to participate in our Bonus Book Plan that allows you savings up to 70% off the publishers' prices of many professional and general interest books!

■ CONVENIENCE —12-14 times a year (about once every 3-4 weeks) you receive the Club Bulletin FREE. It fully describes the Main Selection and Alternate Selections. A dated Reply Card is included. If you want the Main Selection, you simply do nothing-it will be shipped automatically. If you want an Alternate Selection-or no book at all -you simply indicate it on the Reply Card and return it by the date specified. You will have at least 10 days to decide. If, because of late delivery of the Bulletin you receive a Main Selection you do not want, you may return it for credit at the Club's expense.

As a Club member you agree only to the purchase of three books (including your first selection) during your first year of membership. Membership may be discontinued by either you or the Club at any time after you have purchased the first selection plus two additional books.

Other McGraw-Hill Book Clubs: Architects' Book Club • Byte Book Club • Chemical Engineers' Book Club • Civil Engineers' Book Club • Mechanical Engineers' Book Club For more information, write to: McGraw-Hill Book Clubs, P.O. Box 582, Hightstown, New Jersey 08520

MAIL THIS COUPON TODAY

Book Club® P.O. Box 582, Hightstow	n New Jersey 08520
i.o. box 302, Hightstow	11, New Jersey 00320
books indicated, billing m my first selection at the c plus local tax, shipping, a to purchase a minimum c ing my first year of membe	mber and send me the two e for the \$2.89 premium and liscounted member's price of two additional books dure ership as outlined under the his ad. A shipping and han- all shipments.
Write Code No. of	Write Code No. of
\$2.89 selection here	first selection here
\$2.89 selection here	first selection here
\$2.89 selection here	first selection here
	first selection here
Signature	first selection here
Signature	first selection here

E33672

requirements of this part, the operator of a low power communication device which causes harmful interference to an authorized radio service, shall promptly stop operating the device until the harmful interference has been eliminated."

The I/O systems

Now that we have taken a look at the power-supply board, we can return to the computer and discuss its input and output capabilities. (We briefly mentioned some of those I/O capabilities when we talked about the remote-control system and the RS-232 port.)

A computer's only link to the outside world is through its inputs and outputs. If we take, for example, a personal computer, the input is usually a keyboard and the output device is usually a CRT screen. A control computer's I/O is oriented more toward hardware. Individual lines can sense external conditions while other lines control external devices.

The number and type of those control lines are very important specifications of a control computer—they are what determine whether or not the computer can do the task that you have in mind.

A microprocessor interfaces with I/O devices in the same manner as it does with memory: An address is sent out on the address bus, data is transferred over the data bus, and the control bus controls the actual transfer. In many systems, I/O devices are treated exactly as memory, in which case they are said to be *memory mapped*. Memory mapping of I/O functions may be done to save hardware (additional decoders), or it may be done because the microprocessor has no provision for separate memory and I/O space.

The alternative to memory mapping is *I/O mapping*, which our system uses. In that case, the control bus has an additional line called IO/MEM that determines if the data will be transferred between the microprocessor and memory or between the microprocessor and I/O. The 8088 has an I/O space of 64K (which is equal to the memory space of many microprocessors).

The various types of inputs and outputs are implemented with various types of IC's that are enabled onto the data bus whenever their address is present on the address bus. We will decode the I/O space in much the same way that we did for memory. In fact we will use the other half of the same IC (IC16-b, a 74LS139 dual 2to-4 line decoder/multiplexer) plus a few additional gates. (Refer back to Fig. 1 in the April issue of Radio-Electronics.) The signal 10/MEM will be used to enable that half of the decoder—that prevents an I/O device from responding to an address meant for memory. We will use address lines A4 and A5 to select which of the four outputs will be active (low).

Further decoding is required to separate the input devices from the output devices.

Two OR gates (IC17-b IC17-c) provide that function for those IC's that do not have two ENABLE inputs. The memory map that results from that decoding is shown in Table. 3

Digital I/O-bit-addressable

The inputs of a control computer are used primarily to sense the status (high or low) of an external device. Outputs are generally used to turn something on or off. Bit-addressable I/O allows us to act on or read only one bit of information—that bit is isolated from all of the other inputs and outputs. Although bit-addressable I/O is neither the simplest to implement nor the most common type of I/O, it is, in most cases, the easiest to use.

All we have to do to get our outputs is to connect an addressable latch onto databus line D0. By using IC11, a 74LS259, we can latch and output 8 individually-addressable bits to the "real world".

Inputs are no more difficult than outputs. The hardware for bit-addressable inputs consist of a multiplexer (IC8—74LS251) that selects the desired line that will be connected to data-bus line D7. In the case of both the input multiplexer and the output latch, the address lines A0, A1, and A2 are connected to the address inputs of the IC.

Before we go any farther we should remind you that the last bit-addressable input and the last bit-addressable output are used by BASIC for the RS-232 port. Do not change the state of the output or connect anything to the input if you are using a terminal for communications.

A glance at the software required to exercise these I/O functions will give you an idea of how easy it will be to start using the computer. For example, to set the first output high we simply execute the OUT (port, value) statement: "OUT(Ø,1)." That BASIC statement outputs to I/O location Ø, the value 1. (See Table 5 for other port "addresses.") The latch will hold that value on the output line. Reading an input is just as easy. In this case we must assign the result to a variable as in the statement: "LET A = INP(Ø)." Then the status of the first input line, IØ determines the value of A.

Note that the BASIC INP and OUT statements are used instead of PEEK and POKE. That's because we are exchanging the data in the I/O space, not in memory.

The output line of the multiplexer is

Digital I/O—bit-addressable

inverted output of the multiplexer) you would have to mask off the unused bits.

At last we can start using our computer for control. As a demonstration, let's connect 7 LED's to the 7 outputs as shown in Fig. 12. Also connect a single, normally open, pushbutton switch between the first input, IØ, and 5 volts DC.

56Ω 56Ω 56Ω 56Ω 56Ω 56Ω 4 5 6 7 9 10 11 74LS259

connected to data-line D7, the Most Sig-

nificant Bit (MSB) of the data bus. Be-

cause of that, we can check the state of the

input line with a single statement that tests

whether the data on the bus is greater than 127 (or less than 128). If you wanted to use

data-line DØ (which is connected to the

FIG. 12—TO TEST THE bit-addressable output port, you can use this simple circuit. If you install IC4, then you can test the output at socket SO4, pins 1–7.

First we should initialize all LED's to the off state (note that because the LED's are connected to +5, off is high).

10 FOR I = Ø TO 6

12 OUT(I,1)

14 NEXT I

Having turned all of the LED's off, we will wait until the switch is turned on before going further:

20 LET $I = INP(\emptyset)$

22 IF I <120 60TO 2Ø

This will loop until the switch state is turned "on".

30 FOR I = Ø TO 6

32 OUT(I,Ø)

34 NEXT I

Those three lines will turn all LED's on.

30 FOR $J = \emptyset$ TO $5\emptyset$

 $40 \text{ FOR I} = \emptyset \text{ TO } 6$

42 OUT(I,Ø)

44 OUT(I,1)

46 NEXT I

50 NEXT J

60 GO TO 1Ø

Lines 30 to 60 will blink the LED's and then return to the switch-monitoring loop.

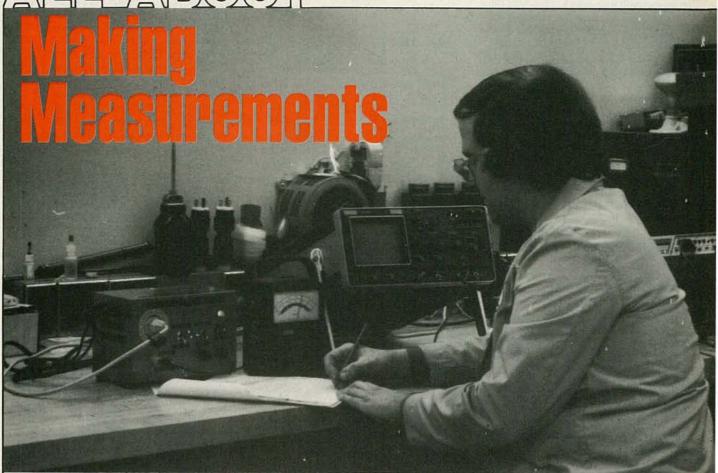
The 74LS251 can sink/source one LST-TL load. If we are not concerned too much about the logic high or logic low voltages, then we can sink or source many times that amount. The practical limits of the output drive capacity is limited to continued on page 110

TABLE 5

Port Description "Address" "Address" 0-7* BIT-ADDRESSABLE, SO4 16 8-BIT I/O - PORT 1, SO2 32 8-BIT I/O - PORT 2, SO3 48 A/D CONVERTER SO1

*PORT 6 IS USED TO ENABLE RE-MOTE-CONTROL TRANSMITTER. PORT 7 IS USED FOR RS-232 PORT.





ELECTRONICALLY

HARRY L. TRIETLEY

In this article, we'll take a look at thermocouples, thermistors, piezoelectric crystals, and other types of transducers. We'll also look at some techniques that will help you use transducers more effectively.

ELECTRONIC MEASUREMENTS HAVE BEcome a part of everyday life. It can even be
seen in your car, where microprocessors—using electronic sensors—
control fuel-injection and ignition systems. Even your auto-exposure camera
uses electronic sensors. Electronic thermometers and weather stations are becoming commonplace, as are microcomputer-controlled appliances. And those
are just a few examples of where transducers are used in consumer applications.
In science and industry, the need for transducers for precision measurements, logging, and automatic control also abound.

In this article, we'll take a look at some of the most common transducers and their applications. We'll see how they can be used to measure temperature, pressure, flow, force, vibration, liquid level, conductivity, and other variables.

Position measurement

The best known and understood position transducer (see Fig. 1) is the potentiometer. Precision single-turn potentiometers can provide accuracy (linearity) to 0.5% and better, and repeatability to 0.1%. They are available with wirewound, metal-film or conductive-plastic elements. Multiturn potentiometers offer the same specifications; they are used for applications where rotation may exceed 360 degrees. Potentiometers are available with different, nonlinear responses—such as logarithmic and square-root.

Because of the potentiometer's high electrical sensitivity, amplification- and readout-circuitry may be simple, or even nonexistent. An ohmmeter might be used to read the potentiometer's resistance directly—but that's not recommended. While the potentiometer's linearity may



FIG. 1—THIS POSITION TRANSDUCER provides a signal proportional to the extension of a stainless steel cable.

be one percent or better, its end-to-end resistance is typically within only ± 3 to $\pm 10\%$. Its contact resistance may add further readout inaccuracy. A better approach is to connect a known voltage

across the potentiometer and use a high impedance voltage readout to measure the wiper position. By properly selecting the voltage, the output may be read directly as inches, millimeters, degrees of rotation, etc. Or, the voltage may be fed to an A/D converter for computer input or data logging.

Potentiometers are not limited to measuring angular and linear position—they can be used to sense any variable which can be *converted* to position. For example, pressure often is sensed by using a bellows that is linked mechanically the wiper of a potentiometer. A bimetallic element will transform temperature to position, while liquid level may be measured using a float. Companies that produce such assemblies commercially often use custom-designed potentiometer elements rather than standard products.

Transformer transducers

Another widely used position transducer is the Linear Variable Differential Transformer, or LVDT. The LVDT is an electromechanical device that produces an output proportional to the displacement of a separate, movable core. It consists of three coils around a cylindrical form. The primary is wound at the center of the form, with a secondary wound at either side. A free-moving rod-shaped core inside the coil assembly links the primary's magnetic flux with the two secondaries.

If the secondaries are connected series-opposing, the net output of the LVDT will be the difference between their voltages. That voltage will be zero when the core is at the center, or null, position. When the core is moved, the induced voltage in the coil toward which the core moves increases, while the opposite coil's output drops. As shown in Fig. 2, that produces a differential voltage output that varies linearly with changes in the core position, the phase changing by 180° as the core moves from one side of null to the other.

Straight-line LVDT'S with linear travel from under 0.1 inch to one-half or three-quarters of an inch are most popular, (see Fig. 3) but devices with travel up to 24 inches are available. Linearities from 0.5 to 0.1% are normal. Units that operate from 115 volts at 60 Hz are available, but operating frequencies from 1 to 20 kHz at one to ten volts are more common. Average sensitivity for each 0.001 inch travel is a few millivolts (per volt of input), but long-travel units are less sensitive.

An LVDT may be read out by connecting its secondaries series-opposing and measuring the output AC voltage. That's less than ideal, however, for several reasons. First, the AC readout will read upscale regardless of which direction the core moves. Second, even when the core is at the center position, the output will not be zero—there will be a residual,

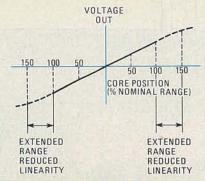


FIG. 2—AN LVDT produces a voltage output as a function of the core position.

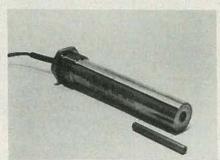


FIG. 3—AN LVDT. Note the separate, free-moving core.

phase-shifted null signal. Another problem is that the output sensitivity may change with temperature due to changes in the resistance of the windings.

The circuit shown in Fig. 4 solves those problems. The secondaries' outputs are rectified, filtered and fed to an amplifier that responds to their difference (a differential amplifier). The outputs are also fed to a summing amplifier that controls the amplitude of the primary voltage source. As the core moves toward secondary 1 or 2, that secondary's output increases while the other drops. The differential amplifier responds to both magnitude and direction; also, the amplifier's output at null is zero. Meanwhile the summing amplifier sees a constant signal, since the increase in one output exactly

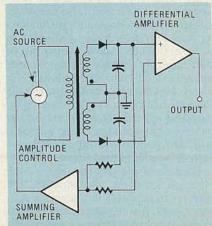


FIG. 4—THIS LVDT circuit provides a linear, bidirectional, regulated readout of core position.

matches the decrease in the other in the linear region. If temperature or other influences affect the primary-to-secondary ratio, feedback alters the AC source to compensate.

Although LVDT's require a bit more circuitry than potentiometers, they're still relatively straightforward to use and offer good sensitivity. Being essentially frictionless they offer long life and excellent resolution and repeatability. LVDT's with built-in oscillator and amplifier circuitry are available to provide DC-in, DC-out operation.

Like potentiometers, LVDT's are used to sense position, pressure or any other variable which may be transformed into position. Also like potentiometers, LVDT's may be custom designed for specific applications.

Strain gages

The strain gage is a simple, no-movingparts device that transforms strain, force, or pressure directly into electrical resistance. To understand its operation, consider stretching a length of wire. As it is stretched, its length will increase and its cross-sectional area will decrease. Therefore its resistance will increase. If the wire isn't stretched too far (past its elastic limit), it will recover. Thus we have a transducer that provides a resistance that goes up or down with applied strain.

Most strain-gage elements consist of etched metal foil or wire arranged in a zigzag pattern for maximum sensitivity. Figure 5 shows two examples. The foil usually is bonded to a high grade plastic or other flexible film and etched, much like a flexible circuit board. Wire may be similarly bonded or, it can be stretched unbonded between support points.

Many conductor alloys and backing materials are available (depending on the

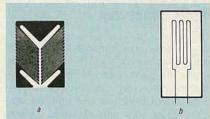


FIG. 5—STRAIN GAGES can be made from foil (as in a) or from wire (as in b)

sensitivity and temperature range required). Silicon strain-gages, which exhibit much higher sensitivity (typically thirty times that of wire or foil) are also available. Unfortunately they also have higher temperature coefficients and more limited temperature ranges, requiring care in application.

Strain gages usually are connected in a Wheatstone-bridge configuration such that the bridge imbalance varies with strain. Since the sensor's resistance is low

and changes generally less than a percent with strain, the bridge output is small. Amplifying electronics must have high gain and good DC stability: High-grade op-amps or instrumentation amplifiers are normally used. Alternately, the bridge may be excited from an AC source, using AC amplification followed by phase-sensitive demodulation for measurement. The bridge voltage should be kept low to minimize errors (resistance shift) due to resistive heating of the sensor.

Achieving precision results with strain gages requires a fair degree of mechanical sophistication. Electrical sophistication also is needed; for example, look at Fig. 6. That system uses temperature-sensitive resistors (R_Tl and R_T2) to compensate for changes in zero and sensitivity caused by temperature changes. Fixed resistors (Rl and R2) are used to trim sensitivity and zero. Temperature-related errors are caused not only by the strain gage elements, but also by mechanical expansion and contraction of the measuring assembly.

Strain-gage resistances usually are low enough (typically 350 ohms) that the resistance of the leads between the regulator and the bridge have to be considered. (The resistance of the leads can lower the bridge voltage, reducing its sensitivity.) When long leads are necessary, errors may be eliminated using a *four wire* regulator. Such a regulator uses an extra pair of wires to sense and control the regulator's output directly at the bridge's input. This is not necessary if long leads are not used.

Many companies offer a wide variety of strain-gage load-cell assemblies for force and weight measurement, and pressuresensor assemblies to measure liquid and gas pressure. Examples are shown in Fig. 7. Typical specifications for such assemblies include 350-ohm bridge resistance, 10-volt maximum excitation, 0.1 to 0.5% nonlinearity, and a full-scale sensitivity of 2 or 3 millivolts per volt of excitation. Load capacities range from a few pounds to a hundred tons or more; similarly, pressures from a few to hundreds of thousands of pounds per-square-inch may be measured. Such devices are used to measure weight, fullness of a bin (using the weight of the bin), liquid level (using fluid pressure at the bottom of a tank), barometric pressure, and many other variables.

The flow rate of liquid or gas is also measured using strain gages (or, for that matter, any other pressure sensors). By placing a restriction in a pipe (as shown in Fig. 8) and measuring the pressure drop across it, the flow velocity may be determined. The most common restriction is the *orifice plate*, a thin metal plate that has an opening that's smaller than the diameter of the pipe. Pressure-measurement taps, at precisely located points above and below the plate, are connected to an as-

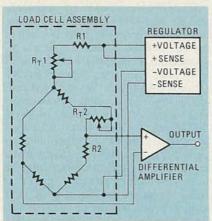


FIG. 6—A COMPLETE STRAIN GAGE bridge compensates for temperature shifts in zero and sensitivity. A four-wire regulator is used to compensate for lead-wire resistances.



FIG. 7—STRAIN GAGE load cells and pressure sensors are available in a wide variety of configurations, some of which are shown here.

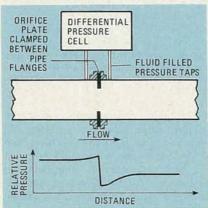


FIG. 8—PLACING A RESTRICTION in a pipe causes a pressure drop that can be used to measure flow.

sembly designed to measure differential pressure. With such an arrangement the flow rate is proportional to the square root of the pressure difference, requiring a square-root amplifier in the electronics.

There are other arrangements that are also used to measure flow rates. For example, the pressure difference between the inside and outside radii of an elbowshaped band in the pipe can be used to calculate the rate of flow. For large, open streams, the liquid height behind a specially-shaped notched dam known as a weir is used. (The relationship between height and flow depends on the shape of the notch, but is not linear.)

Piezoelectrics

Quartz and other natural and manmade crystals generate a small voltage between their opposite sides when stressed. Therefore they're ideal for making force and pressure measurements. (Microphones and phonograph cartridges are examples of other ways that effect is used.) Although useless at DC, such devices are superior to strain gages for measuring high-frequency vibrations or impulses with fast risetimes.

Piezoelectric crystals are not conductive; they act as a high impedance AC source. More precisely, they act as an ACvoltage source in series with a small capacitor. A change in the voltage, ΔV , causes a small charge, ΔQ , to flow on or off the plates of the capacitor. Outputs of piezoelectric transducers are generally specified as picocoulombs per unit force (for example, picocoulombs per psi). Voltage amplifiers for piezoelectric transducers must have a very high input impedance (just as amplifiers for microphones or phono pickups must). The capacitive loading due to input cables can become a problem.

A circuit that minimizes those problems is the charge amplifier shown in Fig. 9. In that circuit, an op-amp (or other high-gain, high-impedance inverting amplifier) is provided with $C_{\rm F}$, a negative-feedback capacitor. The high negative feedback holds the voltage at the input to near zero—nearly all the charge from the transducer flows onto $C_{\rm F}$. Also, since the input voltage is zero, the cable capacitance stores no charge, and so causes no errors.

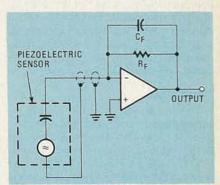


FIG. 9—A CHARGE AMPLIFIER completely transfers the piezoelectric sensor's AC charge output signal to the feedback capacitor, producing a proportional AC output voltage. The feedback resistor (which should be large) stabilizes the DC output level.

The voltage on the feedback capacitor is given by $\Delta V = \Delta Q/C$. Therefore the charge amplifier's output is 1/C volts per coulomb. This output is directly propor-

tional to the AC force or strain on the piezoelectric crystal. The design of a suitable amplifier involves a tradeoff between using a large feedback capacitor (for high negative feedback) and using a small capacitor (for high gain.)

Accelerometers can be made by connecting a mass to a piezoelectric crystal. Any change in velocity causes the mass to push or pull on the crystal, producing an output proportional to the rate of acceleration. Accelerometers are used to study the vibration and shock response of mechanical designs and to measure shock, acceleration and vibration in engines and vehicles. They also are used to monitor seismic vibrations as well as the vibrations of structures such as bridges. A crystal may also be mounted directly between an object under test and the point of impact to measure peak forces during impact testing. The crystals themselves are fairly rugged and capable of withstanding high peak loads.

Piezoelectric sensors are especially valuable in measuring explosions, blasts and pressure surges. Depending on their design, response times to one microsecond are possible. Applications include gun and ammunition testing, engine-cylinder and even atomic-blast measurements. Industrial measurements range from plastic injection molding pressure to the impact force of punch presses.

Temperature measurements

Perhaps the most common uses for transducers is to measure temperature. Electronic temperature-sensors fall into three classes: resistive (thermistors and wirewound), thermocouples, and integrated circuits.

The resistance of both thermistors and wirewound sensors changes with temperature—but that's where their similarity ends. Thermistors are highly sensitive (typically 4%/°C), nonlinear devices with negative temperature coefficients and a narrow range. Wire wound sensors are less sensitive (typically 0.4%/°C), fairly linear, have positive temperature- coefficients, and are wider-range devices.

Thermistors

Thermistors are formed by mixing together various powdered metal-oxides, forming them into desired shapes, and firing them at temperatures around 1000°C (1832°F). They may be formed by pressing the powder into discs, washers, rods, squares, sheets, or other shapes before firing. Another method is to dip platinum-alloy wires into a slurry of the oxides and fire directly to form small beads. The oxides form a semiconductor material whose resistance decreases as temperature goes up. An almost limitless variety of sizes, shapes and tolerances are available, with resistances at room temperature running from 100 ohms to a megohm.

Small discs and beads are commonly used for precision temperature measurement. Discs, generally under 0.1 inch in diameter, may be ground to a precise resistance and are available with accuracies up to ± 0.1 °C or better. Since their construction usually involves soldered connections and epoxy coatings, their service temperatures often are limited to 150°C (302°F) or less. Glass-encapsulated discs are available for use at higher temperatures; they provide superior stability plus a hermetic seal. Bead thermistors may be much smaller and generally operate at higher temperatures. Because of their small size and method of construction, they cannot be ground to tolerance. (Selected or matched units may be ordered, however.)

Designing with thermistors is easy because their high sensitivity means that precise measurements may be achieved using ordinary components. At 4% perdegree, a one-percent error is equivalent to only 0.25°C. Figure 10 shows two basic circuits: a Wheatstone bridge and a parallel network. The bridge provides an output that increases with temperature, while the parallel network's resistance decreases with an increase in temperature. When designing thermistor circuits, the power dissipation should be kept low (0.1 mW or less) to avoid self-heating errors.

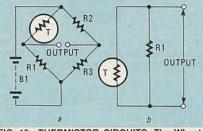


FIG. 10—THERMISTOR CIRCUITS. The Wheatstone bridge output increases with temperature, while the resistor network's resistance decreases.

The bridge may be made to read temperature differentials by replacing R2 with a second, identical precision thermistor. Such a circuit is useful for measuring heat-exchanger or solar-collector performance or for measuring the difference between a wet- and dry-bulb thermometer.

If the circuits in Fig. 10 are changed by adding a series resistor-thermistor combination in parallel with the thermistor, then the bridge and the parallel network may be made to provide linearity to 0.2°C and better over temperature ranges as wide as 100°C. Calculation of the best combinations of resistors and thermistors is not easy, but some thermistor manufacturers offer preselected component sets.

Thermistors often are mounted in probe assemblies or other housings for protection. Figure 11 shows a variety of assemblies such as sheathed probes, surface



FIG. 11—THERMISTORS AND OTHER temperature sensors are available in a wide variety of sensor assemblies.

mounts, thermistors mounted in screw heads etc.

Thermistors offer a variety of uses besides temperature measurement. They often are used as temperature-compensating components in electronics. One example is compensating the temperature-induced changes in a copper meter-coil. Large, nonprecision thermistors are used as current-inrush limiters (their resistance drops as the current heats them up). Large, washer-shaped thermistors monitor temperature in such applications as motor overtemperature protection.

Resistance thermometers

Resistance thermometers generally are made of a length of fine-gauge wire wound on a ceramic (or other insulating) support. Surface-temperature sensors are made of wire or foil sandwiched between flexible plastic films.

Platinum is the most common metal used, but many sensors use nickel, copper and other metals. (Platinum need not be expensive: a typical element uses only 20 inches of 0.001 inch diameter wire.) International-standard (DIN, IEC, ASTM) platinum sensors have a resistance of 100 ohms at 0°C and 138.5 ohms at 100°C. Common temperature ranges go down to -200° C (-328° F) and up to between 500°C and 800°C (932°F and 1472°F), with a tolerance of ± 0.25 °C at zero. Other resistances, ranges and tolerances are available. Wirewound sensors generally are cylindrical, under 0.1 inch diameter, one half to one inch long.

Resistance thermometers have a lower sensitivity and lower resistance than thermistors. For example, 100-ohm platinum sensors change by 0.4 ohms per degree C—one ohm equals a change of 2.5°C (4.5°F). Therefore the lead wires or cables used with them can introduce appreciable errors. To avoid those errors it is common to use readout circuits which either ignore or compensate for lead resistance. Figure

12 shows one such circuit, which requires four interconnecting leads. In that circuit, a constant current is fed through one pair of leads, and the voltage drop across the sensor is read via a second pair. The energizing current does not flow through the measurement leads, so the readout sees only the $I \times R$ volt drop across the sensor itself.

Figure 12 also shows a method of compensating for the nonlinear temperature response of platinum. (Platinum's sensitivity drops slightly at higher temperatures.) A small amount of positive feedback causes the current source to increase at higher temperatures, offsetting the drop in sensitivity. With proper design, linearity as good as $\pm 0.1\%$ from 0 to 500°C is possible. This method does not necessarily work for sensors other than platinum.

Resistance thermometers are widely used for the measurement and control of chemical, refinery, food and other manufacturing processes and in precision testing of jet engines, large diesels, etc. Platinum offers the best precision of any electronic temperature sensor, with stability and repeatability better than $\pm 0.1^{\circ}\text{C}$ after use at 500°C (932°F) and beyond. They are available in most of the same assemblies shown in Fig. 12, but are generally enclosed in sheathed probes.

Thermocouples

A thermocouple is nothing more than two dissimilar wires joined together. It is based on the principle that if two different metals are joined together, they will produce an output voltage that is dependent on the temperature of their junction. Over the years, specific wire pairs have become standardized, with published voltage-vs.temperature tables and agreed-upon letter designations. Types J, K, T, and E designate various combinations of chromel, constantan, iron, alumel and copper. Among them they cover the temperature range from -200°C (-328°F) to 1250°C (2282°F). Types R, S and B use combinations of platinum alloys to cover temperatures up to 1800°C (3272°F). All seven

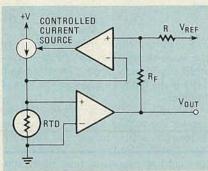


FIG. 12—FOUR-WIRE MEASUREMENT eliminates errors due to lead resistances when measuring with RTD's. A small amount of positive feedback compensates for sensor nonlinearity when using platinum RTD's.

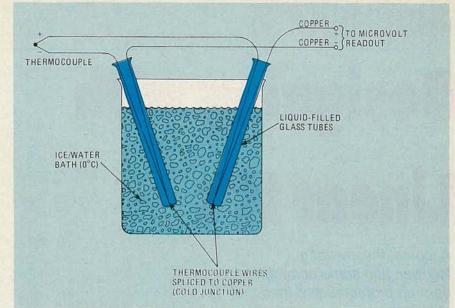


FIG. 13—THERMOCOUPLE COLD JUNCTIONS must be kept at a constant temperature for correct readings. Electronic temperature-compensation could also be used.

TRANSDUCER MANUFACTURERS

This list does not pretend to be complete. Each manufacturer listed makes a variety of transducers.

Analog Devices PO Box 820 Norwood, MA 02062

BLH Electronics 42 Fourth Ave. Waltham, MA 02254

Bournes Instruments 6135 Magnolia Riverside, CA 92506

Celesco 7800 Deering Avenue PO Box 1457 Canoga Park, CA 91304

Entran Devices 10 Washington Ave. Fairfield, NJ 07006

Fenwall Electronics 63 Fountain Street Framingham, MA 01701

Gould Inc., Measuring Systems 2230 Statham Blvd. Oxnard, CA 93030

Micro Switch 11 W. Spring St. Freeport, IL 61032

Schaevitz Engineering 130 Union Ave. Pennsauken, NJ 08110

Sensym 1255 Reamwood Avenue Sunnyvale, CA 94089

Weston Instruments Div. of Sangamo Weston, Inc. 614 Frelinghuysen Ave.Newark, NJ 07114

Yellow Springs Instrument Co. PO Box 279 Yellow Springs, OH 45387 conform to tables developed by the National Bureau of Standards, and are covered by specifications issued by the American National Standards Institute (ANSI). Other types of thermocouples are in use and may be covered by future standards.

Thermocouples lack the sensitivity, accuracy, and stability of resistance thermometers or precision thermistors. They are usable at much higher temperatures, however, and are much more versatile with generally lower cost. Types J,K, T and E have sensitivities around 40 to 60 microvolts per °C while the platinum couples (R, S, and B) trade lower sensitivity (8 to 12 μ V/°C) for higher temperature use. Response is roughly linear. Standard accuracies are around ± 2.2 °C or $\pm 0.75\%$ of the temperature being measured, whichever is greater.

Thermocouples present a unique readout problem in that their connection to copper circuitry creates additional couples. Known as *cold junctions*, those connections produce additional voltages that vary with temperature. The actual readout will be the difference between the measured temperature and that of the cold junctions.

In the laboratory, the cold junctions may be held in an ice bath as shown in Fig. 13. Published thermocouple tables assume that the cold junction temperature is 0°C. In test or control systems that contain many thermocouples, it is not uncommon for all the cold junctions to be placed in a constant-temperature heated block. Most modern instruments, however, include "cold junction compensation" using a thermistor or semiconductor sensor to automatically offset the cold junctions' voltages.

continued on page 99

solutions.

A look at the inverting follower, and some common op-amp problems and their

ear IC's

JOSEPH J. CARR

Part 2 LAST TIME, WE INTRO-duced you to the basic operational amplifier, and two other types of linear amplifier IC's, the CDA and OTA. This month, we will discuss the basic inverting follower, and how to solve some of the basic problems found in operational amplifier circuits.

First, though, let's review the basic properties of the op-amp. There are six of those: 1. Infinite open-loop (i.e. no feedback) gain, 2. infinite input impedance, 3. zero output impedance, 4. zero noise contribution, 5. infinite bandwidth, and 6. both inputs stick together (we'll see what is meant by that in a moment). Of those, properties 1, 2, and 6 are the most important to our analysis. Let's review these and see how they relate to the real

"Infinite open-loop gain" refers to the gain with no feedback. In real devices the "infinite" isn't quite realized, but "very, very high" gain is common. Typical real open-loop gain values range from 20,000 for low-quality op-amps to over 1,000,000 for premium devices. It is the extremely high open-loop gain that makes it possible to set operating gain by manipulating feedback resistors.

"Infinite input resistance" again translates in reality to "very, very high." Although most common devices have input resistances (Z_{IN}) values of around 1 megohm, there are MOSFET-input devices (for example, RCA CA3140) that have input impedance values of 1012

A result of the "infinite" Z_{IN} is that the op-amp input will neither sink nor source current. That fact is critical to our method of simplified circuit analysis.

Our last property states that op-amp inputs "stick together." That means that the two inputs must be treated as if they were both at the same potential. If we apply +1 volt to the noninverting input, then we must treat the inverting input as if it were also at a potential of +1 volt. That property is not just true in theory, but can be observed on the bench using real opamps, real signal sources, and real voltmeters.

The inverting follower

gning with

The inverting follower (Fig. 1) produces an output signal that is 180 degrees out of phase with the input signal.

The signal is applied to the inverting input; the noninverting input is grounded. Grounding the noninverting input places it at zero potential. By ideal property 6, therefore, we must also treat the inverting input as if it is grounded. That situation results in a confusing concept known as the virtual ground. The inverting input is not physically grounded by a piece of wire, but will be at zero potential i.e. ground potential, because the noninverting input is grounded. Thus, we must make calculations based on the assumption that point A in Fig. 1 is grounded. That point is called the summing junction for reasons that will shortly be evident.

The currents at the summing junction are II and I2; Io might exist in real opamps, but is zero in our ideal model. Since only two currents exist, we know by Kirchoff's current law (KCL) that

$$11 + 12 = 0$$
 (1)

so by rearranging equation 1

$$l1 = -l2 \tag{2}$$

So, what do we know about II and I2? Since point A is virtually grounded, the

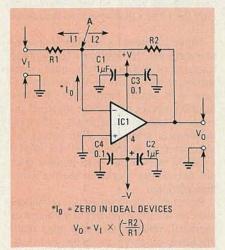


FIG. 1—THE INVERTING FOLLOWER produces an output that is 180° out-of-phase with the in-

following are true by Ohm's law:

$$I1 = V_I/R1 \tag{3}$$

and.

$$12 = V_O/R2$$
 (4)

By substituting equations 3 and 4 into equation 2 we obtain the following:

$$V_{I}/R1 = -V_{O}/R2 \tag{5}$$

The transfer equation of any circuit tells us the gain of the circuit, and that gain is equal to the quotient V_O/V_I; solving 5 for V_O/V_I yields

$$V_{O}/V_{I} = -R2/R1$$
 (6)

You will sometimes see V_O/V_I denoted by Av, which means "voltage gain." The alternate forms of equation 6 are, therefore:

$$A_V = -R2/R1 \tag{7}$$

$$A_V = -R2/R1$$
 (7)
 $V_O = V_1 (-R2/R1)$ (8)

and.

$$V_{O} = -V_{I}A_{V} \tag{9}$$

Equations 6 thru 9 are all variations on the same theme, and should be memorized if you plan to do a lot of op-amp work in the future (it will save you a lot of

The above arithmetic implies that we can set the voltage gain of the inverting follower by setting the ratio of R2 to R1. Note that the absolute values of the resistors are not important, only their ratio. Let's look at a simple example. Suppose we require an amplifier with a 10-kilohm input impedance and a gain of -56. Let's find appropriate values for R2 and R1. Since point A in Fig. 1 is grounded, the input resistance is simply R1. By specifying R_{IN}, we set R1 at the same value, namely 10 kilohms. By equation 7, then:

$$-56 = -R2/(10K)$$
 (10)

$$R2 = (56)(10K)$$
 (11)
 $R2 = 560K$ (12)

There are certain constraints on permissible values for R1 (especially) and R2 (in some cases). Recall from above that R1 determines the input impedance. A common design rule states that an amplifier's input impedance must be at least ten times the output impedance of the preceding stage. If the preceding stage has an output impedance of, say, 100 ohms, then R1 must be 1,000 ohms or more. That constraint is not usually important if the signal source is another amplifier or some other electronic source. It becomes critical, however, when the signal source is a transducer, medical electrode, or a chemical electrode. A certain thermistor transducer has a nominal source resistance of 5 kilohms, so for use with that device, R1 must be 50 kilohms or higher.

There is no theoretical constraint on the values of R2 in ideal op-amps. In real devices, however, current Io (see Fig. 1) is not zero, so it will create a voltage drop across R1 and R2. That voltage drop is reflected as an error term, and is directly proportional to R1 and R2. As a result, when using most common op-amps, use the minimum values for R1 and R2 permissible within the limits allowed R1 by the ten-times rule. An exception to that rule is seen on normally high-Z devices such as the 725, BiMOS devices such as the CA3140, or BIFET devices. Those op-amps have such low Io values that almost any obtainable resistance is practical for R2.

The bypass capacitors on the powersupply lines in Fig. 1 are used to improve the stability of the circuit. Those capacitors are not needed in all cases, especially where unconditionally stable devices (the 741 or 1458, for example) are used. In those devices, the inherent stability is achieved by artificially reducing the frequency response to less than 10 kHz. Those devices are called frequency-compensated operational amplifiers.

On non-compensated op-amps, we may require the capacitors. The polarized units (C1, C2) are for low-frequency decoupling, but are ineffective at higher frequencies (a problem with tantalum units). We therefore must use the 0.1 µF units (C3, C4). In many cases, only C3 and C4 are required, and in all cases must be placed as close as possible to the body of the op-amp.

Op-amp problems

The ideal op-amp of our model does not exist. All real op-amps have certain problems that must be solved.

One irksome problem is output offset-voltages; that is, an output potential that exists when V_O should be zero!

A common cause of output offset-voltages are input offset currents. Those currents exist in real op-amps (remember, I_0 is not zero), and are due to bias currents of the input transistors. Figure 2 shows a method for suppressing the effect of the currents. In that circuit, a compensation resistor (R3) is used between the noninverting input and ground. The value of R3 should equal the parallel combination of R1 and R2. For example, assume R1 = 10 kilohms and R2 = 100 kilohms; R3 should be

R3 =
$$(R1 \times R2)/(R1 + R2)$$
 (13)
R3 = $(10K \times 100K)/(10K + 100K)$ (14)
R3 = 9.1K (15)

The effect of R3 is to develop a voltage drop ($I_02 \times R3$) equal to the voltage drop created by I_01 passing through R1 and R2. The assumption is that I_01 and I_02 are approximately equal. Since the two equal voltage drops are applied to differential inputs, they will cancel each other thereby eliminating the output offset potential.

Not all offsets are so easily trimmed out of the circuit. The method of Fig. 2 will not affect some forms of op-amp offset, and can not deal with DC offset voltage riding on the input signal. For those cases, the methods of Figs. 3 and 4 are required.

The method shown in Fig.3 is used when the op-amp has a pair of offset terminals (often pins 1 and 5, or 1 and 8). A trimmer potentiometer is connected across the offset terminals, and its wiper is connected (usually) to the negative power supply.

Not all op-amps have offset terminals, so we must sometimes use the "universal" circuit shown in Fig. 4. That circuit is usable regardless of whether the op-amp has offset terminals, or not.

The technique illustrated in Fig. 4 uses a potentiometer (R4) and resistor (R3) to inject a countercurrent into the summing junction (point A) of a magnitude and polarity sufficient to cancel any output offset. The voltage at point B is set to exactly counter the offset potential. The "gain" seen by this voltage is approximately equal to -R2/R3. Adjustment of R4 is made with $V_1=0$; that is, with the input shorted to ground.

There are several tactics that can be used to make the control over the offset finer. We can, for example, make R4 a ten- to twenty-turn trimmer potentiome-

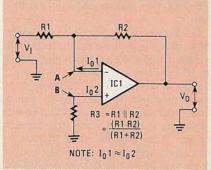


FIG. 2—OUTPUT OFFSET VOLTAGES can be eliminated by getting rid of any input offset currents.

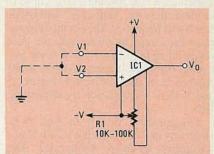


FIG. 3—IF THE OP-AMP has a pair of offset terminals, a potentiometer connected across them can be used to remove any output offset.

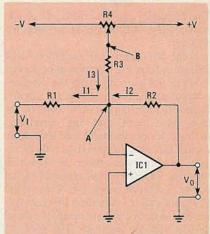


FIG. 4—IN CASES WHERE the op-amp has no offset terminals, this "universal" circuit can be used.

ter, thereby reducing the change in offset per turn. We could also increase the value of R3 so that any given voltage at point B produces a smaller change in offset voltage. We could also use one of a number of techniques to reduce the voltages available to the potentiometer, and thereby create a smaller change of voltage per turn

The frequency response of op-amp circuits must sometimes be trimmed to something less than its "wide open" value. There are at least three reasons for tailoring the bandwidth of a circuit: noise

reduction (noise is proportional to bandwidth), customized requirements (for example, a communications bandwidth of 300–3000 Hz), and prevention of oscillation.

Oscillation in any circuit occurs when the feedback is in-phase and the loop-gain is unity or more. Recall that a phase shift of 360 degrees constitutes "in-phase" feedback. The inverting follower normally produces 180 degrees of phase shift. Additional phase shift occurs in the circuit due to resistance and stray capacitances. There may be some frequency, typically a high one, where that "stray" phase-shift adds up to 180 degrees, which when combined with the 180 degrees inherent in inverters, produces 360 degrees. If the frequency at which that occurs is at a point where the op-amp gain is unity (1) or more, then the "amplifier" will oscillate at that frequency. The circuit designer must take steps to ensure that the gain drops off to less than unity at some frequency below the frequency at which 360 degrees of phase shift occurs. Figures 5 and 6 show methods for accomplishing that.

The method shown in Fig. 5 is simplicity itself. A capacitor (Cl) is shunted across feedback resistor R2. The —3dB breakpoint, f, is given by

$$f = \frac{1}{2\pi R_2 C_1} \tag{16}$$

The frequency response rolls off at approximately 6dB/octave at frequencies above f.

Some IC operational amplifiers have frequency-response compensation terminals that are intended to aid the designer in tailoring the bandwidth of the circuit. Figures 6-a through 6-c show methods for using those "lead" and "lag" terminals. In those devices that have lead terminals, a small valued capacitor (10 to 1000 pF) is used either between them, as shown in Fig. 6-a, or from a lead terminal to the output, as shown in Fig. 6-b. Consult the IC manufacturer's data sheet for exact values for the device you are using. For those devices with lag terminals (Fig. 6-c), ei-

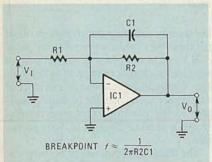


FIG. 5—TO PREVENT OSCILLATION, the opamp's gain must fall to less than 1 below the frequency where 360° of phase shift occurs. The circuit shown above will tallor the bandwidth of the device to be sure that that happens.

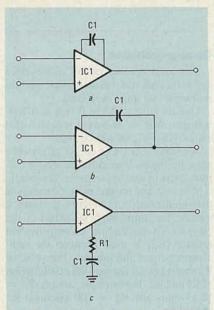


FIG. 6—THREE METHODS of using an op-amp's frequency compensation terminals.

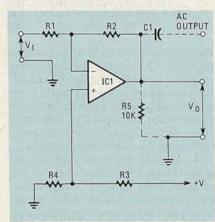


FIG. 7—USING AN OP-AMP in applications where only a single-ended supply is available.

ther a capacitor or an RC network is connected between the terminal and ground. The values of those components are found from equation 16.

Special applications

The basic inverting follower can be modified to produce certain special circuits. Figure 7, for example shows how an op-amp can be used with just a single-sided power supply. Such a situation might occur in automotive electronics, or where some existing equipment has only a single DC supply.

In Fig. 7, the only power supply is +V, and the -V terminal is grounded. We compensate for the loss of -V by applying bias from a voltage divider (R3/R4) to the noninverting input. The ratio of R3/R4 is usually set at 1:3, 1:1, 2:1, or 3:1 in order to give maximum output voltage swing. The disadvantage of that technique is that a DC bias (set by R3/R4) will appear as a permanent offset at the output. If only AC signals are anticipated, then

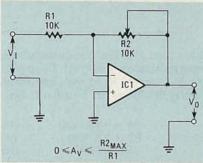


FIG. 8—A GAIN CONTROL can be formed by making the feedback resistor variable.

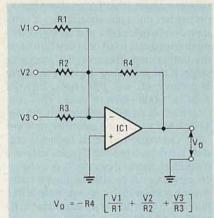


FIG. 9—MULTIPLE VOLTAGE SOURCES can be handled using the circuit shown above.

we can rid ourselves of the offset by capacitor coupling the output (C1). In that case, however, load resistor R5 must be used to prevent the DC offset from latching up the circuit by charging C1.

A gain control can be formed by making the feedback resistor variable (see Fig. 8). The gain will vary from zero to the maximum value of R2/R1. When R2 = R1, the gain ranges from zero to one. Anytime that R2 is less than R1, the gain will be less than one, according to the standard relationship (-R2/R1). Some designers use a stage like that shown in Fig. 8 as the output stage of a cascade chain, thereby affording gain control.

Figure 9 shows a method for accommodating multiple input sources (V1, V2, and V3). The output voltage V_O will be given by:

$$V_O \, = \, R4 \quad \left(\frac{V1}{R1} \ \ \, + \, \frac{V2}{R2} \ \ \, + \, ... \, + \, \, \, \frac{Vn}{Rn} \quad \right)$$

Typical applications for that circuit include use as an audio mixer and in circuits where voltage summation is required.

This month we have discussed the design of circuits using the op-amp inverting follower, certain op-amp problems (namely, frequency response and output offset voltages), and some special applications. In the next part of this series we will discuss the noninverting follower and AC (audio) amplifiers using operational amplifiers.

R-E





Telecommunications

All about computer communications, and the hardware and software you need to become involved with it.

TO GEORGE ORWELL, 1984 WAS THE AGE OF BIG BROTHER. TO those who make their living by writing books about the future, 1984 is supposed to be the age of the "network," with every home connected to almost everything else through the personal computer. You will do your banking through your personal computer, work from your home through your computer, order goods and services through your personal computer, pay for the goods through the computer, get your news through the computer, even pay your taxes through the computer. To hear the pundits tell it, "networking" will provide you with everything except birth and death.

For those of you not yet familiar with the term, let's explain "networking." It is believed by many that within the next few years, probably by 1988 at the latest, virtually all U.S. households with discretionary income to spend will have a household personal computer. The computer will be equipped with a "communications package" consisting of a modem and the necessary software that will permit the computer to access central mainframe computer systems such as those used by your local bank, the information and news services such as the Source and Dow Jones Information Service (for you stocks and bond gamblers), electronic newspapers, electronic book digests, communication services such as E-mail (electronic mail) or a personal computer version of Telex, and "value added" services we haven't even imagined yet. (A "value added" service means an extra charge is added to the basic service fee, much like the extra charge for Home Box Office (HBO) that is added to the basic monthly fee for cable-TV service.)

Another concept of networking is work-at-home. Many jobs do not require a centralized work location. The work, whatever it is, can be done from home through a personal computer. A few examples easily illustrate the work-at-home networking concept: The stockbroker or Wall Street "wheeler-dealer" can easily work from home; he's presently getting his communications by computer anyway. An author need never show up at an office because he or she can download his book or article from his personal computer to his editor's computer through the telephone system. Insurance and real estate agents can also work from home because their records can also be stored within a home computer or accessed from a mainframe computer via a modem. If you stop to think about it, a lot of the future is happening right now.

The reason for the excitement about networking is because it's easy to do and relatively inexpensive for the average home-and-family user. All it takes to access a databank, electronic banking, news services, or even the computers of friends and associates is a modem and the specific software required for a particular function.

Modems

First things first: the modem. For home-and-family personal computers, a modem is a device that connects the personal computer to the dial-up telephone system. Generally, the modem simply plugs into an RS-232-C serial input/output port on the computer, or some other input/output connector specifically intended for a proprietary modem ("proprietary" meaning here a



AN ACCOUSTIC-COUPLED modem has rubberized cups into which the telephone handset seats.

modem that can only be used with a particular computer). The purpose of the modem is to translate a computer's digital electronic signals into audio tones that can be transmitted through the dial-up telephone system. The modem also translates audio tones arriving through the telephone system from a distant computer into digital information for the local computer.

Depending on the particular modem used, the modem-totelephone system connection can be direct or acoustic. Direct means a "hard wire" connection from the modem to the telephone wiring, usually through a modular plug and jack. If your telephone wiring has only one modular jack—for the telephone itself—you can use a modular T-adapter, which provides two modular jack connections: one for the telephone and one for the modem.

The acoustic-coupled modem has rubberized cups into which the telephone handset is placed. A speaker within one cup feeds the audio tones representing the local computer's digital information into the telephone handset's transmitter. A microphone within the cup under the handset's receiver couples the audio tones from the telephone system into the modem for conversion to the digital information for the local computer. (How the conversions are actually made and the frequencies used are subjects for another article.)

Modems come in many different configurations, but regardless of whether they are manually or automatically switched to the telephone circuit, or the type of software used, the speed of information exchange depends on something called *baud rate*.

Baud rate simply means how fast the information can be exchanged through the modem. As far as personal computers are concerned, the "standard" baud rates are 300 and 1200. Without getting into the how's and why's, 300 baud means a transfer rate of nominally 30 characters per second; 1200 baud means a transfer rate of nominally 120 characters per second. Since 1200 is four times greater than 300, at 1200 baud your information can be transmitted in one fourth the time that it would take at 300 baud. In practical terms, that means that if you would normally be on a telephone/computer interconnect for 10 minutes at 300 baud, you will accomplish the same information exchange in 2.5 minutes at 1200 baud. Of course, no one gives the consumer anything free. Presently, there are often substantial surcharges for using a database or information service at 1200 baud. For example, if you pay \$5 per hour of connect time at 300 baud, you might pay about \$18-20 per hour if you use 1200 baud. Also, 1200 baud modems cost about four times the price of a 300 baud modem. (Yes, many modems will operate at both 300 and 1200

As a general rule, the least expensive modems must be manually switched or connected to the telephone system. Either the user must move a switch or place the telephone handset in the modem's cups. General purpose modems of that type, which can be used with almost all computers, cost in the neighborhood of \$80 to \$125 depending on the model and whether you're buying at full list or discount. Those devices are invariably 300 baud; there were no budget-priced 1200 baud modems at the time this article was prepared.

For about \$225 to \$500 you can obtain a direct-connect modem that has auto-dial, or auto-dial and auto-answer. Auto-dial means that at a command from the computer the modem will automatically connect itself to the telephone system and dial the telephone number of the receiving computer. It will also sense when the receiving computer has answered and is on-line, and will indicate on your screen that it is ready for communications.

The auto-dial sequence is originated from the computer keyboard. To do so, the user enters a sequence of keystrokes (just what those keystrokes are depends on the device and the software used) that causes the modem to connect itself to the telephone system. Then the user types the desired telephone number on the keyboard, which causes the modem to either pulse (rotary) or Touch-Tone dial the computer access telephone number. Some telecommunications software allows the user to create a "telephone directory" of often-called numbers. To use the directory, only a designated number, letter, or phrase need be entered and the rest will be taken care of automatically.

When you want your computer to exchange information with an information service or database, you must use an originate modem. An originate modem generates and receives specific tone frequencies recognized by dial-up computers. The computer at the receiving end uses an answer modem. Originate and answer modems are identical, only their input and output frequencies are different.

Until recently, virtually all modems for personal computers were originate-only because no one ever suspected they would be used for anything other than accessing a mainframe computer. But networking doesn't only mean mainframes or a service you must pay for. Imagine for a moment that you are a student working on a group school-assignment. Or maybe you need some technical information a fellow worker or associate has stored in his or her home computer. Or maybe your business partner has the inventory in his home computer, but you are processing orders with your computer, and you need that data from his files. Any personal computer can communicate with any other personal computer except for one thing; if they both use originate modems no information is going to pass between the computers. One of the two computers must be using an answer modem—the same kind of modem device used by the mainframe databank and news services. It doesn't matter who has what as long as one computer has an answer modem and the other an originate modem.

Since it requires very few internal parts to make a modem function in either the originate or answer modes, most modern modems—even the low cost models—can work in either the answer or originate mode. If you plan on exchanging data or correspondence with other personal computers make certain you get an answer/originate modem. The few originate-only modems still available in the marketplace might prove more of a problem than the few dollars you will initially save are worth.



A DIRECT-CONNECT, auto-answer, auto-dial modem, the Smartmodem is from Hayes (5923 Peachtree Industrial Blvd., Norcross, GA 30092).

Originate/answer modems with auto-dial usually also feature auto-answer so you can access your own computer through a remote terminal, another computer, or one of the so-called "lap computers" with built-in modems such as the Radio Shack Model 100.

Auto-answer usually works this way. You preset the modem to

Auto-answer usually works this way. You preset the modem to "answer" your telephone on the fourth, fifth or sixth ring; that's so someone can have a chance to answer the telephone by voice if they wish before the modem automatically answers it. If the modem answers, it transmits an "answer carrier tone" into the telephone. The modem on the remote (originate) end hears the answer carrier and in turn transmits an "originate carrier tone" into the telephone. When the answer modem senses the originate carrier, contact is established and information transfer can begin.

Some software considerations

It is wrong to assume that if you have an originate modem and the other party has an answer modem that everything will work out. Some communications software packages cannot properly receive (or sometimes originate) a binary data exchange unless the computer is using an answer modem.

A binary exchange is an exchange of non-text data. With very few exceptions the information services exchange text transmitted in ASCII—the American Sandard Code for Information Interchange. Thus what is being exchanged is plain text, with no error checking. If a character gets garbled during transmission you can usually figure out what's missing. For instance, if you receive "The quicc brown foxejumped over the lazi dog", you can be reasonably certain that what was transmitted was "The quick brown fox jumped over the lazy dog." Things get tougher if you are working with a BASIC program, but chances are good that you would be able to spot any transmission errors.

All modern communications software, of any kind, for any personal computer, transmits and receives text in ASCII. But what happens if you require absolute precise reception, or you are exchanging a machine-language program, or binary-encoded data? You must receive an exact representation of the binary data because one single garbled bit out of thousands can crash the program, or change a check for a \$100 refund into \$10,000 or more. A binary data exchange requires what is known as a "protocol" exchange.

Basically, it works this way. The originating computer transmits a block of binary data and then mathematically derives a "checksum" value determined by the particular data transmitted. It transmits the checksum following the data and then stops transmitting. The receiving computer calculates a checksum from the data it receives and sends its checksum value back to the originating computer. If the checksums at the originate computer agree, that computer transmits the next block of data and the process repeats. If the checksums do not agree, the originating computer repeats the block transmission until it receives a correct checksum. If after a predetermined number of attempts the originating computer cannot get a correct checksum response, it stops sending and notifies the operator that it cannot complete the transmission.

The software that does protocol transmission is very fussy as to the way in which the checksums are derived and as to the unseen (phantom) signals that pass between the computers as part of the protocol transmission. Those must match precisely; hence, as a general rule exactly the same type of software must be used at both the originating and receiving computers. If the software is different, it must have some way to recognize the various protocols in use.

For example, because it is so easy to use, supports full autooriginate and auto-answer, does so many things without fuss, and is so reliable, one of the most popular communications software packages is *Crosstalk* (Microstuff, Inc., 1845 The Exchange, Atlanta, GA 30339). But it can do a protocol data exchange only with other computers running Crosstalk. On the other hand, the communications software package *M.I.T.E.* (Mycroft Labs, Inc., Box 6045, Tallahassee, FL 32314), which does more or less the same things but not as easily (that point is debatable), can do a binary exchange with computers running software using Crosstalk, CLINK, Hayes, and XMODEM (Christiansen CP/M) protocols, as well as, of course, with com-

```
OMNITERM Connand Mode - Hit (BREAK) to with
                                  X SYSTEM COMMANDS
P PRINTER
                      ist OFF
   SCREEN REFORMATING ist
                                     CHANGE/EVANINE TABLES
                                  U CHANGE WART SETTINGS
  CR SUPPRESSION
                      ist. OFF
                                  A SEND CONTROL-A & GUIT
  LF SUPPRESSION
                      151
                          DN
  DUPLEX ----
                                  a SEND "AT" SYTBOL & GUIT
                      is: FULL
                                  B SCROLL BACK DISPLAN
E ECHO
                      15: OFF
                                  Z ZERO REAL TIME CLOCK
   CR/LF GROUPING
                      ist OFF
                                   F FILL BUFFER FROM DISK
   INPUT TO BUFFER
                   ist OFF
   OUTPUT FROM BUFFER is! OFF
                                   S SAVE BUFFER TO DISK
Baud Rate =
                                   Parity Errors :
Data Bits =
                                   Franting Errors:
 Stop Bits =
                                    verrun Errorst
                                              8 or 25742 Lees
         = EVEN
```

A POPULAR COMMUNICATIONS PACKAGE, Omniterm is from Lindberg Systems (41 Fairhill Rd., Holden, MA 01520).

puters running *M.I.T.E.* Generally, if you plan to do protocol exchanges with anyone make certain your software accommodates their computer's protocols. The best communications software turns out to be worthless if you require a protocol exchange that can't be done.

The Videotex software sold for CompuServe, Dow Jones, and other information services provide the proper protocol for each particular service so you never have difficulty getting a protocol download. If a special protocol is necessary you can generally purchase the correct software at nominal charge. For example, Radio Shack *Model I* and *Model III* users can purchase special "executive" software from CompuServe that allows an automatic protocol download of data from the service to the user.

Virtually all communications software sold today is what we call "smart." meaning it allows the user to store incoming data in memory for later viewing or for storage to tape or disk. It also permits the transmission of stored data from tape or disk to a remote computer. It might perform many other functions such as storing prewritten strings of characters for signing onto an information provider's computer and automatic answerback for Telex (which identifies the originating user when the computer receives a CONTROL-E from the Telex service). Another popular feature is character conversions or filtering. You've got to be a bit careful with the last one-as nice as it is it could cause some problems. For example, one of the most popular modem reserves CONTROL-B for its own internal use and thus a received or transmitted CONTROL-B is automatically changed to another character. But one of the major information providers uses CONTROL-B in its password system. If you use that communications software and attempt to sign on to the provider, and your password has a CONTROL-B, there is absolutely no way to sign on to the remote computer. Such a problem can be gotten around in most software as some means of redefining any reserved or filtered characters is usually provided.

In this article we've tried to show you what to look for, and what to look out for, when looking for telecommunications hardware and software. Whatever your needs, however, bear in mind that with almost no exceptions any personal computer can enter the age of computer networking.

BUILD THIS

TRS-80 TELEPHONE

Turn your computer into an automatic telephone dialer.

HOWARD BERENBON

IF YOU OWN A TRS-80 COMPUTER AND want something unique to do with your computer system, then this project may be what you've been looking for. With just a couple of components, you can build a telephone interface that will let a TRS-80 dial a telephone number. That may be the missing link to your automated telephone directory or your computerized burglar alarm.

In addition to the interface circuit, there is a short BASIC program that is presented to drive the interface circuit. Since that circuit is connected to the cassettetape I/O port, you should be able to connect it to just about any computer with a cassette port and modify the BASIC program to fit your system if you know the port address.

The actual BASIC program is listed in Table 1. It is a Level 2 program that drives the interface circuit through the remotecontrol relay inside the computer that is connected to the remote-control plug. All that is required is the simple phone interface circuit shown in Fig. 1. The circuit is connected to the remote-control plug of your cassette interface cable.

The interface consists of a relay, a silicon diode, one 9-volt rectangular battery, and a microphone jack. That's about \$4.00 worth of parts. Simply connect the contacts of the relay in series with the green telephone wire. Since the relay is a normally-closed type, it will not interfere with the normal operation of your telephone. However, before you actually connect the telephone, you must contact your local telephone company to insure compliance with local telephone-company regulations

The BASIC-language program uses the OUT command to access the I/O port (port FF) and thus dial the phone. It pulses the cassette remote-control relay that is con-

TABLE 1—PHONE DIALER PROGRAM

- PRINT "TRS-80 PHONE DIALER PROGRAM"
- PRINT "COPYRIGHT © 1979 BY HOWARD BERENBON"
- PRINT 30
- 40 PRINT "ENTER AN "A' TO DIAL"
- 50 INPUT A\$
- IF A\$<>"A" THEN 40 60
- 70 CLS:Q=14:R=14
- REM DIAL THE NUMBER IN THE DATA STATEMENT
- x = 200
- 100 PRINT "DIALING"
- 110 READ C
- 120 IF C = 55 THEN 700
- 130 PRINT @ x,C
- 140 IF C = O GOSUB 800
- 150 x = x + 2
- REM DIAL THE PHONE NUMBER 160 ONE DIGIT AT A TIME
- 170 GOSUB 400
- 180 OUT 255,4

- - 190 GOSUB 500 200 OUT 255.0
 - 210 GOSUB 550
 - 220 C=C-1
 - 230 IF C = O THEN 110
 - 240 GOTO 180
 - 400 FOR A=1 TO 90
 - 410 NEXT A
- 420 RETURN
- 500 FOR A = 1 TO Q
- 510 NEXT A
- 520 RETURN
- 550 FOR A = 1 TO R 5
- 560 NEXT A
- 570 RETURN
- PRINT
- 710 PRINT "DIALING COMPLETE"
- 720 END
- 800 C=10
- 810 RETURN
- REM DATA STORAGE FOR PHONE
 - NUMBER
- 1000 DATA 1,8,0,0,5,5,5,1,2,1,2,55

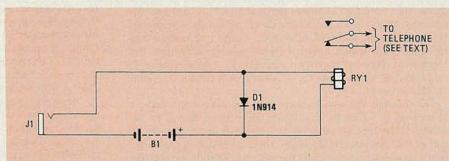


FIG. 1—TELEPHONE INTERFACE circuit can be built on perfboard. The relay contacts are connected in series with the green telephone wire.

PARTS LIST

D1-1N914 diode

RY1-SPDT relay, 5 or 6-volt 500-ohm DC

B1-9-volt rectangular battery

J1-phone jack

nected to the telephone line via the interface circuit.

The dialer is set to dial one phone number, and print the number on the CRT screen as it is dialed. The program simulates the operation of a rotary dial, by continued on page 106

ELECTRONICS BOOK CLUB

The Best Source for Hobbyists and Professionals for Over 18 Years!

Time- and Money-Saving Advice . . . Practical Troubleshooting & Repair Tips . State-of-the-art Technology . . . Hundreds of Projects . . . Plus, Exceptional Savings

Select 5 Books for Only \$ 295





1449 List \$19.95



1507 List \$15.95

FIBEROPTICS &











TELEPHONES















Electronics

1537 List \$16.95 READING SCHEMATICS

1536 List \$14.95









1565 List \$16.95 BUILD A PERSONAL EARTH STATION FOR WORLDWIDE SATELLITE TV

FREE guide to mail order sources for electronic parts and components

Guide

3rd Edition

A \$6.95 Value!

FREE When You Join Now

7 very good reasons to join the Electronics Book Club

- · Big Savings. Save 20 % to 75 % on books sure to increase your electronics know-how
- No-Risk Guarantee. All books returnable within 10 days without obligation
- · Club News Bulletins. All about current selections-mains, alternates, extras—plus bonus offers. Comes 13 times a year with hundreds of up-to-the-minute titles you can pick from
- "Automatic Order." Do nothing, and the Main selection will be shipped automatically! But . . . if you want an Alternate selection—or no books at all—we'll follow the instructions you give on the reply form provided with every News Bulletin
- Bonus Books. Immediately get a Dividend Certificate with every book purchased and qualify for big discounts of 60% to · Extra Bonuses. Take advantage of added-value promo-
- tions, plus special discounts · Exceptional Quality. All books are first-rate publisher's editions selected by our Editorial Board and filled with useful, up-to-the-minute information

ELECTRONICS BOOK CLUB

P.O. Box 10

Blue Ridge Summit, PA 17214

Please accept my membership in the Electronics Book Club and send the 5 volumes circled below, plus, my FREE copy of The Electronics Buyer's Guide, billing me \$2.95 plus shipping and handling charges. If not satisfied, I may return the books within ten days without obligation and have my membership canceled. I agree to purchase 3 or more books at reduced Club prices (plus shipping/handling) during the next 12 months, and may resign any time thereafter.

1113 1128 1218 1299 1337 1393 1409 1449 1451 1465 1473 1474 1493 1499 1503 1507 1529 1531 1536 1527 1520 1565 1577 1604 1622 1665 1671 1695

Name	Phone	
Address		
City	Care of Land of the Control	
State	Zip	RE-584A
	applicants will receive special ordering instruction subject to acceptance by the Electronics	

In Computer Electronics...

NTS INTRONC HOME TRAINING GIVES YOU THE EDGE

The competition for High-Technology careers is strong, and the rewards are great. Give yourself the edge you need by training with NTS.

NTS INTRONIC home training provides you with a special kind of "Hands-On" experience that prepares you better, develops your skills faster. You advance as quickly as you wish, working with actual circuits, diagrams, schematics, and state-of-the-art hardware. There are a dozen different NTS programs in electronics to help you develop and reach your potential. They range from basics to advanced areas in several fields. And the ALL-NEW NTS course catalog spells it all out. It's free, and does not obligate you in any way. Send for it today.

A GROWTH INDUSTRY

High-Technology is a growth industry. The evidence is clear, and most observers predict a steady expansion due to a relatively strong flow of investment capital into computers, electronics and precision instruments. Sales of computers alone will reach an estimated ten million units this year. This means challenges and new



employment opportunities, especially in servicing and maintenance. Computer servicing skills can best be learned by working directly on field-type equipment. NTS electronic hardware is selected and developed especially for the training program with which it is associated. You learn by doing, by assembling, by performing tests and experiments, covering principles of computer electronics, microprocessor trouble-shooting, and circuitry.

MICROCOMPUTERS

NTS offers three programs in computer electronics. You will receive training covering solid-state devices, digital logic circuitry, and the fundamentals of the computer itself. Instruction includes micro-control technology and detailed operation of microcomputers. These courses will prepare you for entry-level in many facets of the computer industry such as field service and customer engineering as well as programming. In addition to written texts your course includes the NTS/HEATH disc-drive computer which you assemble as part of the training process. The assembly and use of the computer will serve to reinforce practical application of principles.

MICROPROCESSOR TECHNOLOGY

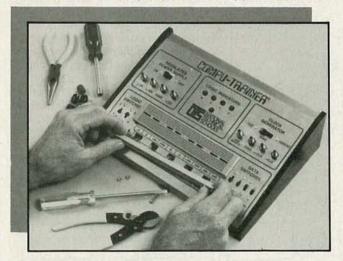
The field of industrial and microprocessor technology encompasses the application of electronic microprocessor control principles. Your course takes you from fundamentals of digital electronics and associated circuitry through the application of the microprocessor as a control device. You will learn how to move and manipulate instructions and information. The microprocessor trainer included in your course is a microcomputer system designed as a practical tool for learning the use of software and hardware techniques utilized in the linking of microprocessors to various systems.

DIGITAL ELECTRONICS

The NTS Compu-Trainer is a fascinating solid-state device which you will build in order to perform over ninety logic circuit experiments. These experiments serve to emphasize an area of electronics which is essential to the understanding of state-of-the-art control equipment; they are also extremely important to those wanting to pursue a career in computer servicing. Separate courses involving the Compu-Trainer are also available in Microcomputer Servicing and Digital/Analog Electronics.

ROBOTICS & VIDEO TECHNOLOGY

Other NTS courses cover a wide range of specialization. In Robotics, the NTS/Heath Hero I is included to train you in robotic applications in

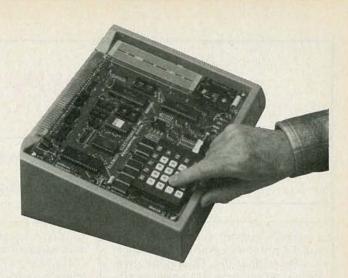


NO OBLIGATION

NO SALESMAN WILL CALL



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



manufacturing processes. In Video technology, a new course features the advanced NTS/Heath Z Chassis "Smart Set" color TV with computer space command remote control and space phone. This is an excellent program for those interested in a career in video servicing with microcomputer basics.

EARN CEU CREDITS

America's industrial giants are turning more and more frequently to home study as an effective way to upgrade employee skills. You benefit from the experience NTS has gained in its 79 years as a leader in technical training. The skills and experience gained in the building of kits and test equipment provide you with training that cannot

be duplicated. And, depending on the program you select, you can earn up to 30 CEU credits for successful completion. Complete details included in the catalog.



Use the mail-in card or fill out and mail the coupon. Indicate the field of your choice. (One, only please.) FREE full color catalog will be sent to you by return mail.

NATIONAL TECHNICA 4000 South Figueroa Street,	
Please send FREE color catal	og on course checked below:
☐ Robotics ☐ Digital Electronics ☐ Auto Mechanics ☐ Air Condition	☐ Computer Electronics ☐ Video Technology ☐ Home Appliances ing/Solar Heating
Name	Age
Address	Apt
City	State
ZipPhone (

HOBBY CORNER

Finding an unknown transmitter location

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

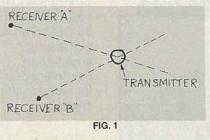
IN THE PAST SIX MONTHS WE'VE RECFIVED a surprising number of requests for a circuit that will allow you to find the location of a radio transmitter. The reasons given for needing such a circuit are quite varied. Several readers want to use the locator on ham (amateur radio) transmitter hunts. Others want to be able to find the source of CB transmissions. One wanted to use it to locate his dog when it runs away. And three other readers want to use the circuit to locate their cars in large crowded parking lots. However, the most recent request comes from a fellow who needs a way to locate his deaf-mute son if they should become separated.

We sincerely wish that we could tell you that there's an easy way to determine the location of a transmitter. But, in fact, there is no simple way to do so. (Don't believe everything you see in the movies.) Finding the direction and distance of a transmitter from your position requires complex circuitry both at the transmitter and receiver locations. During the course of (too) many years, we've had experience both in the air and on the ground with a number of methods of locating a transmitter. Those methods fall into two categories: One requires the operator of the transmitter to send out specialized signals, and the other can be used with any type of transmission

Using the specialized-signal method, an aircraft or som: other type of vehicle can be equipped with receivers that show their location with respect to known transmitters. That information can be converted to give the transmitter location in any type of coordinates. Specialized transmitters may be located on satellites, at or near airports, or on seacoasts. Perhaps the oldest such system is the radio-beacon (AN), which operates below the broadcast-band frequencies. For many years, that system defined the "highways in the sky" for pilots. Then came the Loran system, which was more useful and accurate. The Loran system enabled ships and planes to determine their locations with respect to coastal transmitters. (See the July 1983 Radio-Electronics for a description of the Loran-C system.) Transmitting and receiving equipment was complex and bulky in those early days. More modern systems, such as omnirange and satellites, are even more complex. The construction and use of the latter-type systems is beyond even the most advanced hobbyist.

Therefore, we're now left with a more primitive system that requires no special signaling from the transmitter (any signal will do). This system has changed little from 25-years ago (when I participated in many hidden-transmitter or "fox" hunts). It wasn't all that easy then and still isn't. In any case, the system can give the searcher direction only (and he may be able to guess the distance from the strength of the signal). All that is required is a receiver with a one-way directional antenna. Constructing such an antenna can be difficult, but that depends on the frequency of the signals involved.

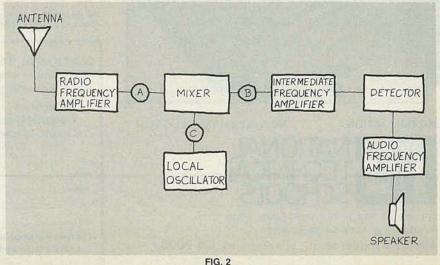
For best results, you really need two readings on the direction of the transmitter. They can be made simultaneously (by two receivers in different locations) or sequentially (by using one receiver and changing its location between readings). The second method assumes, of course, that the transmitter does not move in the



time it takes to change locations. The two resulting directions are plotted (on a map), and simple triangulation gives the location of the transmitter. That process is illustrated in Fig. 1, where a line is drawn from receiver A in the direction of its strongest reading (100 degrees) and the same is done for receiver B for its 60-degree reading. The transmission originates where the lines cross.

However, there are two major drawbacks associated with even this simple location method. The first is the equipment-transmitter, receiver, and directional antenna. You can find helpful information and plans in various publications of the American Radio Relay League (Newington, CT 06111). Be advised, however, that they are dealing strictly with equipment for the amateur-radio frequencies that are operated by licensed hams. The other drawback is the license requirement. Anyone can own and operate a receiver. But a transmitter is something else. There is the serious matter of your right to transmit on any radio frequency. Our laws are based on the fact that the "airwaves" belong to everyone, who under the proper circumstances are entitled to use them free from unauthorized interference. That means that you must be licensed to put a transmitter on the air.

The only exceptions to the licensing requirements are certain carefully defined low-power operations that have a very limited range. Licensing requirements vary



from minimal (CB) to quite stringent, demanding a high degree of knowledge and proficiency. Also, even licensed transmitter operators are required to periodically identify themselves when transmitting. Therefore, we strongly advise you *not* to put an unlicensed transmitter on the air.

The long and short of it all is that using a transmitter and receiver to locate anything or anyone is not only a technically demanding operation but a highly regulated one. Regardless of the merits of your case, we cannot recommend that you undertake a venture of that nature unless you are prepared to devote a considerable amount of time and energy to it. Now let's turn to another communications problem.

Frequency readout

Don Hang (OH) has a communications receiver and is unhappy with the dial calibration. He has a digital frequency counter, but doesn't know how to use it for a frequency readout.

Let's take a look at a basic receiver. Figure 2 shows a simplified block diagram of such a radio. Note that three points (A, B and C) are labeled. Don, you are correct that the signal at point A is the very one to which you are tuned. You could couple your counter there and read the frequency directly but that's a ticklish operation. Extreme care must be taken so that the receiver's alignment isn't thrown so far off that proper tracking across the bands is impossible to achieve.

Point B cannot be used because the signal at that point is at the intermediate frequency or IF—usually 455kHz. If your reading were taken there, the display would always show the IF regardless of the tuned frequency. Actually, the best place to read the frequency is at point c. There, a bit of signal from the local oscillator can be picked off with fewer potential problems than at point A. Nevertheless, you must be careful; and even then it may still be necessary to realign the receiver. Because of that, the best procedure to follow is to use what is called a "gimmick" capacitor. That's nothing more than the very small capacitance created by twisting two short pieces of insulated wire together or, in this case, around the output lead of the local oscillator. The end of a wire crooked around the output lead of the local oscillator may bring out an adequate signal for your

If the signal is not strong enough, you can make the coupling tighter by using another turn or two of wire. Caution: do not make it too tight or the alignment will be thrown off. A better method would be to place a broad-band amplifier stage between the "gimmick" and the counter to boost the signal to a sufficient level. All right—now that you have a signal that's strong enough to produce a reading on the continued on page 107



CIRCLE 73 ON FREE INFORMATION CARD



RADIO-ELECTRONICS

COMPUTER CORNER

You've never tried a personal computer?

LOU FRENZEL

PERSONAL COMPUTERS ARE NO LONGER the new and glamorous things they used to be. In many respects they're really "old hat." They've been around for almost a decade now. The first practical ones appeared in the mid-1970's, several years after the introduction of the first 8-bit microprocessors. (Radio-Electronics published the first computer construction article in July, 1974.) The growth of the personal-computer field has been astronomical during the last seven or eight years and today they are used in millions of businesses and homes. Still, there's an astonishing number of people who have never used or even experienced a personal computer. Even many of those who work in electronics or some related field have never had the opportunity to try a microcomputer. In addition, recent studies show that the total home penetration of personal computers is only about 7%, though the home computer movement is well under way. That means that out of approximately 80 million households in the United States, about 75 million of them still do not have a personal comput-

As a reader of Radio-Electronics, you're more likely than the average person to be one of those who own a personal computer, or at least have access to one at work. Still there are many of you who have not yet taken the plunge. Perhaps you feel that you really don't need or want a computer: After all, what would you do with it? Then again, maybe you are one of those who are secretly afraid of microcomputers. That's a very common feeling and one that keeps many people from benfitting from microcomputers. The fear of the unknown or the fear of failure keeps many would-be computer owners from trying these fascinating machines. Regardless of your reason, there is really no excuse for not at least trying a microcomputer. The old adage that says "don't knock it until you've tried it" still holds true and is so applicable to this situation. Personal computers can be viewed as fascinating toys but they are also useful tools for accomplishing work. Now is the time to take a serious look at these machines that are literally changing the way we work and think. Why not join the 5-million-plus individuals that are expected to purchase a personal computer this year?

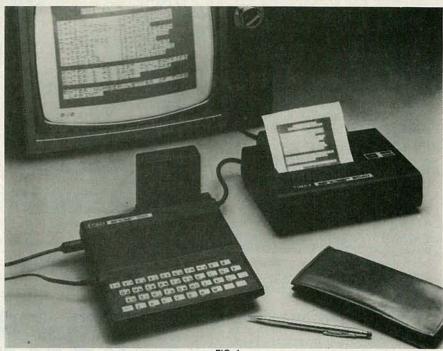


FIG. 1

The "computer literacy" machines

In the past, personal computers have typically been complex and expensive devices. But that's not so today! Thanks to technological developments and the high volume demand, prices have dropped considerably. A good personal computer will cost you much less than a good VCR or stereo system. In fact, today you can purchase a minimum-power personal computer for under a \$100: And for between \$100 and \$200, you can get a powerful and useful one. For that reason, price should no longer be an obstacle. Also, complexity is no longer a valid argument. Most personal computers are so easy to use that even the youngest child should have little trouble. In fact, the average personal computer today is no more complex to use than a VCR or video game.

There are many people who have taken the approach that they'll learn something about computers (by reading magazines or books) first, and then buy one later. But it seems that they never get around to actually buying one. The best way to get started with personal computers is to jump right in and buy one. After all, there's nothing like hands-on experience for learning! Just keep in mind the rule that says: I hear, I forget; I see, I remember; I do, I understand. Computers are like bicycles in that you have to actually use one to learn how it works. No amount of listening to others or reading can get you there. You have to experience it for yourself.

The best way to get your feet wet is to purchase one of those, so-called, "computer literacy" machines. Those are the low-cost microcomputers you see advertised on TV or displayed in your local toy and department stores. There are some real bargains around because of the price wars currently going on in the low-end personal-computer market. Therefore, there's no time like the present to take advantage of the situation. Let's take a look at some of the machines that fall into the low-end category.

The lowest priced microcomputer on the market today is the Timex/Sinclair 1000 shown in Fig. 1. There are well over a million of those machines already in use today and hundreds of thousands of them are being sold every month. The standard Timex price is \$49.95 but they can found on sale for as little as \$29.95. At that price you get a complete ready-to-use computer that hooks-up to your TV (which is used as a monitor). An ordinary audio-cassette player/recorder can be used for loading programs and storing data. The Timex/ Sinclair 1000 comes with a Z80 microprocessor, 2K of RAM (Random Access Memory) and a BASIC interpreter in ROM (Read Only Memory). You can learn to program in BASIC (Beginners All-purpose Symbolic Instruction Code) or you can try out a variety of useful programs and entertaining games. There is no cheaper or easier way to get started. The Timex computer is sold in just about any store where Timex watches are ordinarily sold, including most department and specialty stores.

If you find that you like the Timex computer, you can always expand it and make it much more useful. Specialty manufacturers provide a wide range of accessories to expand that popular unit. One such manufacturer is Memotech Corporation (7550 West Yale Avenue, Suite 200, Denver, CO 80227), who makes add-on memory packages with 16K, 32K, and 64K capacities. Memotech also furnishes a variety of I/0 interfaces such as the popular Centronic parallel printer interface and the RS-232 serial interface. Other available accessories include: an editor/assembler utility in ROM, a high-resolution graphics package, and even a 32-column dot-matrix printer and full-sized keyboard. On top of that, there are many software houses that publish software packages for the Timex 1000. Timex also makes several other computers, such as the 1500 and the 2000.

Another good choice is the Texas Instrument (TI) 99/4A. Because TI has dropped out of the personal-computer market, you can get a 99/4A package at an incredible discount. That's fantastic for a machine that uses the powerful TMS-9900 16-bit microprocessor and features 16K of RAM and BASIC in ROM. That computer uses a wide range of ROM program-cartridges and can use your TV set as a video display. TI also has several expansion devices for that computer on the market, including a memory-expansion module, I/0 interfaces, floppy-disk mass storage, and a speech synthesizer.

Another very popular low-priced home computer is the Commodore *VIC-20*. The *VIC-20* features the 6502 microprocessor, 5K of user RAM, and plug-in ROM cartridges. You should be able to find one on sale for less than \$100. By the time you read this, their 16K version should be available for that same low price. Commodore and others publish a wide variety of game programs and other, useful software. The *VIC-20* features sound and excellent color graphics.

Radio Shack is a newcomer to the socalled "computer literacy" machine field. Although Radio Shack has been making computers for many years, they've only recently announced the addition of the low-cost *MC-10*. Their popular Color Computer models fall into the computer-literacy category but not the prices. However, their new *MC-10* Micro Color Computer is bargain priced at \$79.95. It comes with 4K of RAM standard and can be expanded to 20K with a 16K plug-in module (\$49.95). The computer also has good color graphics with eight colors, and sound. Both text and graphic characters are displayed in a 32-character by 16-line format. A BASIC interpreter is con-

tained in ROM and the reference manual that comes with the machine teaches you how to program.

The Atari 600XL is also worth considering. This one replaces Atari's previous low-end model 400 computer. Like the old one, the 600XL also uses the 6502 CPU and can runs all 400 software. But, in contrast, it features 16K RAM and a standard keyboard. The 600XL is priced at \$149.50.

In a sense it doesn't really matter which microcomputer you buy. Your main objective is to learn and get some expericontinued on page 107



RADIO-ELECTRONICS

STATE OF SOLID STATE

Stereo-sound IC

ROBERT F. SCOTT, SEMICONDUCTOR EDITOR

IF YOU'VE GROWN ACCUSTOMED TO THE big spatial sound of hi-fi stereo equipment, you probably find the monaural sounds of AM radios and TV sets somewhat less than enjoyable. With that thought in mind, Signetics has introduced the TDA3810, a spatial, stereo, and pseudo-stereo sound circuit. That audioprocessor IC converts monaural-audio signals into realistic "pseudo-stereo" sound. It can also enhance the stereo effect when inserted in the audio-signal paths of FM-stereo radios where the apparent stereo separation is less than ideal because of limited speaker spacing (for example, in portables or in your car). It can also be added to most monaural TV and AM/FM radio circuits.

Figure 1 shows a schematic of a circuit using the TDA3810, along with a block diagram of the IC. The IC operates from a DC supply voltage ranging between 4.5 and 16.5 volts and draws a maximum of 12 mA. Its input impedance is typically 75,000 ohms. Minimum input-signal voltage (at pins 2 and 17) for the IC is 2-volts RMS rated at .2% total-harmonic-distortion (THD). Its output THD is rated at 0.1% (for frequencies between 40–16 kHz with an output voltage of 1 volt.) The IC's average voltage gain is about 2.4 dB in the spatial mode, and unity otherwise. Its channel separation is typically 70 dB.

The TDA3810 also provides automatic switching between the mono and stereo modes. And it also has manually controlled logic switching between the mono and pseudo-stereo modes. (Mode selection is determined by the settings of S1 and S2.) Two outputs (at pins 7 and 8) drive LED1 and LED2, which are used as mode indicators. There is also a muting circuit that keeps the LED indicators from flickering.

A monaural signal is fed to the paralleled left and right inputs (pins 2 and 17 respectively) where it splits to follow two signal paths. In one path, the signal is fed through to the output without modification. In the other, all frequencies between 300 Hz and 2 kHz are delayed for a frequency-dependent amount of time (for example, 500 \mus at 800 Hz) to produce a pseudo-stereo output. In the spatial mode, the stereo effect is enhanced by

applying about 50% of the 180° out-ofphase feedback as crosstalk between the right and left channels. Additional information is available from: **Signetics Corp.**, PO Box 409, Sunnyvale, CA 94086.

8-bit analog-to-digital converter

Analog Devices recently introduced the AD673, a monolithic 8-bit analog-to-

digital converter (ADC). This IC provides a microprocessor interface that performs an 8-bit conversion in 30 µs maximum. In addition, it has three-state output latches that are controlled by the data-enable input pin. The data-enable control allows the microprocessor to accept data whenever it is ready. Also included in this IC is a successive-approximation register, a Zener diode reference, a comparator, and

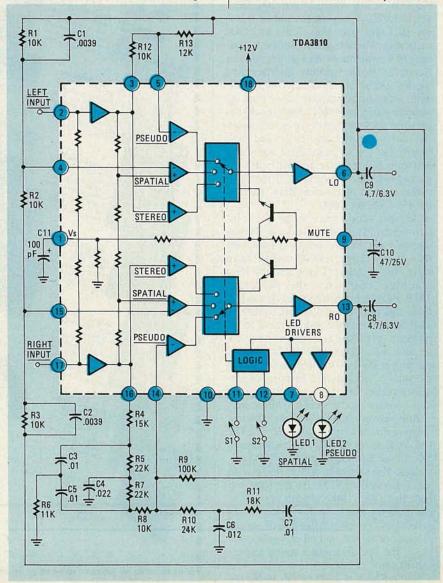


FIG. 1

a clock. The three-state output buffers specify 250 μ s maximum access time. The IC is pin-programmable for either 0 to \pm 10 volts or \pm 5 volts full-scale.

The AD673 is powered by two supply voltages; one, a positive 5-volt supply and the other can be either -12- or -15volts. Its relative accuracy is guaranteed over the specified temperature range at ±1/2 LSB maximum. Maximum offset drift is also specified as ± ½ LSB; maximum gain drift is ± 2 LSB. The above specifications apply for temperatures ranging from 0 to $+70^{\circ}$ C for the "J" grade and -55°C to +125°C for the "S" grade. The IC is available in 20-pin plastic or hermetically sealed ceramic DIP packages. Commercial grade prices for the "J" series range from \$7.90 to \$12.50 in lots of 100. The "S" grade is priced at \$38.20.—Analog Devices, Semiconductor Div., 804 Woburn St., Wilmington, MA 01887.

New technical data book

A new 1080-page databook, Linear Integrated Circuits and MOSFET's (SSD-240B) contains detailed technical information on RCA's broad range of linear IC's and small-signal MOSFET's. Included are many IC's for applications in both industrial and consumer electronics devices.

The first section, a general overall guide to available products, provides a complete index of types, photos of the many package types, product classifications and selection guides, listings of special terms and symbols, and a crossreference showing RCA replacements for many industry types. This section is followed by technical data on devices grouped into categories including Operational Amplifiers, Voltage Comparators, Data-Conversion Circuits, Arrays, Power Control Circuits, Differential Amplifiers, Special-Function Circuits, Automotive Control Circuits, Audio Circuits, Radio Circuits, TV/CATV Circuits, and MOSFET's.

The final section covers device types supplied for military, aerospace and high-reliability applications and shows dimensional outlines for all package types. It also includes lists of current application notes on IC's and MOSFET's. Copies of the SSD-240 Databook may be purchased for \$7.00 per copy from RCA Solid State Division.

NPN transistor arrays

RCA recently introduced two NPN transistor-array IC's that are designed for high-frequency applications up to 1.5 GHz. The two devices are high-quality versions of the CA3046 and CA3127E and operate over a temperature range of -55 to +125°C. Each array consists of five general-purpose silicon NPN transistors on a common substrate. The

CA3246E array has three independent transistors, along with two differentially connected devices housed in a 14-pin plastic DIP package. The CA3227E consists of five independent transistors in a 16-pin package.

Each transistor in the array has a gainbandwidth product (f_T) in excess of 3 GHz. That permits the transistors to operate effectively up to 1.5 GHz for use in VHF amplifiers and mixers, IF converters and amplifiers, and other similar devices. At 25°C ambient temperature, each transistor in the array can dissipate up to 85 mW. Maximum power dissipation for the package is 425 mW up to an ambient temperature of 75°C. Above 75°C, the package must be derated linearly at 6.67 mW/°C. The breakdown voltage for each transistor are: collector-to-emitter voltage ($V_{\rm CEO}$) 8 volts, collector-to-substrate voltage ($V_{\rm CIO}$) 20 volts, and collector-to-base voltage ($V_{\rm CBO}$) 12 volts. Each unit can handle 20 mA of collector current.

In 1000-piece lots, the CA3246E is priced at \$1.93 and the CA3227E is priced at \$2.18. For more information and/or a data sheet (File No. 1345), write to RCA, Solid State Div., Box 3200, Somerville, NJ 08876.



This will be coming to you when you subscribe to

Radio-Electronics:

· HELPFUL CONSTRUCTION ARTICLES

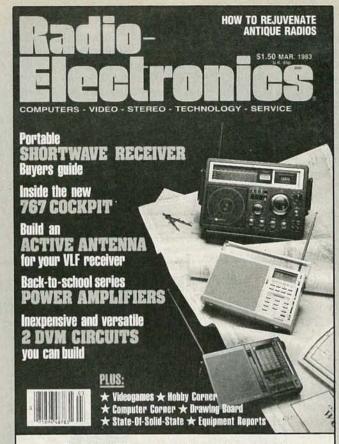
Test Equipment Hi-Fi Accessories Telephone Accessories Music Synthesizers Computer Equipment Automotive Equipment Intruder Alarms Home & Car Video Accessories

 NEWS ON NEW TECHNOLOGY . . .

Computers Microprocessors Satellite TV Teletext Automotive Electronics Speech Synthesizers IC Applications

• FASCINATING "HOW TO DO IT" ARTICLES

Build Your Own Projects Make Your Own PC Boards Wiring Techniques Soldering and Desoldering Design and Prototyping



Radio-Electronics covers all aspects of the fast moving electronics field ... featuring COMPUTERS • VIDEO • STEREO TECHNOLOGY • SERVICE COMMUNICATIONS • PROJECTS

aet it all

. HOW YOU AND THE COMPUTER CAN BE FRIENDS

> Getting Started Programs, Circuit Design, Games A/D-D/A Interfacing Peripheral Equipment

· NEW AUDIO DIMENSIONS FOR YOUR PLEASURE

Noise-Reduction Devices How to Connect that Extra Add-On Hi-Fi Accessories New Technology

• TV WONDERS FOR YOUR FUTURE

Latest Receivers and Circuits The Home Entertainment Center Projection TV Today Satellite TV Receivers Jack Darr's Monthly Service Clinic Service Problems and Solutions

- AND you also get these regular MONTHLY FEATURES:
 - · LOOKING AHEAD by Dave Lachenbruch
 - · HOBBY CORNER by "Doc" Savage
 - STATE-OF-SOLID-STATE by Bob Scott
 - · WHAT'S NEWS, new products, stereo news
 - · VIDEOGAMES, new products, game reviews
 - · and NEW IDEAS, STEREO PRODUCTS, NEW COMPUTER PRODUCTS FOR HOME/JOB and MUCH MORE

Subscribe today to Radio-Electronics. Don't miss a single issue and ... you save as much as \$13.03 off the newsstand price.

When you select one of the subscription offers listed on the handy coupon—you'll be assured of having your copy reserved, even if it sells out on the newsstand. Make sure you get all the excitement in every issue of

Radio-Electronics, every month, by filling in and mailing the coupon, today.

Mail to:	Radio-Elect	ronics	
	P.O. Box 2520	D. Boulder, O	CO 8032

Every Month! Get the Best-Mail Today!

•	А,	**	-	т	u

	l year—12	issues only	\$14.97 (You	save \$6.03	off newsstand	d price.)
-	A CONTRACTOR OF THE PARTY OF TH	The state of the s	The same of the same	A SECURITY OF THE PARTY OF THE	the same and the s	· · · · · · · · · · · · · · · · · · ·

Payment	Enclosed
Dill 146	

☐ 2 years—	(Save More)—24 issues—\$28.97 (Save \$13.03 off the newssland price.
Name	
	(please print)

Bill Me

Address _

Offer Valid In U.S. Funds Only. Allow 6-8 weeks for delivery of first issue State

Zip Code

Canada-Add \$3.00 per year All other countries-Add \$7.50 per year

MAKING MEASUREMENTS

continued from page 79

Another problem when reading at a distance is the cost of long runs of thermocouple wire. This is partially solved by splicing the thermocouple to "extension wire", less expensive thermocouple wire specified over a narrower temperature range. The savings are particularly important when using platinum thermocouples, since the extension wires are made from nonprecious metals.

The low sensitivity of thermocouples requires good first-stage stability in the readout circuitry. For precision measurements, low-drift amplifiers or chopperstabilized inputs must be used. (Chopper stabilization improves the DC drift of an amplifier.)

Thermocouples are linear enough that no linearization is needed for moderate accuracy over moderate temperature ranges. Nonlinearity above 0°C is generally 1% to 5%, depending on the thermocouple and the temperature range.

Thermocouple applications are almost limitless. The wires are available in large or small gauges, in cables using a wide variety of insulations and in ceramic insulating tubes for very high temperature use. The sensing junction, formed by welding the two wires together, may be put into enclosures such as those shown n Fig. 11. The junction may be welded, epoxied or glued directly to a surface or may be exposed directly to air or liquid for fast response. The temperature of molten steel, for example, is measured by plunging the two wires directly into the steel.

Integrated Circuits

Integrated-circuit temperature sensors are fairly new and are not at all standardized. At this time at least five device families exist, each unique in design and output. They generally make use of the fact that the voltage drop across a forwardbiased diode or transistor junction decreases by about 2 millivolts per degree C. IC sensors are generally offered in transistor or IC packages: they are not yet available in the same variety of assemblies as other sensors.

Despite the lack of standardization, some generalizations are possible. Operating temperatures are similar to IC's; -55 to +150°C (-67 to +302°F) or some portion thereof. Accuracies generally are several degrees, requiring user calibration for tighter measurements. Selected sensors as close as ± 1°C are available, but are expensive. Stability at high temperatures is not as good as with most other temperature sensors. IC's are linear, sensitive and easy to interface with readout circuitry. But look for specifications to improve in the future.

FACTORY NEW! FACTORY PERFECT!

Renowned manufacturer of top quality electronic testing devices replaces a current model with a newer version!

PUBLIC NOTICE!

C.O.M.B. is now authorized to liquidate discontinued model at a drastically reduced price!

Precise,

easy-to-read

LCD digital

readout!



Ideal for professionals and do-it-yourselfers!

Weston products are highly respected by professionals for superior quality and advanced technology! Here's a factory-perfect test instrument that carries on that fine tradition. This Volt-Ohm Meter is ideal for field service, repair shops, laboratories, classrooms and home handymen. Use it to check all types of circuitry problems and electrical functions.

EASY TO USE! Turn range control knob to one of five functions: Low Volts, Volts (AC/DC), Continuity, Resistance or Diode Test. Connect test leads to desired voltage points. The display quickly shows precise measurements!

EASY TO READ! Large, high contrast LCD display. For any improper measurement condition, the display alerts you by FLASHING!

HEAVILY PROTECTED! Functions are overload protected against voltages as high as 750V AC or 1000V DC. Casing is shock,

- grease and water-resistant for added protection. Auto ranging for easy hands-off operation. Auto sensing and indication of mixed AC/DC
- signals. Auto "zeroing" and polarity.
 Lab grade 0.1% DC accuracy. AC accuracy, 1%.
- Input impedance: 10 megohms.
 Continuity and diode test functions with beep tone for low resistance or forward voltage drop. Built-in measuring jacks. Fully safety insulated.
- · All functions use same test leads (incl.) and in-
- put jacks. No changing of connectors!

 Operates on 9-volt battery (included).

2 Year Limited Warranty





Toll-Free: 1-800-328-5727

mms In Minnesota, call: 1-800-742-5685



Manufacturer's Suggested Retail

0.0 0

59.95

C.O.M.B. Co. / Liquidators Dept. F-515-62143 14605 28th Avenue N., Minneapolis, Minnesota 55441

Thick leatherette case

included, with conven-

ient belt loop.

Send ____Volt-Ohm Meter(s) at \$58.00 each plus \$3.25 each for shipping and handling. (Allow 3-4 weeks for delivery. Add 2-3 weeks extra if paid by check. No C.O.D.s.) ☐ My check or money order is enclosed. (Minnesota residents add 6% state sales tax.)

Charge my: □ VISA □ MasterCard® □ Am. Ex.	□ Diners Club
Acct. No.	Ехр
PLEASE PRINT CLEARLY	
Name	
Address	VI VI
City	
State	

Sign Here

MAY 1984

RADIO-ELECTRONICS

SERVICE CLINIC

TV tuner and IF amplifier troubles

JACK DARR, SERVICE EDITOR

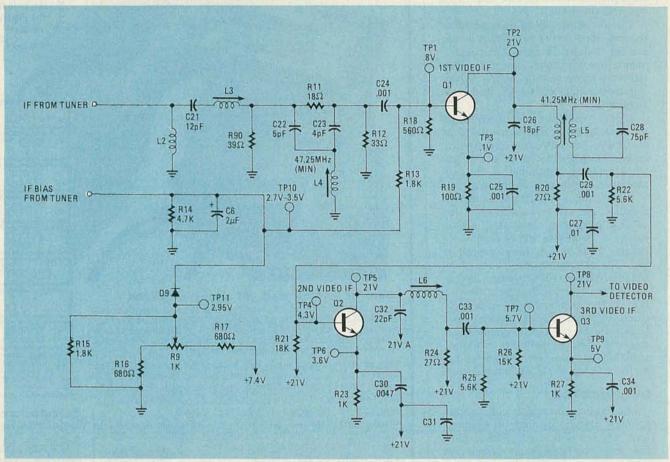


FIG. 1

THERE ARE TWO STAGES IN A TV SET THAT have always been hard to test. They are the IF (Intermediate Frequency) amplifier and the tuner sections. We're talking about IF's that use discrete transistors in their design, and standard tuners-the old-fashioned kind, with three-gang selector switches. Both of those sections give many TV repairmen lots of problems, but fortunately there's an easy and accurate way to check both of them. For the most part, the difficulty has been that both of those stages handle high frequencies and, as a result, trying to make tests on those stages upsets the operation of the circuitry involved. The answer to the problem is to find a test point that is not "hot." In the IF section, the points that can be used are the emitters of the three or four amplifier stages but the tuner section is something else. We'll turn our attention to the IF section first.

Testing the IF section

Figure 1 shows a schematic of a typical IF amplifier used in many TV sets. The IF amplifiers can be identified by the fact that each emitter goes to ground through a small resistor. In testing that section what we want to know is if the emitter voltage is present and if so, how close it is to being correct. For instance, (refer to Fig. 1) the emitter voltage of transistor Q2 should be 3.6 volts. If that voltage is zero we know that the transistor is open or not conducting for some reason. To use the emitter as a test point, simply connect your meter probes across the emitter resistor and measure the voltage. A digital meter is essential here because the normal voltages will be something like 2.74V, 1.28V, etc.—so a very accurate meter is necessary. The DC voltage is developed across the emitter resistor by the transistor's collector current; therefore, if the emitter voltage is correct, the collector and base voltages are also correct. If, on the other hand, you find a transistor that reads zero volts at its emitter, that transistor is probably open and should be replaced; it not, then some previous stage (component) is malfunctioning.

An open transistor can be replaced by a general-replacement transistor provided the right method is used. You must make sure that the replacement transistor is an electrical equivalent of the original. One thing to watch out for is the IF rating or the upper frequency cutoff point of the replacement transistor. It should be at least

50 MHz, or better still, 60 MHz or 75 MHz. If you cut it too close you may lose some badly needed gain. The voltage rating will be ample, since collector voltages are low. Another thing that should be mentioned is that there are two pin configurations in the TO-92 transistor-case style. One is the E-B-C and the other is E-C-B, with the base and collector pins transposed. You can usually find one with the same pin configuration; but if you can't, you can simply bend the base and collector leads to conform to the layout and then cover one or both with a small piece of spaghetti tubing (insulation).

You don't need to worry about throwing the stage out of alignment, either. We made test some years ago using a sweep generator and a scope, and the curves displayed for both the original transistor and a general replacement type were the same. In no way was there any deviation from the original curve (which I had drawn on the screen with a grease pencil!). So, the new one will work just as well as the original. Symptoms of IF transistor failure are similar to tuner problems; that is, both can cause a slick screen (no picture and no snow). If you want to pin it down a bit, pull the IF input plug and feed in the signal from a tuner subber. A picture indicates trouble in the tuner; no picture indicates a bad IF amplifier.

Tuner section

Tuners are a different kettle of fish. The problem here is not usually an electrical one, but in most cases a physical one. Many times the problem encountered will be the familiar and frustrating "I can see it but I can't get to it" syndrome. (I had one where the transistor that I had to reach was mounted between two wafers of the bandswitch (see Fig. 2), an area about 1.5 inches deep. And, as you may already have deduced, I had no tool that was small enough to fit into that area—especially not my soldering iron!) It's times like those that make you start looking for the address of the nearest tuner-repair service!

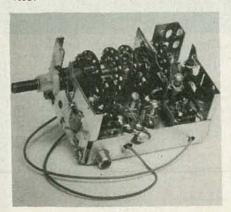


FIG. 2

Let's look at the symptoms of a set that was working, but has suddenly lost its

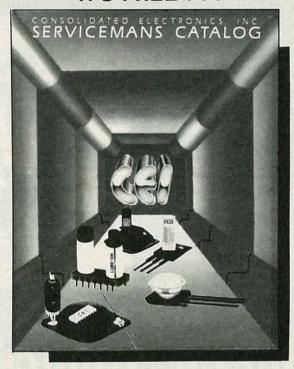
picture—obviously some part has failed. However, the problem isn't necessarily in one of the tuned transformers, but is more likely to be a resistor, capacitor, or transistor. Here, what you have to do is locate the bad component—the next tests will help you to quickly do just that. Symptoms of tuner trouble will give you a good clue as to the location of the bad stage. For instance, if an RF stage goes out, you'll usually see "snow" on the screen but no picture or sound—the snow comes from the mixer stage. Also, a mixer-oscillator transistor going out will generally give you no sound and no picture with a "slick" screen (no snow).

Probably the easiest way to troubleshoot a TV's tuner section is through signal tracing. (Signal tracing is the process of injecting a signal into the input of a circuit and then following the signal path from the output to the input until you find the malfunctioning stage or component.)

To use that method, an RF signal source is needed. That source can be an RF generator or simply a TV antenna with a few modifications. To use the antenna as a signal source, one side of the antenna must be grounded and the other side connected to a small capacitor (about 200 to

IT'S HERE!

IT'S FREE . . .



. . . AND IT'S YOURS!

Consolidated Electronics has a catalog that's sure to please you. We've slashed 80% of our prices in this catalog. We at CEI are so sure that you'll find our quality parts dependable that we've put a TWO YEAR WARRANTY on everything. Not only that, CEI is offering FREE shipping and handling. Just call us TOLL FREE for details.

CALL TOLL FREE TODAY!

1-800-543-3568

1-800-762-3412

NATIONAL WATS

OHIO WATS

705 WATERVLIET AVE., DAYTON, OHIO 45420 IN DAYTON • (513) 252-5662

TELEX NO. 288-229

CIRCLE 18 ON FREE INFORMATION CARD

It's like no other magazine in the world!

Between the covers of this special annual publication are carefully selected articles on scientific developments, recent technical advances, consumer products trends, development of services, exotic communications advances, design information, hobbying tips, and "what's new" material compiled for your reading pleasure and information. Each article was specifically chosen and prepared for publication by the editorial staff of Radio-Electronics magazine, updated to the moment it went on press and printed. Here's what you will read about in the 1984 edition:

video entertainment—It couldn't be said all in one article so we compiled a 16-page special section covering the changing and growing field of entertainment in the home: new video components with screens from the gigantic to the tiny postage-stamp size, accessories that didn't exist last year, and tips on getting the most from what you own or plan to buy.

SATELLITE TV—The countryside is strewn with parabolic tracking dishes installed by home owners to pull-in the countless television channels transmitted back to earth by satellites poised in space in geosynchronous orbits. You, too, can enjoy the programming selection—and much of it is commercial-free, too!

MOBILE TELEPHONES—What was once a status symbol for the idle rich is quickly becoming a working

tool for the common man. Cellular technology promises more channels with a little help from applied computer technology.



DIGITAL AUDIO DISCS—Laser rays are bringing new noise-free, pulse-encoded audio programming to your stereo system embedded in a plastic disc immune to strawberry jam, sandpaper, and desert heat.

MAIL ORDER BUYING—You've heard the bad points, including the myths. Now, here are the facts and economics of buying mail order that will be an asset to your business or hobby.

PLUS—There's so much more, we have space only to mention an electronic guitar tuning project, theory on digital filters, how to make inexpensive computer cables, build a programmable home thermostat, tips on buying pocket-size shortwave receivers, stereo audio for TV, all about VLF active antennas, news on pagers, how to restore antique radios, and....

Radio-Electronics ANNUAL 1984

How to Order-SEND CHECKS OR MONEY ORDERS ONLY **RE184** Allow 6-8 weeks for delivery We can't drop your copy of Radio-Electronics Annual 1984 into the mail sack until we receive an order from you! So, do it today! Fill out the coupon below, giving us all the information requested, write a check or money order (no ☐ I know you have a limited supply of the 1983 Edition of the Radio-Electronics Annual. Please send me_ _ copies. I am enclosing \$2.50 for each stamps) for the correct amount, and mail at once to: copy plus \$1.00 for postage and handling for US, Canada, and Mexico. All other countries add \$2.00. US funds only. RADIO-ELECTRONICS ANNUAL Circulation Department 200 Park Avenue South Please Print New York, NY 10003. Okay, drop my copy of Radio-Electronics Annual 1984 into the mail bag. I Name am enclosing \$2.50 for the issue plus \$1.00 for postage and handling for US, Canada and Mexico. All other countries add \$2.00. US funds only. Street Address copies of Radio-Electronics Annual 1984. I am enclosing \$2.50 for each copy plus \$1.00 for postage and handling for US, Canada, and City Mexico. All other countries add \$2.00. US funds only State ZIP

300 pF). Now, touch the open end of the capacitor to the input of the mixer transistor, usually the base. If the signal is passed on to the CRT, the mixer/oscillator stages are working. The picture will be pretty snowy but it does show that the signal can come through and that that section is operational.

Once you find that mixer/oscillator stages are OK, go to the collector of the RF amplifier transistor. If the signal gets through that stage, the interstage coil, switch, etc., are good. If not, you could have a bad contact in the switch or an open coil. If the switch and coil check out OK, next go to the base of the RF amplifier transistor or the emitter-if it happens to be a common-base circuit. If you lose the signal between the collector and the input, you have a defective RF amplifier. The signal-tracing method can also be used to troubleshoot other sections in the TV set with the proper signal source. For instance, the audio section can be tracedout using an audio-signal generator or signal tracer.

These tests will work on the majority of older sets—that is, any TV set that was made before they started to make all the IF's in one IC. That covers a multitude of sets! They're the ones that are growing older, and hence more likely to fail. So the market is still there. Good luck!

SERVICE QUESTIONS

NO RASTER

I have a Magnovox T991 that has no raster. Sound and HV are OK. I've changed the video delay module and the IF module. What next?—R.K., Chicago, IL

The RGB and the chroma modules also can cause brightness problems, but changing them is haphazard and costly. Measure your kine socket voltages. Focus voltage at pin 1 should read 5.5 kV. Pin 10 should read between 450 and 800 volts, depending on the setting of the master screen control. Pin 9 is a fixed 50 volts. Typical voltages on the three cathodes should be about 175 volts, but will vary widely depending on brightness and background settings. If those voltages go above 190V, the kine will be cut off. See what's missing and find out why.

NO PICTURE

On a Sylvania EO-3-1, while the raster is on the tube I get a full screen with no video, but after a few seconds, the vertical height gets smaller and finally goes into a white line. TA20 of the power supply shows 37.1 volts. I measure only 17.0

volts.-L.S., Brunswick, OH

You're mistaken about TA20 calling for 37.1 volts. It's TA22 that should read that voltage, while TA20 calls for 24.5 volts. That's an important point to clarify. Those two voltage sources, as well as several others, are supplied by Q502, the regulator. The IF strip depends on the 22.8-volt source and the vertical outputs depend on the 32.8-volt source, both coming out of Q502 as well. Since you are getting 17.0 where you expect 24.5 volts, I suspect that something is pulling down the whole supply. Try lifting the different loads until you find one that brings the voltage ID. That's where you will find your problem.

INTERMITTENT SWEEP

I had two cases of intermittent sweep with the GE AC-B chassis and I fixed them both. Now I have another AC-B that loses horizontal sync sometimes after three hours, other times after five minutes.— B.O., Jersey City, NJ

You didn't say, but I'll bet the two you fixed had poor solder connections around the griplets in the vertical circuits. I will also bet you have the same problem now—this time in the sync circuit. Unfortunately, those griplets, which connect top-of-board signal paths to the bottom of the board, are not referred to in the sche-

continued on page 106

FORDHAM DISCOUNTS DISCOUNT PRICES ON HITACHI SCOPES

We will beat any advertised price

SPECIAL OFFER! For a limited time only

35 MHz DUAL TRACE SIGNAL DELAY LINE

Vertical sensitivity 5m V/div to 5V/div and 1m V/div to 1 V/div with 5X amplifier ● Trigger modes Automatic, Normal, TV (+), TV(-).

REG \$895 OUR PRICE \$5995 WITH PROBES



V-355F

60 MHz DUAL TRACE DELAYED SWEEP

High sensitivity ● 1 mV/div (10 MHz) ● 5 ns/div sweep rate ● 3rd channel display (trigger view) ● Variable trigger hold-off

● Full TV triggering ● Single sweep ● Automatic focus

correction.

our PRICE \$995 WITH PROBES



100 MHz QUAD TRACE DELAYED SWEEP

Large, bright 8x10 cm screen

• Quad trace operation/Ch1, Ch2, A trigger and B trigger • High sensitivity 500 μ V/div (5 MHz)

• Full TV triggering OUR

\$1299⁹⁵



WITH PROBES

FORDHAM (master charge) VISA*

in N.Y. State 800-832-1446

■ VISA ■ COD ■ Master Charge ■ Money Order N.Y. State residents add ■ Check appropriate sales tax. COD's extra (required 25% deposit) ADD FOR SHIPPING AND INSURANCE \$250.00\$4.50 \$251.00 to 500.00 6.50 501.00 to 750.00 8.50 751.00 to 1000.0012.50

over 1000.00......15.00

COMMUNICATIONS CORNER

Digital RFI problems

HERB FRIEDMAN, COMMUNICATIONS EDITOR

HIGH TECHNOLOGY OFTEN CREATES A multitude of unforeseen problems. For example, back in the days when we were told that we should be seen and not heard, we got rid of insects in the vegetable garden by stomping on them, or we simply shared what mother nature had provided—we got what the insects didn't destroy. In time, we built an arsenal of chemicals to kill the insects. They did the job but they also destroyed the land, killed fish and birds, etc. The same problem often occurs in electronics. (You pay for what you get.)

In electronics, many of us grew up on Pyranol capacitors, a tremendous breakthrough in capacitor technology. Unfortunately, the stuff that makes it a great insulator and coolant can also harm birds, fish, game, and people. It's not our intention to start any arguments, but rather to simply point out the way the real world works. Remember that there is no such thing as a "free lunch." Every new "breakthrough" in the state-of-the-art

hurts someone or something.

The latest "breakthrough" to cause unforeseen and extensive problems is digital communications or more precisely, digital anything. Back in the days when we simply stomped on garden insects, there were only two major forms of RFI (Radio Frequency Interference) as far as the general public was concerned. The first type was harmonics and spurious emissions from amateur-radio transmitters that wiped out some TV channels-usually Channels 2 and 4 (see Fig. 1). The other type of RFI was hash or electrical noise from the local utility's powerline hard-ware, such as "pole pigs" (powerline transmission transformers) and capacitor banks that jammed or wiped out radio communications from below the broadcast band to well up into the TV channels. And if you were lucky enough to escape the hash caused by powerline hardware, your neighbor's vacuum cleaner or mixer was certain to throw you a zinger every once in a while. But all that was easily handled: amateur-radio operators simply cleaned up their transmitters. Recently, however, the FCC for the most part has just ignored powerline and appliance

But digital RFI is something else. It's hard to avoid and often hard to clean up,



but it certainly can't be ignored because it's starting to permeate everything. Digital RFI, rather than the marketplace, might well determine whether some fantastic new communication technology will ever become viable.

Digital noise generators

Turning to home entertainment, the distributors of high-fidelity equipment see the digital disk as the gizmo that will eventually revive the Hi-Fi industry. But the engineers who design the systems know that the 41-kHz sampling rate is going to produce harmonics right up into the broadcast band. Without extensive shielding and RFI suppression (a technology not presently germane to Hi-Fi equipment), we might well be listening to our neighbor's latest records instead of the local DJ. That's because the signals from your neighbors digital-disc recording might be radiated into the air, superimposed on the radio transmission, and picked up by your radio receiver.

And now we come to the "biggies:" videotext, the computerized transactional services such as banking and shopping at home, and teletext. Between allowing AT&T to enter digital services via the telephone system, the transactional services through cable TV, and the recent approval by the F.C.C. for digital teletext encoding on TV signals, it's conceivable that eventually most homes will have digital signals running throughout the house wiring-radiating into places where they don't belong. Already engineers and technicians are worried about whether the other digital services will affect theirs; after all, it takes just a glitch or two to wipe out a simplified (non-redundant) digital transmission.

Digital RFI

Digital RFI comes about because harmonic generation is indigenous to the very waveforms used in the digital process. Whether the waveform is narrow or wide it starts off with "square" edges, as shown in Fig. 2-a. The leading and trailing edges are steep wavefronts that, if you recall from your early studies in electronics, are efficient generators of oddorder harmonics. Then there's also the digital repetition rate. Computer hardware such as that used for videotext and transactional services operate in the range of approximately 300 Hz to 19 kHz, and are controlled or determined by digital signals in the 2 MHz to 5 MHz range. Essentially, we're generating RFI from the mid-audio range well up into the RF region (Fig 2-b). And we're feeding much of that interference through unshielded cables to recorders, printers, video dis-

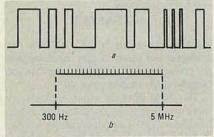


FIG. 2

plays, telephone equipment, and powerlines. (Powerlines? Yes powerlines.) Have you ever heard what a commonly-used digital remote-controlled light switch does to broadcast reception?

In actual fact, we haven't begun to experience the effects of consumer-equipment digital RFI on home and commercial communications systems. It might well determine just how far we can go with computerized high-tech devices in the years to come.

Kaulo-Electi	BOOKSTORE	
Build Your Own Satellite TV Receiver	□ Special Projects (Spring 1981) \$4.50 □ Special Projects #4 (Summer 1982) \$4.50 □ Special Projects #5 (Winter 1983) \$4.00 □ Special Projects #6 (Spring 1983) \$3.50 □ Special Projects #7 (Summer 83) NOT AVAILABLE □ Special Projects #8 (Fall 83) \$3.50 □ Special Projects #9 (Winter 84) \$3.35 □ Radio-Electronics Annual 1983 \$3.50 □ Radio-Electronics Annual 1984 \$2.50 □ How to Make PC Boards \$2.00 □ All About Kits \$2.00 □ Modern Electronics (Vol. 1. #1 \$2.25 □ April 1908)	
South, New York, NY 10003. Please allow 4-6 weeks for	Alliott	
delivery. If you need a copy of an article that is in an issue we indicate is	MONTH YEAR	
unavailable you can order it directly from us. We charge 50¢ per page. Indicate the issue (month & year), pages and article desired. Include payment in full, plus shipping and handling	PAGES @ 50¢ each	
charge.	TOTAL PAGES TOTAL PRICE	
MAIL TO: Radio-Electronics Reprint Department, 200 Park Ave. South, New York Total price of order Sales Tax (New York State Residents only) Shipping & Handling (U.S. & Canada only) (Includes FIRST C		

All other countries (\$2.00 per item, sea mail)

(\$4.00 per item, air mail)

State

REPRINT



WRITE FOR FREE CATALOG FOR ALL YOUR NEEDS IN

TEST EQUIPMENT, TOOLS & PARTS AT THE BEST PRICES.

CIRCLE 19 ON FREE INFORMATION CARD



TELEPHONE DIALER

continued from page 86

pulsing out the digits to the phone interface. It will function with both rotary dial and pushbutton phones. Any length phone number is placed in the DATA statement at line 1000, with commas separating each digit. The last number entered is "55." That is used to flag the end of the phone number.

To dial, lift the telephone receiver and listen for a dial tone. Then type the letter "A" at the keyboard. The program will print each digit of the phone number as it's

To test the dialer without connecting the telephone to the interface circuit, listen to the relay as a phone number is being dialed. When dialing is in progress, the pulses generated by the program can be heard.

Modifications

Though as shown in Table 1, the BASIC program is limited to dialing one phone number, it may be modified for dialing several numbers rather easily. To do that, the program can be used as a subroutine, with a phone-number access program written around it.

The BASIC program simply uses the OUT command to pulse the remote-control relay, which is addressed at I/O port FF. To activate the cassette remote-control relay, the number 4 is output to port FF (see line 180). To deactivate the relay, a "0" is output to port FF (see line 200).



"But Marge-think of the terrific reception that we'll get!'

SERVICE QUESTIONS

continued from page 103

matic so they are difficult to locate. Monitor the sync-clipper transistor, in and out, with a scope and voltmeter. Once you know where the signal is being lost, the rest becomes easier.

NO RASTER

I get no raster on an RCA CTC48. I've changed the three output modules and the chroma module. Still nothing. Can you Help?-G.M., Walled Lake, MI

The MAL001A/B video module, or more specifically, an open first video amp transistor (Q3) could be cutting off the outputs. Although the brightness limiter (Q302) usually causes too-much-brightness problems, it must be considered.

DARK BAND ON SCREEN

I own a tube-era Sanyo color TV set that has a dark band across the top of the screen. I have replaced filters without luck. Could you suggest a cause?-B.D., Miami, FL

Yes, a filament-to-cathode leak in one of the signal tubes. Any tube-from the RF amp to the video output-could be causing your problem.



CIRCLE 68 ON FREE INFORMATION CARD



nlimited



NEW KIND OF MAGAZINE FOR ELECTRONICS PROFESSIONALS

LISA — PC — MACINTOSH — PEANUT Quick comparison of these four popular computer systems

UPGRADING BUDGET PRINTERS...

Graphics and tractor feeds are easy and inexpensive to add to your system. Here's a

bunch of practical modifications

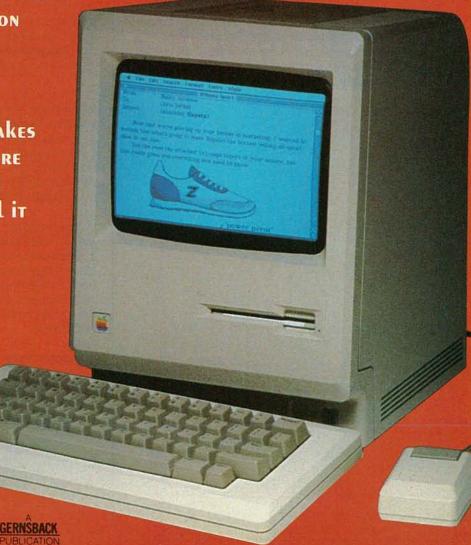
you can make to your Epson or Smith-Corona

MACINTOSH...

A shiny new Apple that takes several careful looks before you can really understand what it can do—how well it can function—and how nexpensive it really is!

CP/M FOR BEGINNERS...

IT REALLY ISN'T difficult
TO USE! And ONCE
YOU KNOW HOW, IT
CAN BE EASIER AND BETTER
THAN MANY OTHER SOCALLED USER-FRIENDLY
OPERATING SYSTEMS



CONTENTS

Vol. 1 No. 1

May 1984

4 Lisa, PC, Macintosh, And Peanut

A look at four popular systems and how they stack up against each other. **Byron Wells**

6 Macintosh: A New Variety Of Apple

Apple's new computer has created a bit of excitement. Find out why, and exactly what it is that makes the Macintosh so special in our in-depth review of that new machine. **Marc Stern**

9 CP/M For Beginners

Though it has scared off many a beginner, CP/M is one of the best, and easiest-to-use operating systems available. **Herb Friedman**

12 Upgrading Budget Printers

Just because you own a budget printer doesn't mean that you have to settle for budget features. Here's a look at some products for upgrading some of the most popular inexpensive printers on the market.

Herb Friedman

2 From The Publisher

3 Editorial

FROM THE PUBLISHER

Welcome to **ComputerDigest**. This is Volume 1, Number 1 of what we intend to make a long series of continuing publications. Our purpose is to bring you something that you cannot get elsewhere currently: a broad look at what is happening in computers from the viewpoint of the electronics professional.

That means that **ComputerDigest** is not written for the typical computer operator or hobbyist. It is written for the electronics professional—engineer, technician, or hobbyist—who has his feet solidly placed in the field of electronics. To sum it up—the typical **Radio-Electronics** reader.

Because of that slant, that orientation, we are different! However, we do not replace any other computer magazine. In fact, if we are successful in obtaining permission to reprint articles from other computer magazines, we may well serve as an introduction to what those magazines have to offer. In fact, you may blame us—**ComputerDigest**—some time in the future for causing you to subscribe to so many other publications.

But for now, as Byron Wels, our editor points out on his facing page—we need to know what kind of magazine you want **ComputerDigest** to be. We need to compare your input with our plan, making modifications where we can to make the two pictures overlap. So do write. We'll read your letters, respond to them as quickly as possible, consider all of your suggestions carefully, and go on to make **ComputerDigest** a really great publication.

I know I've said it before, but it is important so I will repeat myself one more time. **ComputerDigest** is an added section in **Radio-Electronics**. Note that the pages are numbered separately. It takes no editorial space away from any R-E reader. If you like reading R-E, but are not interested in computers, just ignore the section. If you do like it, you can tear it out and save it as a separate publication.

ComputerDigest is our investment in the future of electronics. Join with us and learn more about this existing exploding field. You are an electronics professional today, and that means you're going to have to know about computers.

Sincerely,

LARRY STECKLER PUBLISHER

EDITORIAL

Another Computer Magazine!

No! This one is different. Really different!

Considering the numbers of computer magazines available today, you could go broke trying to read them all. What's more, the amount of time you would use up just going through all of them would keep you from getting anyplace near your computer.

That's why ComputerDigest is here.

We do read all the magazines in the field, and we read them very carefully. When we see an article that we feel is important to you, we pull it out and put it aside. Then, once a final selection is made, each of those articles is read again and carefully edited to carve off the fat and leave only that which is necessary to make it readable and informative.

When we can't get permission to reprint an article, we assign one of our own authors to do a story that fully covers the subject in our own style and format. In this issue, every article is original with us. Next month, we hope will start showing carefully selected and edited reprints.

You gain two ways. First you don't have to buy those magazines you don't really need. Second, you get to preview a lot of magazines you may have been considering subscribing to. If you like the kind of articles they publish (after you preview one or two in ComputerDigest) you can subscribe, knowing that it is a magazine you will want.

Naturally, we can't operate in a vacuum. We need some input from you too. We'd appreciate your comments, and we hope we'll be able to get a letter column started with the next issue. So do drop us a line and give us the benefit of your thinking. We need and want your help to make ComputerDigest a more helpful, valuable publication for you.

We know you'll like what you find in the pages that follow, and that you will be looking forward to our next issue. We feel that we have an excellent opportunity to serve, and we intend to take an aggressive stance to accomplish that purpose.

Thank you for joining us here, and we hope we'll be talking to you again, and often, in the future.

> BYRON G. WELS EDITOR

COMPUTER

Hugo Gernsback (1884-1967) founder

M. Harvey Gernsback, editor-in-

Larry Steckler, CET, publisher Art Kleiman, editorial director Byron G. Wels, editor Brian C. Fenton, technical editor Carl Laron, associate editor Robert A. Young, assistant editor Ruby M. Yee, production manager Robert A. W. Lowndes, production associate

Dianne Osias, production assistant

Joan Roman, circulation director Arline R. Fishman, advertising coordinator

Gernsback Publications, Inc. 200 Park Ave. South New York, NY 10003 Chairman of the Board, M. Harvey Gernsback President; Larry Steckler

ADVERTISING SALES 212-777-6400

Larry Steckler Publisher

EAST/SOUTHEAST

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

MIDWEST/Texas/Arkansas/Okla.

Ralph Bergen Radio-Electronics 540 Frontage Road—Suite 325 Northfield, Illinois 60093 312-446-1444

PACIFIC COAST Mountain States

Marvin Green Radio-Electronics 15335 Morrison St., Suite 227, Sherman Oaks, CA 91403 818-986-2001

IBM vs

Although there are more than two computer Apple—always seem to dominate the headlines. machines

When you talk to the experts, all you're going to get is confused. Most people who already own computers compare other computers to those they have. It's something like buying a new car. It takes a bit of getting used to. If you're switching from a stick shift to an automatic you're going to have some adjustment problems. And the additional little gadgets on the new car will probably remain unused until you get accustomed to their being there!

Got a keyboard with the legends printed right on the keys? You might not like having the legends off to the top of the key, on a separate insert. But once you get used to it, who knows? You might even learn to like it.

What we're trying to say, is that while a lot of information is available when it comes to making major decisions, we'd suggest that you do not base an important decision on a superficial factor.

Because most of us like to comparison shop, here's a good jumping-off place for you:

Apple's Macintosh

This personal computer will solve all kinds of problems for anybody from a schoolperson to a business manager. It comes with a mouse, and offers a 32-bit (internal architecture) microprocessor and bit-mapped graphics. You get many of the advantages of the Apple 32 supermicro at an excellent price.

Apple's Lisa

There are three, count 'em, three Apple Lisa's. The Lisa 2, the 2/5 and the 2/10. If you want Apple, and want more Apple than you can get in a MacIntosh, go for the Lisa series. Again, the more Lisa you get, the better off you will be, so we advise investing the most you can afford to make your first expense your last. All the Lisa's come with a mouse, and as you'll see from the specifications, they keep getting more and more powerful...

TABLE 1

Apple Macintosh

Microprocessor MC68000

Memory
Disk drives
Disk storage

64K ROM 128K RAM
One 3½ inch microfloppy
400K per disk

Disk storage 400K per disk
Keyboard 58-key detached (numeric keypad

optional)

Size $9.7 \text{ (width)} \times 10.9 \text{ (depth)} \times 13.5$

(height) inches

Weight 16½ pounds (without keyboard or

mouse)

Other comments Mouse, independent clock/ calendar,

two RS-232/RS-422 serial ports, built-in video monitor, sound/voice generator.

TABLE 2 Apple Lisa 2

Microprocessor MC68000 Memory 16K ROM,

Disk drive Disk storage

Keyboard Size MC68000 16K ROM, 496K RAM One 3½-inch microfloppy 400K per disk

76 keys with numeric pad 18.7 (width) × 15.2 (depth) × 13.8

(height) inches 48 pounds

Weight 48
Other comments Thr

Other comments Three slots, two serial ports, one parallel port, built-in speaker with software-controllable tone generator.

APPLE

manufacturers, the same two—IBM and Let's compare what their most popular offer.

TABLE 3 IBM PC

Microprocessor 8088

Memory Disk drives 40K ROM, 16K (standard) to 256K RAM Up to two 51/4-inch diskette drives

(optional)

Disk storage Keyboard

160K per diskette

detached, with 6-foot cable. 83 keys,

auto repeat

Size

20 (width) × 16 (depth) × 5.5

(height) inches

Weight

21 pounds (without drives) 28 pounds

(with two drives)

Other comments Cassette I/O, five expansion slots, builtin speaker, BASIC interpreter. RF

modulator or video monitor must be

purchased separately.

TABLE 4 IBM PCjr

Microprocessor 8088

Memory Disk drives 64K ROM, 64K RAM

one 51/4-inch double-sided drive

(optional)

Disk storage Keyboard

360K on a double-sided diskette cordless infrared keyboard with 62

chicklett keys

Size

13.9 (width) × 11.4 (depth) × 3.8

(height) inches

Weight

6 pounds (without drive) 9 pounds

(with one drive)

Other comments Cassette I/O, two joysticks. Cord for keyboard is optional. Display is 40 columns, 80 columns with upgrade that also increases RAM to 128K. (Both that upgrade and disk drive are included with the enhanced version. Connector for TV is optional, direct and composite video are standard.



APPLE's MACINTOSH (above) and IBM's PCjr-two new machines generating a lot of excitement.



IBM's PCir.

Many have taken to calling this "the Peanut," and it's a truly innovative unit with some features that tickled our fancy—like the cordless keyboard that is coupled to the system unit via infrared signals to provide a degree of freedom heretofore unavailable. It's an excellent, low-priced starting unit, and will do a workmanlike job for the small office or for the home.

IBM's PC

There are two PC's from IBM. The PC and the PC XT. Chances are that when you visit your local dealer, if you ask to see the jr it won't be long before he's selling you "up" to a PC or an XT. Both are excellent values, and sufficiently powerful to do any sort of job that you'd call on a desktop unit for. There's a vast array of software available for both, and the specifications speak exceedingly well for these units.

MACINTOSH: a new variety of apple.

Apple's long-awaited new business computer has arrived. Let's take a look at what it has to offer.

MARC STERN



■No one will know for some time the impact that the Macintosh will have on computer users and the computer industry—but we'd be willing to bet that it will have a major effect. The Macintosh, with its MC68000 microprocessor, icons, and mouse, (we'll explain shortly) may be an example of how all computers will be designed in the years to come.

To be sure, the Macintosh isn't the first small computer to use the MC68000. For example, Radio Shack's Model 16, which was introduced a couple of years ago, and Apple's Lisa both use it. But the Macintosh is the first system to use the power and capability of that microprocessor in a computer that costs under \$2500.

Just what do you get for your \$2500? You get the main unit, the keyboard, and the mouse. The main unit includes a 9-inch black-on-white display (512 × 342 pixels), the microprocessor and related circuitry, (including 128K RAM and 64K ROM), a 3.5-inch Sony microfloppy-disk drive that can store up to 400 kilobytes; two RS-232/RS-422 serial ports, and built-in sound and speech hardware. That's quite a bit of power in a lightweight (17-pound) unit.

Icons and a mouse

Perhaps the most important features of the Macintosh are those that make it easy for almost anyone to use it. With the mouse (a desk-top "roller controller") and icons (graphic representations of a command or function), you can do a great many things without knowing the first thing about operating systems or command structures. All you have to do is move the mouse on the desk, and the screen pointer (cursor) moves to a picture (icon) that indicates the action you want to take. Then, you push the single button on the mouse and the system goes to work.

For example, if you want to open a file, you simply point to a file-folder icon, push a button on the mouse, and a file is opened. Or, if you want to create some text (provided the proper application program is in the disk drive) you then point to the appropriate picture or menu command at the top of the screen and you are in the text-processing mode. During this time, the computer is handling all the tasks without requiring you to remember any commands to control its operating system.

That ease of use points the way the personal computer world is likely to go. It seems almost inevitable that the personal computer of the future will be easy to use yet powerful. It's likely the personal computer of the future will take only a few hours or so to learn adequately so you can use it for whatever purpose you have in mind.

The Macintosh is a logical progression of the small computer-system. In the last decade, since the first, "primitive" microcomputers became available, the industry has advanced a step at a time from 4-bit to 8-bit to 16-bit and to 32-bit architecture. Each step in this progression has brought with it an increase in power and capability.

Eight-bit microprocessors, with their 16 address lines, can directly address a maximum of 64K (actually 2^{16} or 65,536) memory locations. However, that figure was the upper limit of its capability. Some 8-bit-based systems do claim the ability to address more memory, but they are using fancy memory and timing techniques (bank selecting) to achieve that affect.

For its time and for most purposes, that was more than adequate for many computer users. It was a fairly simple setup, requiring only 16 address lines, eight data lines, and various control-bus lines. But that simplicity had its drawbacks, especially for systems and program developers, who just love more and more computing power. The 64K limit of memory addresses and the relatively primitive level of instructions available limited them in what they could do.

Fortunately, the 16-bit microprocessor began to make its appearance. Here is a device which can directly address more than a megabyte of memory (9^{20} bytes). Of course, it is a bigger, more powerful device. It uses 90 address lines plus a 16-line data bus for its 90 internal data registers, and lines for timing and other control functions. System designers and programmers can do a great deal more with it because not only can it support far more memory, it also has a richer instruction set.

Although it was the type of device which could do cartwheels in the eyes of developers, it was also a device which required more support circuitry than an 8-bit microprocessor. So, of necessity, the motherboard in a 16-bit computer became much more complex.

And that brings us to the *Macintosh* and its 32-bit internal architecture, the next step in the microcomputer revolution. Unlike its predecessors (such 8-bit devices as the Z80 or 8080 and such 16-bit

microprocessors as the 8086/8088), the MC68000 is packaged in a 64-pin flat pack with 24 address lines, 16 data lines, and 20 control lines. It has a 32-bit internal architecture (its has seventeen 32-bit data and address registers) and it has the capability of directly addressing 16 megabytes with its 24 address lines.

Macintosh's only limitation at the moment is the amount of RAM available: 128K. Unless a program designer wants to move applications routines in and out of memory with constant use of the single disk drive (a second optional drive is available), most routines will actually be single tasks. When Apple upgrades the Macintosh to a promised 512K of RAM in the fall, then multitasking and true concurrency will be available.

Still, Apple's unique way of handling input and output makes it seem as if Macintosh is capable of concurrency. You are able to call up two concurrent applications under the main program and have them resident on screen, with one of the executing. Much of this is due to the fact that a large part of the Macintosh's operating program is stored in read-only memory and is called for by the disk-based applications program. Because it is, very little RAM is wasted holding the operating system and thus the entire 128K is available for use.

But this is getting away from the point here which is that Macintosh's microprocessor points the way to the future and it is a logical step in the microcomputer revolution.

16 or 32 Bits?

You might have noticed that whenever we said "32bit," the word "architecture" always followed. Although Apple markets the Macintosh as a 32-bit computer, there are some who would debate that terminology, preferring to call it, instead, a 16-bit computer. The reason is the number of data lines. The 68000 uses 16 data lines (rather than 32) to bring data to its 32 registers. The result is that the device must make two 16-bit fetches, which slows things a bit. However, once the data are inside the processing unit, they are processed in a 32-bit manner. So what kind of computer is the Macintosh? It is a 16/32-bit machine. The MC68000 uses special timing routines for data

THE MACINTOSH WILL NOT take up too much room on your desktop. Its "footprint" (not including the keyboard or mouse) is 10×10 inches.

input, so it works nearly as fast as a true 32-bit microprocessor—although Motorola (the microprocessor's manufacturer) calls it a 16-bit device. For convenience, though, we'll continue calling the Macintosh a 32-bit machine. Just remember, we're referring to the microprocessor's internal architecture.

Macintosh comes with 192K of internal memory, which consists of the 64K ROM that stores many of the operating system primitives and device drivers, as well as other system and device calls, and 128K of RAM. Mass storage is via a 3.5-inch microfloppy diskette, which holds 400K of information on a single-sided double-density disk.

When you open the system box you will find all of the Macintosh's memory and processing power is on one motherboard running along one side of the box. This board contains the CPU, RAM and ROM. It also contains the connectors for the mouse controller, as well as the connector for the optional external floppy disk drive. Further, it also contains dual serial ports to interface a printer and modem. The system also contains a built-in, battery-driven clock/calendar and the sound/speech generation chip.

With the exception of the 68000 CPU and microfloppy diskette drive, the basic Macintosh outline is pretty similar to many other small computer systems on the market. But Apple has done something that is unique. For a better understanding of this, it's only necessary to take a look at the architecture of the system, as well as the user interface to see why Macintosh is innovative.

Unique architecture

At the heart of this system is the 68000 CPU and its memory. In the Macintosh, the RAM data-output lines are connected to a different bus from that used by the rest of the system, increasing operating speed. The RAM has three different entry ways, each of which give the CPU, screen display and sound-generation hardware separate periodic access to the data and address buses so that sound, video and the current task that the 68000 is performing appear concurrently executing to the user.

The ROM, which contains low-level graphics primitives, operating system routines, and user-interface



A VARIETY OF ACCESSORIES is available for the Macintosh, including an outboard drive, a numeric keypad, printer, modem, and carrying case.

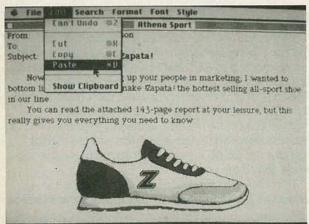
routines, is directly connected to the system bus and is used only by the CPU. Because of the way its software is encoded and stored—in low memory locations the ROM-based subroutines function as extensions of the 68000 instruction set and operate at system speed. Therefore, the ROM is always accessed at 8 MHz.

Video memory appears as a linear array of 10,944 16bit words of data. Because of the arrangement of video memory with the rest of the system, RAM access time slows to about 3.5 MHz during the horizontal video refresh period. That prevents video glitches.

A key to the Macintosh system, though, is the serial bus. It is through this bus that most peripherals will interface with Macintosh. It can run in two modes, the first using an external clock which allows data transfer at up to one megabit-per-second; the second mode uses an internal clock and allows data to be transferred at up to 230 kilobits-per-second. That is the speed at which most peripherals will transfer their data.

It is through this latter feature that Macintosh implements "virtual" slots. Rather than relying on conventional slots as has been Apple's policy with its tremendously successful Apple II + and IIe lines, the company interfaces each piece of peripheral equipment in a daisychain manner off the serial bus. Each peripheral has its own power supply and will use the 230-kilobit data-transfer rate.

While a closed bus might seem to be a disadvantage, virtual slots do have some advantages that become apparent. For starters, it means the system box can remain closed, thus preventing radio-



A MEMO CAN easily be illustrated with graphics. Note the window near the top corner of the sereen.

frequency interference (RFI) problems that have troubled many other manufacturers. Further, since there are fewer mechanical connections in a serial interface than on a typical add-on computer card, there are fewer places where mechanical troubles can occur. And, since each peripheral will use its own power supply, the power requirements of the Macintosh can be kept low and stable, and the company doesn't have to worry about beefing up the supply to handle future peripherals. In that way, costs are kept down. Finally, for software developers, the virtual-slot system means that the memory map will always remain the same—there will be no peripheral cards inserted into memory that will change the mapping itself. Therefore, developers can be assured the programs they write

will run, without worrying about whether company X's peripheral card will change things.

One last feature of the system architecture is its simplicity. Using programmable logic-arrays, large-scale and very large-scale integration techniques, Apple has been able to keep the IC package count to about 50. That not only helps to keep the computer's size and cost down, it helps to ensure reliability.

The user interface

The second key to Macintosh's uniqueness is the user interface. It is simple to learn and easy to use. Rather than relying on the traditional operating system approach with its rather cryptic A> (or whatever) prompt, followed by the need for a command or series of commands, Apple has chosen the mouse and screen graphics and menus as the way someone will be able to access and use any of the applications which he may need.

The windowing capability allows several documents to be displayed on screen simultaneously. The windows can be moved, expanded or shrunk. This means that numbers, words and pictures can easily be cut and moved around and repasted elsewhere.

Since Macintosh uses an unchanging memory and access format, all programs—will use the same command structure in the same way. No longer is it necessary to learn and relearn new commands as new programs are acquired. This means that software designers are forced into standardization that is seldom seen in the microcomputer world.

With the Macintosh, there's no more worry about learning long, complicated command strings or the like. And, rather than taking 20 to 40 hours to master the machine, Apple estimates it will take 10 or less. Also, the software allows the system to share files across several programs and it gives software developers direct access to its many features through a "developer's toolbox."

Future trends

What is in store for the future of Macintosh is still up in the air and several questions remain with it. Like it has done before, Apple has introduced a system that is totally incompatible with the systems it already has on the market—although it will "talk" with the Lisa (it is upward compatible—meaning that the Lisa can run Macintosh software, but not the other way around).

Further, since there is no compatibility with the near industry-standard MS-DOS operating system and since there is likely to be none, there have been questions raised about its future in the business market. Also, it comes totally without software—not even BASIC is included when you buy it, so you must start adding to the system's price at the start. (Apple, however, will throw in word-processing and graphics software if you buy the computer within 100 days after its introduction date of January 24, 1984.)

In conclusion, the future of the Macintosh is still unclear. Yes, many people and the company are ecstatic about the machine, but there is still some uncertainty around. Whatever the outcome, one thing is for sure, Macintosh's impact on the small computersystems market is likely to be felt for years.

YOUR KEY TO CP/M

HERB FRIEDMAN

Here's a CP/M primer that's perfect for beginners others who need to know about that operating system on a non-technical level.

■It often appears that CP/M is the bogeyman of personal computing. Some colleges short on funds take in substantial extra income with rather expensive "How to use CP/M" adult education courses. Highly paid consultants will come to your home or office any hour of the day or evening to give you personal training in CP/M. Magazine authors suggest you consult the local "CP/M expert" to work out your problems. And computer stores offer as an excuse to users who wiped out all traces of their software from a hard disk that "it's your fault if you misuse CP/M."

Why is CP/M so difficult to use? In truth, it's not difficult at all; it's often easier to use than most of the so-called user-friendly operating systems.

Most difficulties in using CP/M arise because the system has remained essentially the same while the hardware, the program software, and the type of person using the software has changed dramatically. Many of the original CP/M concepts no longer pertain to how the modern personal computer is generally used. But once you understand CP/M in terms of modern hardware and software and your own technical level, you will find that it becomes a delight to use.

What's CP/M?

CP/M, an acronym for Control Program for Microcomputers, is only a disk operating system with a fancy name. It's primary purpose is to create disk files and then permit the user to use the files in any desired manner. For example, the output from a disk file could be directed to a printer, or another disk drive to make copies, or another computer, or a modem, or a paper punch—anything at all.

On the opposite side of the coin, CP/M allows almost anything to be used to create the disk file. The input could come from a keyboard, a teletype machine, a CRT terminal, a card reader, paper tape again, anything.

Some of those devices and uses might sound strange because you have not heard of them or your computer has no provisions for them; and that's a good part of the reason some users have difficulty using CP/M. CP/M was never intended for the modern personal-computer or the typical person using it today.

The fact that it remains the leading 8-bit computer operating system is a testimonial to how well it was initially thought out, touching bases that hadn't even been thought of in the late 1970's.

CP/M was intended for a "personal computer" that, like the mythical kingdom of Camelot, lasted for one brief instant in time. It was written for a central computer to which other equipment—called "peripherals"—were connected. Depending on the particular installation the input to the computer could be from any of several devices such as a teletypewriter, a video terminal consisting of a keyboard and CRT display, batch processor, a telephone line, a paper-tape reader, virtually anything. Similarly, the computer could feed any number of devices, among them a highspeed line printer, slow speed letter-quality-printer, several disk drives, paper-tape punches, teleprinters, even another computer. Hence, CP/M was designed to accommodate all those various peripherals, and numerous software routines commonly used by "data processing" technicians were built into CP/M so the user could easily use the peripherals.

Today, however, the typical personal computer rarely connects to that much hardware. Nor does the user need the software functions that go with the hardware; yet the functions remain in CP/M. If you call a function not implemented for your particular computer, either nothing happens, your information gets directed to places unknown to you, or the keyboard locks up. If you just don't use the features there won't be any problems. We'll cover what not to use a little later.

Also, the documentation was intended for the computer scientist/engineer/technician, and even some of them had difficulty understanding it. For many applications-oriented users of personal computers, inconsequential hassles become insurmountable problems because the user doesn't understand the technically-oriented documentation.

To make life easier and simpler for those of you who aren't computer experts, and don't care to become experts, we're going to cover CP/M from a strictly nontechnical applications-oriented viewpoint. Some of you will undoubtedly gnash your teeth and shout to the world "that isn't right." Gnash away! This short course in CP/M is intended strictly for those who want

to use their computer, not write the next multimegabyte integrated word processor/spreadsheet/ graphics program.

Note: To avoid confusing computer keyboard commands, the punctuation—the periods, commas, colons, etc.—which are by normal convention located within parentheses will be shown outside the parentheses.

Drives and user areas

As stated earlier, CP/M is a disk operating system. It will write and read disk files on any of up to 16 individual or "dual identity" disk drives which are alpha labeled as "A:", "B:", "C:", etc. The colon (":") is part of the disk drive hardware identification; without it CP/M has no idea what you are talking about, and the lack of the colon is the reason why what should be an ordinary copy command can result in inaccessible disk files. While a disk drive can be assigned any letter (within reason), because of the way modern personalcomputer software is written, the main drive, the socalled primary default drive, is always A: and the second drive is always B: You could have your second drive designated C: but a lot of commercial software wouldn't have the vaguest idea what to do. Unless you modify the software that is the way it must be done; otherwise, you will end up with software that won't run, or software that simply erases it's own records. (Self-erasure is very common to hard disks where A: and B: are the same disk mechanism.)

Take note that some programs permit the user to eliminate the colon when specifying disk drives, and some so-called "utility" software permit the user to use CP/M without the colon. Using a colon at one time and not at other times causes more problems than the convenience is worth because omitting a colon at the wrong time can "crash" (ruin) a file. Try to do it CP/M's way at all times—use the colon even if you don't have

The basic CP/M system that handles the filing and retrieval of disk data has several inherent command functions. The most commonly used command is DIR (for "directory"), which will cause the display device to show a directory of the disk files. The directory can be "keyed" so that only a desired group of files appears at any one time.

One of the attractive features of CP/M is that it can create up to 16 individual "user areas" on a single disk that are keyed to individual directories for each user area. "User area" is essentially an invisible tag applied to one or more disk files, and the computer always "comes up" in user 0 when CP/M is first booted up.

You enter a user area from the command line—when the "A>" shows on the screen—by typing user 1, user 5, etc. Since the computer automatically comes up in user 0, the command user 0 need be entered only when leaving some other user area.

User areas work this way: Assume your disk drive will record 200K bytes of data. Any program written to the disk is placed in the user-0 area and a DIR command will display a listing for all the disk files. If all the files were simply written to the disk, the directory would appear as shown in Fig. 1. But let's assume you don't want the directory listing cluttered with a string of

```
DIR
CARDFILE COM : MBASIC
FAMILY BAS : BOOKEEP
INSUREB4 BAS : PIP
                                                                                 COM : LABEL2 BAS : MAILPAC BAS
BAS : CHECKS BAS : CHECKS82 BAS
COM : CARDFILE PRM : CARDFILE DAT
COM : COMHEX COM : MITE COM
```

FIG. 1—THIS TYPICAL DIRECTORY display shows the CP/M utilities, MBASIC and its files, and a Cardfile database with

unrelated files; you would like them arranged into homogeneous groups. For example, you would like only the CP/M utility programs—PIP, STAT and XDIR—to be available on boot up, with MBASIC and all its related programs with the .BAS extension listed independent of both the CP/M utilities and the database program with its individual data files and prompt screens. Figure 2 shows how only the CP/M utilities would be displayed.

```
DIR
A: PIP
             COM : STAT
                              COM : XDIR
                                              COM
A>
```

FIG. 2.—THIS IS HOW we would like the computer to "boot up," with a DIR showing only the utility files.

What you can do to avoid the clutter is to tag each individual file by assigning it a user area tag. As shown in Fig. 3, we could place the MBASIC file and its programs in user-2 area by first typing user 2. Anything done from here on will have the user 2 tag, so if we now move (write) MBASIC and its related programs to the disk they will all have the user 2 tag. All programs created by MBASIC will also automatically get the USER 2 tag.

```
USER 2
A>DIR
A: MBASIC COM : LABEL2
A: BOOKEEP BAS : CHECKS
                                              BAS : MAILPAC BAS : FAMILY BAS
BAS : CHECKS82 BAS : INSUREB4 BAS
```

FIG. 3-MBASIC AND ITS FILES should have their own exclusive tagged directory.

To keep our database files separate we might give them a USER 5 tag. From the "A>" command prompt we type user 5. Everything we do will now get the user 5 tag. If we write our database, in this instance Cardfile, to the disk, the program and all its generated prompts and files will be tagged user 5 (see Fig. 4).

```
USER 5
          COM : CARDFILE COM : CARDFILE PRM : CARDFILE DAT
```

FIG. 4—A DATABASE PROGRAM, such as cardfile, and its files could similarly have its own tagged directory.

If you now go back to the "boot up" condition by typing user 0, you would see only the CP/M utilities, as shown in Fig. 2.

In Fig. 2, the computer has been "booted" so it "comes up" automatically in the the user 0 area and a DIR command produces the response NO FILE. In Fig. 3 the computer has "come up," we have first entered USER 2 and then DIR. Notice we have a directory listing of MBASIC and its files. In Fig. 4 we have entered user 5, then DIR, and we get only a directory of the Cardfile files.

There is normally no way a single DIR command will list files from other user areas unless special software has been provided, and this is not usually done except for the computers with hard-disk drives such the Kaypro 10. Kaypro provides a special directory program

that will list all files regardless of their user area. (There are available special utility programs that simplify getting directories and moving from user area to user area, but they are a subject for another time.) In fact, because hard-disk drives contain so many files it's often difficult to locate a desired file unless they are organized in homogeneous user area. In fact, a full directory listing for the software that comes bundled with the Kaypro 10 would take almost four full screens to display. That does not include any user-generated files. Using user areas simplifies loading programs—it's certainly a lot easier to locate and use the desired files from a user area than trying to dig them out from the "full directory."

While the user areas are often a decided convenience you must keep in mind that the user area on the default drive, the control drive determines the user area on all other drives. If you copy a program from drive A: to a disk on drive B:, or C:, or whatever, it will be copied to the same user area from which it came. Same thing if B: is the default drive. Often, the user will be in a user area, say user 4, and copy a program to a backup disk in drive B:. Sometime later, forgetting that a user area was used during the backup, the user calls for a DIR on the backup disk and the screen shows NO FILE, because DIR checks the 0 area of B: and the files have the user 4 tag.

In Part 2 of this series we'll show how to move programs between user areas. For now keep this point in mind: It is easy to move files from any user area into the one being used. It is difficult, often almost impossible for a non-programmer to move a file from the assigned user area into any other because the original CP/M made no provision to do it easily.

Utilities

Because CP/M is a "universal" program it is always specifically enhanced by the computer manufacturer for a particular computer. That is done through special utility programs that are supplied with CP/M, as well as by utilities supplied by Digital Research, the outfit that wrote CP/M. Some are invaluable for day to day work; others can cause the total destruction of the disk files if used by a non-programmer—they shouldn't even be on the average user's work disk because they were intended for computer scientists, technicians, and programmers. The TV technician using a personal computer for business, the dentist keeping patient records, the service shop using a spreadsheet program for financial projections, and the wheeler and dealer doing stock transactions from home have rare or no need for some of the supplied utilities; again, all they can do is damage the disk data or confuse the user.

The Digital Research utilities are: ASM, DDT, ED, LOAD, DUMP, STAT, EXSUB, SUBMIT, SYSGEN, and PIP. ASM is an assembler for those who write assembly programs; you probably don't need it so erase it from your working disk (not from the master or backup copy of CP/M). DDT is also for software experts and is used primarily to modify program code. Normally, it can also be erased from the working disk; but even if you haven't the vaguest idea of what DDT is all about, it is required one single time if you want to use user areas.

In Part 2 we'll give you a short seven-statement routine for DDT that you don't have to understand at all, but it will open up user areas to you—and then you can forget all about it.

ED is a rudimentary line-oriented editor that wasn't even good in "the good old days;" kill that one also. LOAD and DUMP are also for computer science types; you will probably never use them so kill them from the work disk. SUBMIT is a way to automatically link commands, as is XSUB. Many software houses supply their programs in SUBMIT or XSUB format under a different name. For beginners and application-oriented users it's best to avoid those programs until it's you who are the local CP/M expert.

SYSGEN is the program that is used to place the CP/ M system on other disks. Leave it on the work disk. STAT means "statistics." It will tell you almost anything you want to know about a disk or the programs stored on the disk, such how much free space is available on the disk; how much disk space a program takes up (or needs if you're making a copy); the devices connected to the computer; the condition (setup characteristics) of the devices. STAT is important, and you should hands-on experiment with it until you can use all its "bells and whistles."

PIP—an acronym for Peripheral Interchange Program—is the utility that moves files from place to place and it is the keystone of CP/M. Unfortunately, PIP works on two levels: very-easy-beginner and difficultto-understand mumbo-jumbo technese. (Technese is a language whose purpose is to insure that outsiders don't understand what's going on. For example, social workers speak technese, educators speak technese, etc.) In Part 2 of this series we will cover PIP strictly on the beginner level. Be prepared to follow along "hands on" because you'll be the local "CP/M applicationssoftware expert" when you're finished.

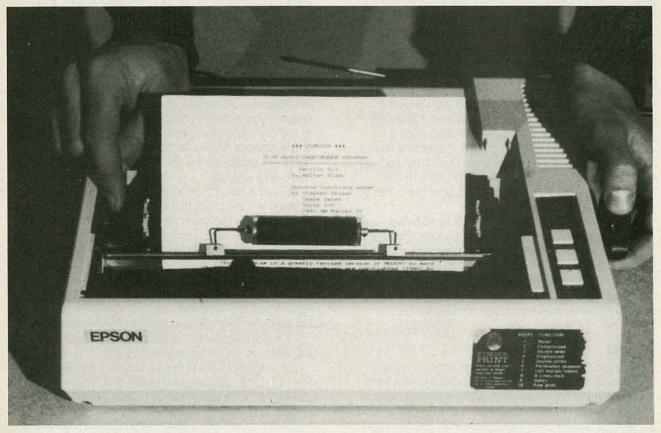
The manufacturer's utilities generally include some form of CONFIG (configure) utility, and either a FORMAT utility or a COPY utility that will either format a disk or copy one complete disk to another disk. That should be on the same work disk as SYSGEN. The command FORMAT (or FORMAT through the COPY program) places invisible magnetic "tracks" and other information on blank (new) diskettes so they can be used to store disk files. You cannot store information until a disk is formatted. If the disk isn't formatted there is no personal computer using any operating system that will know the disk exists. That is a point often forgotten, if ever known, by many "toy store" computer salespersons.

The CONFIG program is a means whereby the user can assign different technical attributes to various "ports"—the connections for a printers, modem, or whatever. It is generally not needed on the work disk since once CP/M is configured, meaning "set up" for particular hardware or software there is rarely any need to change things.

If the manufacturer provides other utilities they are generally intended for his particular computer, or specific software, and aren't really part of CP/M.

Next time, we'll PIP and STAT through several disks and user areas. Be prepared by having a few SYSGEN'ed disks available.

Upgrade Your Budget Printer



Many low-priced printers can be easily upgraded to give them new features and greater flexibility. Here's a look at some of the upgrade kits currently available for two of the most popular of those printers.

HERB FRIEDMAN

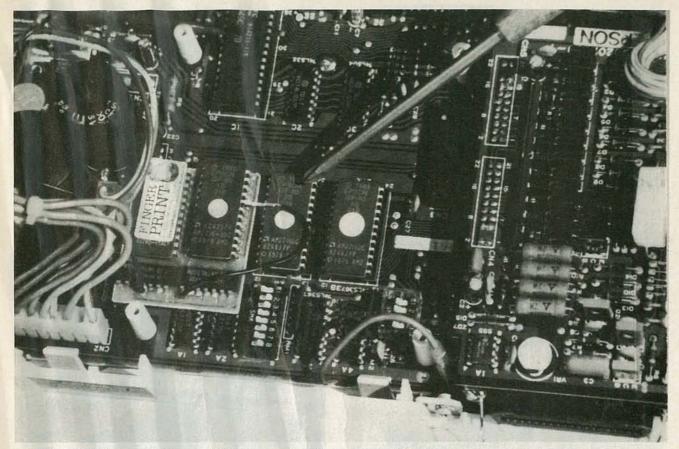
■If you have been into personal computing from its "hobbyist" days, or have built your system on a tight budget, it's odds-on that you have either an Epson MX-80 matrix printer or Smith-Corona TP-1 (or TP-2) daisy printer. Either, or both, have probably given you years of trouble-free service, but lately you find that more and more software can't be used with your printer, or you want to upgrade the computer but find your printer can't quite hack it as an up-to-date printer with the new computer hardware.

Essentially, what you have is still functional equipment that's been made obsolete by modern software, or by modern uses for a personal computer.

The Epson MX-80 printer, which could be used with any computer having a Centronics-compatible parallel printer output, was intended primarily for the Radio

Shack TRS-80 Model 1, the most popular computer of its day, hence the MX-80 featured a Radio Shack graphics mode. Much of the modern software, however, is written for the graphics mode of the newer MX-80 printers, which has the graphics capability for the present most popular 8-bit computers, the Apple II and IIe. Even if the software is for other than Apple computers the graphics will most likely be intended for the graphics capability of the most recent version of the MX-80.

The MX-80 (and its clones such as the Texas Instruments and IBM printers) accommodates only tractor-feed paper. If you want to print on single sheets, such as letterhead, the only way to do it is to use a special plastic tractor/pin feed "carrier," some of which are prone to damage the printhead when pushed



THE FINGERPRINT assembly snaps into ROM socket 1B, while the ROM that normally goes in that socket is installed on the Fingerprint assembly.



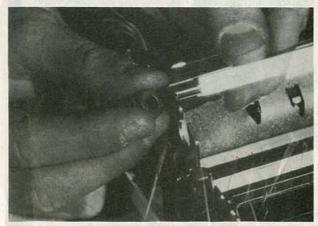
AN ADHESIVE MYLAR LABEL you affix to the front of the printer lists the new functions provided by the Fingerprint.

schedules, even business stationary—which includes letterheads and envelopes. To insure precise alignment of the printing, continuous forms must be tractor or pin fed.

So what we have is a popular tractor-feed matrix printer that needs at least new graphics capability and the ability to feed single sheets, and a daisy printer that needs a tractor feed in order to accommodate continuous forms. Let's see what we can do to satisfy those important needs.

Upgrading the printers

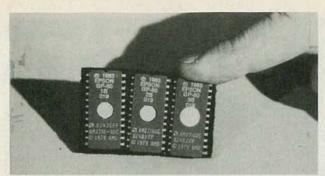
Regardless of why you purchased the MX-80 or TP-1



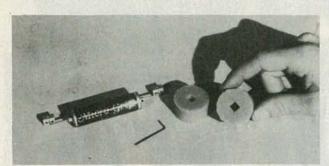
TO ADD the Micro-Grip single sheet feed to the MX-80 you simply remove the collar securing the drive bar on the left

in the first place, user-installed retrofit kits are available that will upgrade either printer to accommodate modern needs. While some of the retrofits are better or more convenient than others, we know those discussed here will really work exactly as promised because we actually tried them out.

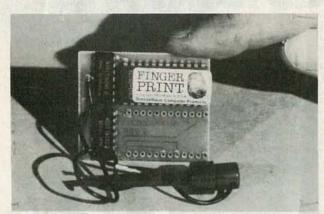
The first of the user-installed MX-80 retrofits was Epson's own Graftrax, which consisted of three ROM's, two of which plugged into empty sockets in the base of the printer while the third replaced an existing ROM. Among other things, the Graftrax upgrade provided for dot-addressable graphics, itallics printing, and even more important, backspacing. It was terrible



EPSON'S OWN Graftrax-Plus upgrade consists of three ROM's supplied on a strip of conductive foam



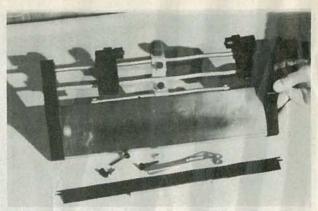
THE MICRO-GRIP single sheet upgrade kit. Its use does not interfere with tractor operation.



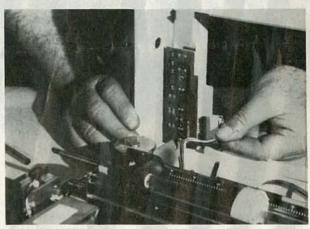
THE FINGERPRINT module plugs directly into an Epson ROM socket. The existing ROM is moved to the empty socket on the board.

through the printer mechanism. While the original MX-80 has a host of features such as compressed or enhanced printing it lacks a backspace, which precludes underscoring from some of the less expensive (but otherwise excellent) word processors that are available.

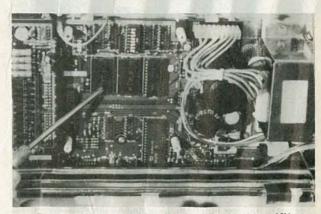
The "letter quality" Smith-Corona daisy printer TP family, which consists of the TP-1 and the newer TP-2, is the "buy of buys" when it comes to letter-quality printers for home-and-family and small businesses. The TP-1 was the first under-\$1000 daisy printer, which by early 1984 was selling for as little as \$250. Thousands upon thousands of personal computer users who could not otherwise possibly afford a letter quality daisy printer struck gold in the TP-1/TP-2—the price might very well be the reason you decided to get a letter quality printer even though you already had a matrix printer. (If a type 251 ribbon is used—which was not mentioned in the early documentation—the TP-1



THE PASSIVE TRACTOR FEED upgrade kit for the Smith-Corona printers. The main section is supplied as a complete assembly.



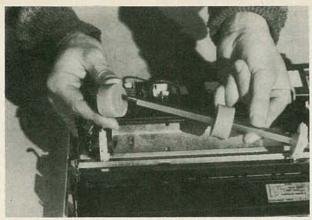
EPSON TELLS YOU to work on the printer with the cover attached, but don't do it-"pull the plug" instead.



THE THREE ROM sockets located in the base of the MX-80 printer. If you have an original MX-80 two of those are empty and one is filled.

can produce "camera ready" print quality the equal of machines costing well over \$1000 because it is essentially the printer end of a Smith-Corona electronic typewriter with an accessory interface for computer output.)

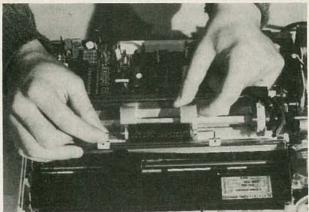
The problem with the TP-1 and the TP-2 is that they were intended for single-sheet documents such as business letters, etc., which is logical because it is really the printer mechanism from a typewriter. But today, much modern software is intended for continuous forms printing, such as checks, labels, IRS



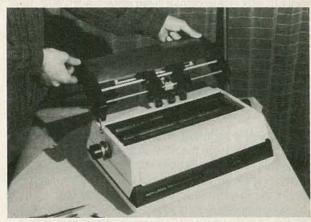
SLIDE THE ORIGINAL plastic paper guide roller from the driver bar and slide the two Micro-Grip rubber rollers on the bar. Then replace the collar.



separate the casing top because the leads to the fan are too short.



ATTACH THE PRESSURE roller assembly to the paper bail and the single sheet retrofit is finished.



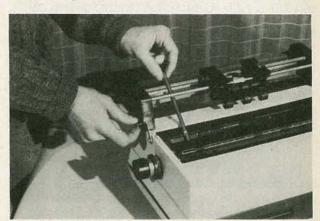
IT APPEARS TO BE permanently installed, but the tractor mechanism goes on and off in seconds.



A SINGLE SHEET being printed by the MX-80. Be certain the pin-feed mechanisms are against the sides of the paper it feeds straight.

backspacing because the printhead returned to the extreme left and then advanced for each backspace, but it was adequate for general word processing: underscore, kerning, etc. Unfortunately, a graphic printout would cycle the head continuously until the drive motor could be heard slowing to a crawl.

The latest retrofit available from Epson dealers is Graftrax-Plus, which gives your old model MX-80 the advanced features of the latest model. Among the Graftrax-Plus highlights are the Apple-compatible graphics (no more Radio Shack Model 1 graphics); a



SLIDE THE SUPPLIED GAUGE—actually a notched rod—on the drive bar, tighten two screws, and the tractor assembly is adjusted for use.

true backspace that puts graphic printouts in high gear and relieves the strain on the printer's printhead-drive motor; a "fine print" that can be used for superscripts and subscripts; automatic perforation skipover (no more program listings printing on the perforations); and a continuous underscore that can be turned on and off from within a program or word processor. (A continuous underscore is formed simultaneously with the character; the head does not backspace for the underscore.)

The Graftrax-Plus retrofit kit consists of three ROM's

and the latest Epson-with-Graftrax printer manual which explains all the "bells and whistles." The Graftrax-Plus retrofit has the same kind of installation as for the original Graftrax upgrade—just plug the ROM's into the correct sockets. One "caveat" however: The Epson instructions leave the top of the printer attached when you open the printer by separating the top and bottom; it has you delicately balancing the cover on its end. If you look closely you'll see the wires to the switches in the cover are attached through a connector. Mark the orientation of the connector with a pencil or pen and then separate the connector and put the cover in a safe place until you're finished.

Pushbutton control

As long as you have the printer open consider a retrofit called Fingerprint (Dresselhaus Computer Products, 837 E. Alosta Ave., Glendora, CA 91740), which allows the three printer control pushbuttons to also program ten operating modes: compressed print; double-wide; emphasized; double-strike; perforation skipover; left margin indent; 8 lines/inch spacing; itallics, and fine print. For example, just touch the printer's ON-LINE button twice and the printer shifts to compressed type without any commands from the computer.

Fingerprint is supplied on a small printed-circuit board that swaps for the ROM in a socket 1B, the one that's replaced in the Graftrax retrofit. Instead of substituting for the ROM in socket 1B, install the Graftrax ROM in the Fingerprint socket and then snap the Fingerprint assembly into socket 1B. You clip two attached Fingerprint leads where indicated and you now have both the Graftrax and the Fingerprint retrofits, and with virtually no extra effort required on your part.

Single sheets

If you quit now you'll have one heck of a matrix printer, but you can go one step farther and add a real single-sheet feed by installing a Micro-Grip Friction Feed (Bill Cole Enterprises, Box 609, Wollaston, MA 02170). The Micro-Grip retrofit does not interfere with the tractor operation, but it does permit single sheets to be fed directly through the printer without the need for a plastic carrier.

The Micro-Grip kit consists of three components: two rubber rollers that replace the existing Epson paper guide roller (which is sandwiched between the two tractor pin feed mechanisms), and a rubber-roller pressure assembly that clamps to printer's paper bail the bar that holds the paper down for printing.

To install the Micro-Grip retrofit it is necessary to very slightly dismantle the printer's feed mechanism so the rubber rollers can be fitted to the tractor-drive bar (instructions are provided in the kit). It is, however, a minor disassembly, and the whole installation shouldn't take more than 10 or 15 minutes. Just be certain you don't push or bend anything while you are doing the work—do everything very, very gently.

When you see the Micro-Grip installed you won't believe it will work, but it does. The only problem is the paper tends to skew, and the instructions on how to "fine tune" the paper feed really don't do much of anything. You'll spend more time fussing with the "fine tuning" than printing. Just ignore the "fine tuning" instructions. Instead, gently slide the tractor pin-feed devices against the sides of the paper and apply their locks, thereby locking them in position against each side of the paper. The pin feed assemblies will guide the paper so it rolls through nice and straight. The adjustment of the pin-feed mechanisms are "permanent" as long as you keep using single sheets. To use continuous form tractor paper you simply slide the two rubber rollers to the side and reset the tractors, or leave the rollers where they are and pull the paper bail (with its roller) away from the paper; the Epson will print on continuous tractor feed forms just as well without the bail.

Installing a tractor feed

The tractor feed upgrade for the Smith-Corona TP-1/TP-2 isn't really a retrofit because it does not really become a permanent part of the printer, it can be easily removed in seconds. The tractor feed mechanism, which is available from some (not all) Smith-Corona dealers and the Smith-Corona service centers is a "passive" tractor feed, meaning it's really a guide that insures precise registration even though the paper is really driven by the normal platten mechanism—just like a single sheet.

While installing the tractor feed upgrade can be a user-performed task, Smith-Corona does not provide the first three pages of the documentation with the kit; the pages that show how to do it yourself. Smith-Corona service centers will do the installation for \$10 if you deliver the printer to the center.

What's missing are these instructions. First, remove the casing top by loosening two screws at the top front and then prying the top out of the three clamps in the base, thereby separating the casing top from the base. The three clamps are across the rear of the base; you'll need to use a large screwdriver as a pry bar and you'll swear you're breaking the case but that's what it takes to release the three clamps at the back of the casing. Don't disconnect any wires even though they are short; just flip the cover up.

Use common sense and remove the combination dust cover and paper rest, and install the supplied black metal strip (which is called an "electronics cover") so it spans the two screws that originally held the paper rest's pivots—remove the rest with its pivots. Remove the hinge-screws that hold the paper rest to the casing top. Drive out the hinge pins into which the screws fit and gently drive in the new, supplied, hinge pins with a small soft-face hammer—or the back end of a screwdriver. That's it—reassemble the cabinet.

The supplied documentation shows how to install and adjust the tractor mechanism itself, all of a 10 minute job at the very worst. A special gauge is provided in the kit for alignment of the tractor mechanism. The whole project looks much more difficult than it is. Actually, separating the back of the casing top from the base will be the most difficult part of the upgrade.

With the tractor-mechanism upgrade the TP-1/TP-2 can accommodate either single sheets, tractor-fed sheets, or tractor-fed forms and labels. As with the Epson retrofits, you lose nothing; you only gain.

NO WRONG NUMBERS

continued from page 63

TABLE 1-JUN	MPER POSITION
Desired Code Number	Pin Number, IC2
2	4
3	7
4	10
5	1
6	5
7	6
8	Q

TABLE 2-R14 AND R17 SETTINGS

11

Desired	R14 Setting	R17 Setting
Code	(Read at TP2)	
Number	A CONTRACTOR OF THE PARTY OF TH	
1	697 Hz	1209 Hz
2	697 Hz	1336 Hz
3	697 Hz	1477 Hz
4	770 Hz	1209 Hz
5	770 Hz	1336 Hz
6	770 Hz	1477 Hz
7	852 Hz	1209 Hz
8	852 Hz	1336 Hz
9	852 Hz	1477 Hz

know about the project. In that case, tell them to call during a certain time and leave the project turned off. If they become curious and ask why a particular time, simply tell them that's the only time you'll be home.

You may also wish to have the project respond to some code number other than 7. In those cases switch jumper JU1 on the decoder board as shown in Table 1 and adjust R14 and R17 for the frequencies shown in Table 2.



HOBBY CORNER

continued from page 93

counter, how does it compare with the reading on the receiver dial? Not so good, huh? Let's see how far off it is. Tune to a station of known frequency (perhaps one of the WWV signals). Comparing the known frequency with the counter reading will show that the difference is the intermediate frequency of the receiver (probably that 455 kHz, again).

Now, repeat the comparison with the receiver tuned to various stations on the different bands. Aha!...On some bands the counter shows a reading of 455 kHz above the station frequency and on others it's below. Make a note of which bands are above and which are below. Now you're in business, Don. Just add or subtract the IF from the counter reading and you will have an accurate digital readout of the tuned station's frequency. If the adding and subtracting is too much trouble, you can try your "gimmick" capacitor on the output of the RF amplifier. Use only a very light coupling. It's almost certain that you'll need one or two broad-band amplifier stages to boost the signal enough for the counter.

Those of you who do not have a counter may wish to refer to one of the ARRL publications for construction details of digital frequency readouts (see above for the ARRL address). It's not a simple piece of equipment to build. In fact, you may prefer to buy a counter and hook it up according to the above instructions. R-E

COMPUTER CORNER

continued from page 95

ence.

Once you discover whether or not you like it or whether it can be useful to you. you can make your decision as to what to do next. Most people really take to computers once they realize that they are not so mysterious. Very often they find that those low-cost machines just don't have the power or versatility for their needs, but that's really OK. Your next purchase can be one of the larger and more powerful machines.

On the other hand, if you find that you really don't take to personal computers or that you can get along without them. that's fine! Since you didn't pay very much for the machine, you can put it on the back shelf with little or no guilt. Or you may want to give it away to one of your kids, a relative, or a friend to get them started in computing. In any case, now is the time to act. R-E

CABLE TV

Buy Direct & Save

ER SPECIALS





40 CHANNEL CONVERTER \$2995

Advanced Solid State design and circuitry allows you to receive mid & super band channels. Restores programming to Video Recorders.



36 CHANNEL REMOTE CONTROL CABLE CONVERTER \$6995

JERROLD 400 THE ULTIMATE CABLE TV CONVERTER



60 CHANNEL INFRARED REMOTE CONTROL \$12995

Send \$5 for Complete Catalog

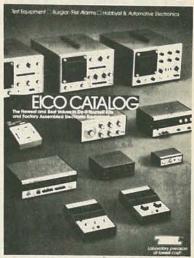
DIRECT V SALES

P.O. BOX 1329 JEFFERSONVILLE, INDIANA 47130

> CALL 1-812-282-4766

CIRCLE 53 ON FREE INFORMATION CARD

The world of electronics ee-wizardı



32-pages of test instruments - from the latest digital multimeters to the famous EICO scopes. Security systems. Automotive and hobbyist products. Kits and assembled. EICO quality. EICO value. For FREE catalog, check reader service card or send 50¢ for first class mail.



108 New South Road Hicksville, N.Y. 11801

Versatile Lab Power Supply



• 0-30 VDC at 0-2A • Excellent Regulation Ripple & Noise - 500 uV • Built-in Short-Circuit and Overload Protection

Model 3002A features continuously adjustable current limiting and precision constant voltage/constant current operation with "automatic crossover." This lab-grade unit can also be used as a current regulated power source.

Optional 10-turn voltage & current controls: \$25 each. Add \$3.00 for UPS shipping in Continental U.S. Check, Money Order or C.O.D. accepted. Illinois residents add 6%

ELECTRO INDUSTRIES, INC. 4201 W. IRVING PK., CHICAGO, IL 60641 312/736-0999

CIRCLE 44 ON FREE INFORMATION CARD

RECEIVING ANTENNA

Gives excellent reception, 50 KHz to 30 MHz.

New MFJ-1024 Active Receiving Antenna mounts outdoors away from electrical noise for maximum signal.

Gives excellent reception of 50 KHz to 30 MHz signals. Equivalent to wire hundreds of feet long. Use any SWL, MW, BCB, VLF or Ham receiver.

High dynamic range RF amplifier. 54 in. whip. 50 foot coax. 20 dB attenuator prevents receiver overload. Switch between two receivers. Select auxiliary or active antenna. Gain control. "ON" LED. Remote unit, 3x2x4 in. Control, 6x2x5 in. 12 VDC or 110 VAC with

optional adapter, MFJ-1312, \$9.95.

Order from MFJ and try it. If not delighted, return within 30 days for refund (less shipping). One year unconditional guarantee.

Order today. Call TOLL FREE 800-647-1800. Charge VISA, MC. Or mail check, money order. Write for free catalog. Over 100 products.

CALL TOLL FREE ... 800-647-1800

Call 601-323-5869 in Miss., outside continental USA, tech/order/repair info. TELEX 53-4590.

ENTERPRISES, INCORPORATED

Box 494, Mississippi State, MS 39762

NEW BOOKS

For more details use the free information card inside the back cover

THE HHC USER GUIDE, by Jonathon Sachs, Soft River Software, with Rick Meyer; Osborne/McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710; 192 pages, including appendicies, glossary, and index; 61/2 × 91/4 inches; softcover; \$14.95.

The HHC is a portable computer manufactured by Panasonic, Quasar, and Olympia. It is distributed by Quasar Corporation and Olympia Corporation. An HHC from any of those companies can work equally well with peripherals, software, and capsules distributed by any of the other companies. (At the time this book went to press, the authors had no data on the availability of Olympia's specific peripherals and software, because Olmypia is the newest distributor of the HHC.)

This guide presents easy-to-use operating instructions for the HHC multipurpose system. There is a complete description of HHC peripherals, including thermal printers, programmable memory extenders, and video adapters. It discusses many of the HHCpackaged application programs, such as electronic mail, financial forecasting, time management, and sales-order entry. It also covers the HHC programming languages: MBASIC, SnapBASIC, and SnapForth, the high-level language of the HHC's operating

CIRCLE 121 ON FREE INFORMATION CARD

THE BEGINNER'S BOOK OF ELEC-TRONIC MUSIC, by Delton T. Horn; TAB Books, Inc., Blue Ridge Summit, PA 17214; 376 pages, including appendicies, glossary, bibliography, and index; 5 \times 8% inches; softcover; \$12.95.

This book tells how one can create one's own synthesized live or recorded sound using home-built circuitry or commercially available equipment. There is also an extensive listing of available electronic music recordings and a complete buyer's guide to commercial synthesizing equipment (modular, normalized, pre-set and computerized).

Sound and acoustic principles are thoroughly reviewed and there's a detailed look at sound sources for electronic music-oscillators, noise generators, and recorded sounds. The reader is told how new sounds can be created by additive or subtractive synthesis. and the fundamentals of using filters, amplifiers, modulation, controllers, and other devices to manipulate musical sounds. There's also practical advice on setting up one's own electronic-music studio.

CIRCLE 122 ON FREE INFORMATION CARD

ELECTRONICS PROTOTYPE CONSTRUC-TION, by Stephen D. Kasten; Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, IN 46268; 398 pages, including appendicies and index; 5-3/8 × 7-1/4 inches; softcover; \$17.95.

This book is concerned with construction techniques for converting schematics and

ideas into functional electronics prototype units. It is divided into four major parts:

Wire-wrapping, deals with methods, boards, hardware, power supplies, and tools.

Printed-circuit boards: covers doublesided PC boards, camera-ready artwork, photo-resist techniques, etching, electroplating, soldering, drilling, assembly, cleaning, and protective coatings.

Graphic Techniques: tells about photofabrication, photographic principles, photo masks, darkroom equipment, screen printing, transparencies, 35mm photography, and 35mm photographic reduction.

Hardware packing: explains enclosures, parts layout, wiring, front panels, fabrication tools, machining holes, and cabinet finishing. CIRCLE 123 ON FREE INFORMATION CARD

MAKING INFORMATION SYSTEMS WORK FOR YOU, by Trevor J. Bentley; Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; 178 pages, including index; 6 × 9 inches; softcover; \$8.95.

Trevor J. Bentley is one of the foremost authorities on management-information systems today. As an accountant in years past, he often provided information that managers didn't know how to use. Later, as a manager, he often received unneeded information.

This book presents a formula for defining management's information needs. There is very little technical language, and the technical aspects that are important were supplied by Irvine H. Forkner. The two authors together provide inside tips to help the reader better understand the use and value of information systems, plus practical advice on making the whole process run more smoothly. From the preliminary cost of owning and operating a system to information analysis and documentation, this book covers what the reader will need to know in order to get the best results

from an information system.
CIRCLE 124 ON FREE INFORMATION CARD

COMMODORE 64 COMPUTING, by Ian Sinclair; Prentice-Hall, Inc., Englewood Cliffs, NJ 07632; 133 pages, including appendix and index; 6 × 9 inches; softcover, \$12.95 (also available in hardcover, \$19.95).

This book provides a clear, plain-English guide to BASIC programming on the Commodore 64. From connecting your machine to your TV receiver to program design using color graphics and sound, the all-important information necessary for a working knowledge of what the Commodore 64 can do is provided. There is also step-by-step instruction on how to convert programs written for the Commodore PET and how to use the CP/M option.

The book is illustrated with examples that show how to do sprite graphics, color commands, and programming for sound.

CIRCLE 125 ON FREE INFORMATION CARD

Soft.ware

New for our readers....A mail order source of software from Apple

Home Business		
	Recommended List Price	You Pay
Bank Street Writer (Broderbund) (Disk)	\$69.95	\$49.95
dBase II (Ashton-Tate) (Disk)	700.00	400.00
Home Accountant (Continental	74.95	49.95
Software) (Disk) Tax Advantage (Continental Software)	59.95	39.95
(Disk) Wordstar w free CP M card (Micropro	612.00	385.00
Inti) (Disk) PFS: File IIE + II + (Software	125.00	85.00
Publishing) (Disk) PFS: Graph IIE + II+ (Software	125.00	85.00
Publishing) (Disk) PFS: Report IIE + II + (Software	125.00	85.00
Publishing) (Disk)		
Visicalc IIE (Visicorp) (Disk)	250.00	179.95
Education		
Mastering the SAT (CBS Software)	150.00	110.00
(Disk) Success: Addition Subtraction (CBS)	24.95	19.95
Software) (Disk) Success: Multiplication Division (CBS)	24.95	19.95
Software) (Disk)		770000
Spellicopter (Designware) (Disk)	39.95 39.95	29.95
Algebra I (Eduware) (Disk) Rocky's Boots (The Learning	39.95 49.95	29.95 39.95
Company) (Disk)	49.95	39.95
Juggle's Rainbow (The Learning Company) (Disk)	29.95	24.95
Master Type (Lighting Software) (Disk)	39.95	29.95
Master Type (Scarborough Systems) (Disk)	39.95	29.95
Alphabet Zoo (Spinnaker Software) (Disk)	29.95	24.95
(Disk) Kindercomp (Spinnaker Software)	29.95	24 95
Story Machine (Spinnaker Software) (Disk)	34.95	25.95
The Graphics Magician (Penguin	59.95	42.50
Software) (Disk) Sat Word Attack (Eduware) (Disk)	49.00	35.00
Entertainment		
Choplifter (Broderbund) (Disk)	34.95	25.95
Lode Runner (Broderbund) (Disk)	34.95	25.95
Zaxxon (Datasoft) (Disk)	39.95	29.95
Zork I (Infocom) (Disk)	39.95	29.95
Zork II (Infocom) (Disk)	39.95	29.95
(Disk) Prisoner 2 (Interactive Fantasies)	32.95	25.95
The Mask Of The Sun (Ultrasoft) (Disk)	39.95	29.95
Miner 20-49er (Microlab) (Disk)	39.95	29.95
Wizardry: Proving Grounds (Sir-Tech Software) (Disk)	49.95	39.95
Wizardry: Knight of Diamonds (Sir- Tech Software) (Disk)	34.95	27.95
Flight Simulator II (Sublogic Corporation) (Disk)	33.50	25.95
Temple of Apshai (Epyx, Inc.) (Disk)	39.95	29.95
Rendezvous (Eduware) (Disk)	39.95	29,95
4		

Radio-Electronics Software Store 200 Park Avenue South New York, NY 10003

Number ordered	
Total Price	8
Sales Tax (NY State Resident	ts only)
Shipping and Handling (\$2.00 per item)	
TO	TAL ENCLOSED \$
Name	
Address	
Co. Co.	-

SORRY - NO CREDIT CARD OR COD ORDERS

CONNECTOR CATALOG is 16 pages designed to help customers meet EMI/RFI requirements, including FCC Docket 20780. Catalog FCC-1 provides product descriptions, performance characteristics, electrical data, contact arrangements, mounting and terminations, assembly data, and tips on how to select and order the proper connector and "black box" to meet your particular EMI/RFI requirements.

Products are grouped by type in this catalog, which features more than 45 black-andwhite photographs of the D subminiature shielded D series, D subminiature transverse monolith filter connector, and extruded and die-cast shielded black boxes. Those products have applications in computers and computer peripherals, electronic games, telecommunications, medical electronics, and business machines, where signals generated are typically in the 10-kHz to 1000-MHz range. Free upon request.-ITT Cannon, 10550 Talbert Ave., Box 8040, Fountain Valley, CA 92708

CIRCLE 131 ON FREE INFORMATION CARD

ELECTRONIC PARTS CATALOG is 48 pages, illustrated partly color, and covers a full range of electronics parts and supplies. Included among the products listed are such things as AC adaptors, battery chargers, capacitors, DC adaptors, earphones, fuses, heat sinks, joysticks, meters, microphones, PC boards, power supplies, relays, semiconductors, LED displays, speakers, switches, telephone accessories, terminal strips, video accessories, wire, and many others. Free upon request.-All Electronics Corp., PO Box 20406, 905 S. Vermont Ave., Los Angeles, CA 90006

CIRCLE 132 ON FREE INFORMATION CARD

SWITCH/DISPLAY MODULE CATALOG is 12 pages and covers a line of decade Multicount switches combined with display modules. On-board decoders, memory, and other circuitry in TTL or CMOS logic make these switches suitable for applications such as counting and timing measurements, generation of selectable clock signal, and position control. Free upon request.-Interswitch, 700 Airport Boulevard, Burlingame, CA 94010

CIRCLE 133 ON FREE INFORMATION CARD

"CONNECT IT" CATALOG is 8 pages in full color, describing Vaco's new solderless-connection program. The program includes new terminal packaging and displays, plus new terminal merchandising and sales aids, including a display poster, salesman's sample case, and catalog.

Other new products introduced in this catalog are ratchet crimping tools, 3-way vaconnectors, and a new coax stripper. The catalog is free upon request.-Vaco Products Company, 1510 Skokie Blvd., Northbrook, IL 60062 R-E

CIRCLE 134 ON FREE INFORMATION CARD

Tuners, amplifiers. effects. keyboards, studio equi drum computers easy to assemble kits, books & more

name	
address	

FAIA Electronics. Inc

_ state ____ zip

Dept. 5R , 1020 W. Wilshire Blvd. Oklahoma City, OK 73116 800-654-8657 9AM-5PM CST M-F

CIRCLE 52 ON FREE INFORMATION CARD

EARN BILL MONEY

REPAIR GAMES & COMPUTERS

ATARI 2600, 2600A ATARI 400, 800 COMPUTERS COLECOVISION . INTELLIVISION

EXCLUSIVE! All popular game and computer parts now available from a single source!

EWC is the exclusive national distributor of the Electronic Institute's repair courses and Kurz-Kasch Signature Analyzers and Test Fixtures, and the largest distributor of test instruments and supplies for digital servicing.

Over 28 years of proven quality, affordable prices, last service, and guaranteed satisfaction at EWC, your one-stop electronic parts supplier.

COMPARE OUR LOW PRICES AND TRY US FOR YOUR EVERY-DAY REQUIREMENTS.

GENERAL ELECTRIC UBES

10 pc. minimum may be assorted O OFF THORDARSON #VMT-08 TRIPLERS

Replaces GE-528. ECG-523. SK-3306. First line. boxed premium quality.

Q95 each only

Call toll-free on our 24 hour order hotline and ask for your copy of our new 92 page catalog.

LIST

ELECTRONICS WAREHOUSE CORP. 1910 Coney Island Avenue Brooklyn, N.Y. 11230 • (212) 375-2700 CALL TOLL FREE: (800) 221-0424

CIRCLE 9 ON FREE INFORMATION CARD

VISA*

CONTROL COMPUTER

continued from page 74

about 15mA in the low state and about 10mA in the high state. The output capacity can be increased by using IC4, an opencollector Darlington array. The generous sink capacity of this device makes it handy for controlling relays. A snubber diode is included in the package, which is important if you will be switching any type of inductive load. Without it, the inductive kickback would cause intermittent problems when running a program (or it could destroy the computer outright).

Digital I/O-8-bit port

The next type of I/O consists of 8 parallel bits-often referred to as a byte-wide I/O port. The byte-wide port is a natural extension of the microprocessor data bus and, as such, it is the most convenient method of transferring data to or from peripheral devices, such as printers, voice synthesizers, or BCD thumbwheel switches.

Unfortunately, that's all we have room for this time. Among other things, we'll look at the byte-wide port in more depth in the next, and final, installment of this article.

NEW IDEAS

continued from page 38

of the IC3. They are paralleled to provide enough current to drive IC4, an MOC3031 optically-coupled triac driver. When the triac is turned on, current will flow through the triac and the lamp or appliance that is connected to its terminals, turning it on, too.

The touchplate can be made from a one-inch square piece of copper-clad board with a 4-inch piece of wire soldered to it. It should be connected to capacitor C2, as shown. Once you have it all together, the next step is to make sure that it works. To do so, close switch S1 (labeled CAL) and connect a lamp to the load terminals. Now, apply power and adjust potentiometer R5 down from its maximum resistance until the lamp comes on. Bring your hand near the touchplate to insure that the lamp extinguishes. If everything is OK, open S1; the lamp should alternately switch on or off when the touchplate "switch" is activated.

For safer and more stable operation, a low-voltage supply can be used (with R10 adjusted accordingly). However, it will be difficult to mount the switch behind a wall plate if you do that.

The MOC3031 triac driver was selected because of its low drive-current requirements. The less expensive MOC3010 can be used instead of the MOC3031 if zerovoltage switching is not desired. In that case, resistor R11 must be changed to 180 ohms. Switch S1 and resistor R9 are an optional aid and are used in setting up the threshold for operation.—Stephen Du-

NEW IDEAS

This column is devoted to new ideas, circuits, device applications, construction techniques, helpful hints, etc.

All published entries, upon publication, will earn \$25. In addition, for U.S. residents only, Panavise will donate their model 333-The Rapid Assembly Circuit Board Holder, having a retail price of \$39.95. It features an eightposition rotating adjustment, indexing at 45degree increments, and six positive lock positions in the vertical plane, giving you a full teninch height adjustment for comfortable work-



I agree to the above terms, and grant Radio-Electronics Magazine the right to publish my idea and to subsequently republish my idea in collections or compilations of reprints of similar articles. I declare that the attached idea is my own original material and that its publication does not violate any other copyright. I also declare that this material has not been previously published.

Title of Idea

Signature

Print Name

Date

Zip

Street

City

State Mail your idea along with this coupon to: New Ideas Radio-Electronics, 200 Park Ave. South, New York, NY 10003

A First in the industry, with over thirty years of use by satisfied customers.

Spray Pack Mark II gets into places of close tolerance and washes out the dirt. leaving a thin film of lubricant which lasts indefinitely, with zero effect upon current capacity and resistance

Spray Pack Mark II has been tested and proven in the Space Age and is still the finest lubri-cleaner available. It is quick, safe, effective - a MUST for every tool

Spray Pack Mark II is the best-priced lubri-cleaner.

Available at Leading Distributors

SPRAY-PAC

CAUTION:

NET WT. & O



CIRCLE 89 ON FREE INFORMATION CARD



DESCRAMBLER **PARTS**

We stock the exact parts and PC Board for Radio Electronic's February Article on building your own Cable TV Descrambler

#701 PARTS PACKAGE . \$29.95 Includes all resistors, capacitors, diodes, transistors, integrated circuits, coils and IF transformers (BKAN-K5552AXX)

#702 PC BOARD \$16.95
Etched and drilled silk-screened PC Board as shown

BOTH #701 & #702 \$39.00 Add \$2.50 Postage & Handling





Orders only 1-617-339-6714

JaW

P.O. Box 52 Cumberland, RI 02864

CIRCLE 4 ON FREE INFORMATION CARD

MARKET CENTER

FOR SALE

CABLE TV SECRETS—the outlaw publication the cable companies tried to ban. HBO, Movie Channel, Showtime, descramblers, converters, etc. Suppliers list included. Send \$8.95 to CABLE FACTS, Box 711-R, Pataskala, OH 43062

RESISTORS 1/4&1/2W5%C.F. 3 cents, 1%M.F. All values. No minimums. Volume discounts. Write JR INDUSTRIES, 5834-B Swancreek, Toledo, OH

SCANNER/monitor accessories—kits and factory assembled. Free catalog. CAPRI ELECTRONICS, Route 1R, Canon, GA 30520.

ALARM! VIC 20/64 CoCo Sinclair become \$1000.00 burglar fire system. Cassette, documentation (specify microprocessor) \$29.00. Catalog \$2.00 refundable. SKIDMORE'S H'N'S, PO Box 5097, Greensboro, NC 27403. Auto dialer with tele-phone book program \$49.00 Commodore, Sinclair.

DESCRAMBLERS for downconverters, high gain. Send \$1.00. RB ELECTRONICS, PO Box 643, Kalamazoo, MI 49005

PICTURE flyer lists quality electronics surplus at low prices. Since 1970. Send for the last 3 issues. STAR-TRONICS, Box 683, McMinnville, OR 97128.

THE Intelligence Library—Restricted technical information & books on electronic surveillance, surveillance-device schematics, lock-picking, investigation, weapons, identification documents, covert sciences, etc. The best selection available. Free brochures. MENTOR, (Dept. Z), 135-53 No. Blvd., Flushing, NY 11354.

MILITARY communications radios: CPRC-26 Canadian field radio, compact size, transceives 42-54 nadian field radio, compact size, transceives 42-54 MHz FM, 6 channels, with battery box, antenna, one crystal: \$19.50, 2\\$37.50 good condition. PRC-510 backpack radio (Canadian version of U.S. PRC-10), transceives 38-54 MHz FM continuous tuning, with headset, antenna, battery box: \$39.50, 2\\$77.50. ARC-27 aircraft guard receiver, 220-250 MHz AM single channel: \$12.50 mint. R-108 receiver, 20-28 MHz FM: \$27.50 mint. 45-day replacement guarantee. Schematics included. Add \$5/unit shipping. BAYTRONICS, Dept. RE, Box 591, Sandusky, OH 44870.

CABLE TV equipment, notch filters for "beeping" channels. Information \$1.00. GOLDCOAST, PO Box 63/6025 RE, Margate, FL 33063.



OVER 1200 electronics parts, kits, and computer products. Lowest prices. Send \$1.00 (redeemable) for catalog. Stamp brings flyer. DAYTAPRO ELECTRONICS, 3029 N. Wilshire, Arlington Hts., IL

ELECTRONIC surveillance! Incredible manual. "Homebrew Bugging" reveals secret techniques used by professionals (schematics included)—\$15.00. Send \$3.00 for catalog. A.T.I.S., Dept. R, 61 Gatchell St., Buffalo, NY 14212.



New ITEMS . . . New BARGAINS! **UPON REQUEST!**

Send today for FREE Copy of NEW CATALOG WS-84! • Address: Dept. RE

FAIR RADIO SALES



Causes speed radar guns and devices to read out your choice of either a percentage of your true speed when in automatic mode (example: Your speed; 76 mph, auto mode set for 75%; speed displayed — 57 mph), or the speed that you dial in when in manual mode. Transmits only in the presence of speed radar, or by manual override. Operates on both X and K bands. WARNING: The device described in this literature is not legal for use against police radar, and is not FCC approved.

For complete literature and plan package, send \$14,95 to: Phillips Instrument Design Co. Inc. 9560 S.W. Barbur Blvd., Suite #109 S. Portland, Oregon 97219

To run your own classified ad, put one word on each of the lines below and send this form along with your check for \$2.15 per word (minimum 15 words) to: Radio-Electronics, 200 Park Avenue South, N.Y., N.Y. 10003

ORDER FORM

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of \$20.00. Plans/Kits () Business Opportunities Education/Instruction () Wanted (() For Sale () Satellite Television

Special Category: \$20.00

PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19 .	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

PLEASE INCLUDE FOR OUR FILES YOUR PERMANENT ADDRESS AND PHONE NUMBER.

CLASSIFIED COMMERCIAL RATE for firms or individuals offering comercial products or services). \$2.15 per word prepaid (no charge for zip code)...MINIMUM 15 WORDS. 5% discount for 6 issues, 10% for 12 issues within one year, if prepaid.

NON-COMMERCIAL RATE (for individuals who want to buy or sell a personal item) \$1.50 per word prepaid...no minimum.

ONLY FIRST WORD AND NAME set in bold caps. Additional bold face (not available as all caps) at 20¢, per word. All copy subject to publisher's approval. ADVERTISEMENTS USING P.O. BOX ADDRESS WILL NOT BE ACCEPTED UNTIL ADVERTISER SUPPLIES PUBLISHER WITH PERMANENT ADDRESS AND PHONE NUMBER. Copy to be in our hands on the 20th of the third month preceding the date of the issue (i.e., August issue closes May 20th). When normal closing date falls on Saturday, Sunday, or a holiday, issue closes on preceding working day.

FORTY-nine educational electronics kits with self-learning project manual. Details \$2.00 refundable with order. TRIANGLE ELECTRONICS, 89 Arkay Drive, Hauppauge, NY 11788.

RF parts/Motorola transistors. MRF454 \$16.50, MRF455 \$13.50. Catalog available. RF PARTS CO., 1320 Grand, San Marcos, CA 92069. (619) 744-

UP to \$500.00 per month. Sell computer software in your home. Write to: COMPUTER SERVICES, PO Box 7748, Tucson, AZ 85725.

CABLE-TV products Jerrold, Hamlin, and Oak converters. Send \$3.00 for information. ADDITIONAL OUTLET CORP., 111 E. Commercial Blvd., Ft. Lauderdale, FL 33334.

RECONDITIONED test equipment. \$1.00 for catalog. JAMES WALTER TEST EQUIPMENT, 2697 Nickel, San Pablo, CA 94806.

7,000,000 tubes, 6000 different types. World's largest inventory. Free catalog. UNITY ELECTRONICS, Dept R, PO Box 213, Elizabeth, NJ 07206

POLICE code unscramblers, other scanner accessories, telephone recording device, DNE, Inc., Rt. 7, Box 257, Hot Springs, AR 71901 (501)



1001 BARGAINS IN SPEAKERS

Tel.: 1 (816) 842 5092



WEN MULTI-CHANNEL

Complete Antenna Systems from \$6995

Full 800 Mhz Range Tune 1.9-2.7 Ghz Includes all **ITFS Channels**

DEALERS WANTED

COD's and Credit Card Orders call TOLL FREE

1-800-247-1151



6009 N. 61 Avenue Glendale, AZ 85301 1-602-247-1151



NEW!... repair any TV... easy. Anyone can do it. Write, RESEARCH, RR No. 3, Box 601BR, Colville,

EXACT same PCB and Toko coil set (no. 4) for descrambler in February article only \$15.00 shipping \$2.00. JIM RHODES, 1025 Ransome Lane, Kingsport, TN 37660.

CONVERTERS all types for all systems, lowest prices anywhere, quantity discounts, dealer inquiries accepted. Send \$1.00 for catalog. PG VIDEO CORP., PO Box 296, Latham, NY 12110 (518)

CAMP base station CB antennas for back woods. Ground plane antenna for portable use \$14.95 plus \$2.50 shipping and handling. NIMROD ELECTRONICS, PO Box 20421, Reno, NV 89515-0421.

9-CODE telephone scrambler, several new unscramblers for scanners, telephone and scanner accessories, tone encoders/decoders. All factory built. Free catalog. **KRYSTAL KITS**, PO Box 445, Bentonville, AR 72712 (501) 273-5340.

CABLE—satellite—microwave—UHF—video accessories. SASE 40 cents. H.M.S., 2011 w.11th St., Upland, CA 91786.

COMPUTERS, clones, drives, monitors, expansions, software. Bargain prices—directory of manufacturers in Taiwan, Hong Kong \$4.00. MULTITEK, Box 25, Allentown, PA 18105.

RARE parts and surplus electronics bargains. RF, linear, digital computers, robotics. Free catalog. ODD BALL ELECTRONICS, PO Box 879R, Duncanville, TX 75116.

PRINTED-circuit artwork, design/layout quality, prompt. Send schematic. SOMMER CIRCUIT DE-SIGN, 1227 Kimber, Wooster, OH 44691. Visa/Mas-

VCR protective cover clear vinyl 1876 x 15½ x 5 beautifully made \$11.95. WINDOW MOODS, 8228 Scotts Level Road, Baltimore, MD 21208.

ELECTRONICS business on sale because of illness. Parts and components of special electronic mosquito repeller, imported from Germany and assembled here, are for sale at a bargain price. Also for sale is a Blister packaging machine as well as assembling tools. Write **PO BOX 4197**, St. Augustine, FL 32085 or call (904) 797-5585 or (904) 797-3336.

INVENTORY reduction sale. Save\$\$. Expl: 5%1/4or1/2W resistor kit 20ea. indv.pkg 80 values \$25.00. Pots, trimmers, caps, transistors, etc. Send SASE. BUD'L'FIXIT TV, 3072 Sunset Ct., Norco, CA 91760.

CONNECTORS—audio, co-axial, aviation, computer, industrial and many other types. Send \$2.00 for complete price list and ordering information. Largest inventory in country. CONNECTOR TECHNOLOGY INC., 5A Veronica Ave., Somerset, NJ

1023 Merivale Road Ottawa, Ontario K1Z 6A6 (613) 728-7900

H4P 1N1 M5B 1K5 (514) 731-7441

(416) 977-7692 Calgary 3220-5th Ave. N.E. Bay 2 Calgary, Alberta T2A 5N1

(403) 235-5300

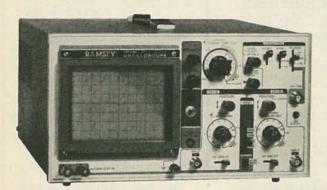
M3J 1Y8 (416) 630-0400

Vancouver 3070 Kingsway Vancouver, B.C. V5R 5J7

(604) 438-3321

Visit your nearest Active store, call, write or circle the Reader Service Card for your copy of Active's new catalog.

THE FIRST NAME IN ELECTRONIC TEST GEAR



NEW FROM RAMSEY-20 MHz DUAL TRACE OSCILLOSCOPE

Unsurpassed quality at an unbeatable price, the Ramsey oscilloscope compares to others costing hundreds more. Features include a component testing circuit that will allow you to easily test resistors, capacitors, digital circuits and diodes . TV video sync filter . wide bandwidth & high sensitivity • internal graticule • high quality rectangular CRT • front panel trace rotator • Z axis • high sensitivity x-y mode • very low power consumption • regulated power supply • built-in calibrator

rock solid triggering
 high quality hook-on probes

5 high quality hook-on probes included



RAMSEY D-1100 **VOM-MULTITESTER**

Compact and reliable, designed to service a wide variety of equipment. Features include • mirror back scale • double-jeweled precision moving coil • double overload protection • an ideal low cost unit for the beginner or as a spare back-up unit.

\$1995

test leads and battery included



RAMSEY D-2100 DIGITAL MULTITESTER

A compact easy to use unit designed to operate like a pro.
Featuring • 3½ digit LCD • low
BAT. indicator • all range overload protection • overrange indication • auto-polarity • Transistor tester . dual-slope integration . vinyl carrying case

\$5495

h_{FE} test leads, battery & vinyl carrying case included



RAMSEY D-3100 DIGITAL MULTIMETER

Reliable, accurate digital measurements at an amazingly low cost • In-line color coded push buttons, speeds range selection • abs plastic till stand • recessed input less • overload contection jacks • overload protection on all ranges • 3½ digit LCD display with auto zero, auto polarity & low BAT. indicator

\$5995

test leads and battery included



CT-70 7 DIGIT **525 MHz COUNTER**

Lab quality at a breakthrough price. Features • 3 frequency ranges each with pre amp • dual selectable gate times • gate activity indicator • 50mV @ 150 MHz typical sensitivity

 wide frequency range • 1 ppm accuracy

\$11995

wired includes AC adapter



CT-90 9 DIGIT **600 MHz COUNTER**

The most versatile for less than \$300. Features 3 selectable gate times • 9
digits • gate indicator • display hold
• 25mV @ 150 MHz typical sensitivity
• 10 MHz timebase for WWV calibration • 1 ppm accuracy

\$14995

8	CT-90 kit	\$129.95
	OV-1 0.1 PPM oven timebase	59.95
	BP-4 nicad pack	8.95



CT-125 9 DIGIT 1.2 GHz COUNTER

A 9 digit counter that will outperform units costing hundreds more. • gate indicator • 24mV @ 150 MHz typical sensitivity • 9 digit display • 1 ppm accuracy • display hold • dual inputs with preamps.

\$16995

wired includes AC adapter



CT-50 8 DIGIT **600 MHz COUNTER**

A versatile lab bench counter with optional receive frequency adapter, which turns the CT-50 into a digital readout for most any receiver • 25 mV @ 150 MHz typical sensitivity • 8 digit display • 1 ppm accuracy

\$16995



DM-700 DIGITAL MULTIMETER

Professional quality at a hobbyist price. Features include 26 different ranges and 5 functions • 3 % digit, ½ inch LED display • automatic decimal placement • automatic polarity

\$11995

wired includes AC adapter



PS-2 AUDIO MULTIPLIER

The PS-2 is handy for high resolution audio resolution measurements, multiplies UP in frequency • great for PL tone measurements • multiplies by 10 or 100 • 0.01Hz resolution & built-in signal preamp/conditioner

\$4995

PS-2 kit



PR-2 COUNTER PREAMP

The PR-2 is ideal for measuring weak signals from 10 to 1,000 MHz • flat 25 db gain • BNC connectors • great for sniffing RF • ideal receiver/TV preamp

\$4495

wired includes AC adapter

PR-2 kit \$34.95



PS-1B 600 MHz PRESCALER

Extends the range of your present counter to 600 MHz • 2 stage preamp • divide by 10 circuitry • sensitivity 25mV @ 150 MHz • BNC connectors drives any counter

\$**59**95

TERMS: . satisfaction guaranteed . examine for 10 days; if not pleased, return in

wired includes AC adapter

PS-1B kit \$49.95

ACCESSORIES FOR RAMSEY COUNTERS

Telescopic whip antenna—BNC plug ... \$ 8.95 High impedance probe, light loading . . . 16.95 Low pass probe, audio use 16.95



\$39.95

PHONE ORDERS CALL 716-586-3950

original form for return • and 6° for shipping and insurance to a maximum at \$10.00 • overseas add 15° for surface mail • COD add \$2.50 [COD in USA only] • orders under \$15.00 add \$1.50 • NY residents add 7° sales tax • 90 day parts warranty on all kits . 1 year parts & labor warranty on all wired units



RAMSEY ELECTRONICS, INC. 2575 Baird Rd. Penfield, N.Y. 14626

SHUGART SA1002 8" hard disk drives new— \$269.00 each. S100, IBM, Heath, SS-50, TRS-80I, Apple II interfaces available. Controller, \$331.00. **DIGITAL SEARCH** (803) 877-9444.

SCANNERS, lowest prices. We take trade-ins! Catalog. GUILDERLAND COMMUNICATIONS, 7570 Glencrest Ave., Liverpool, NY 13088.

CATALOG. Free giant color catalog. Audio, video, telephone, power supplies, switches, meters, cables, connectors, alarms, radar, parts, etc. Over 1200 items. Volume discounts, Write today! INTER-NATIONAL TECHNOLOGY, Box 302, Odessa, FL

INTERNATIONAL power converter. Run 115v 60Hz computer, TV on 230v 50Hz. 25 watts and up. Write for details. AL TEMPS ENT., 720 Smithtown Ave., Bohemia, NY 11716.

AUTOMOTIVE security catalog. 1984 24-page color catalog, \$2.00. ASE, PO Box 382, Plainview, NY 11803.

CIRCUIT boards: Your artwork, quick delivery, reasonable, quality. ATLAS CIRCUITS, Dept. A, Box 892, Lincolnton, NC 28092 (704) 735-3943

TIMEX/Sinclair software. Cassette \$9.50. Send SASE for details to SCOTT BENSON, Box 1013, Reseda, CA 91335.

HIGH quality electronics kits and products. Send \$1.00 for colorful catalog and one free flasher LED. INTERNATIONAL POLYTECHNICS, PO Box 862C, New York, NY 10002.

FREE pay-TV reception. "How-to" book. HBO, Showtime, Cinemax. \$4.95. **DIPTRONICS**, PO Box 80A, Lake Hiawatha, NJ 07034.

PROFESSIONAL quality, Phillips head, stainless steel, nuts and bolts. Discount prices. Send stamp for list and sample. TEP, PO Box 295, Purdy's, NY

PLANS & KITS

PRINTED-circuit boards. Quick prototypes, production, design, reflow solder send print or description for quote to KIT CIRCUITS, Box 235, Clawson, MI 48017.

CABLE-TV converters and equipment. Plans and parts. Build or buy. For information send \$2.00. C & D ELECTRONICS, PO Box 21, Jenison, MI

HI-FI speaker kits, auto speaker systems, and raw drivers from the world's finest manufacturers. For beginners or experts. Free literature. A&S SPEAK-ERS, Box 7462R, Denver, CO 80207 (303) 399-8609

PROJECTION TV... Convert your TV to project 7-foot picture... Results comparable to \$2,500.00 projectors... Total cost less than \$30.00... Plans & 8" lens \$19.95... Illustrated information free... MAC-ROCOMA-GI, Washington Crossing, PA 18977. Creditcard orders 24 hours. (215) 736-3979.

MOST advanced sine converter descrambler available. PCB and plans \$15.00. JIM RHODES, 1025 Ransome Ln., Kingsport, TN 37660.

FLEAS? Rid your house of bugs/rodents ultra-sonically. Plans \$2.95. KIDD, 4925 Seawolf, Santa

NEW!... repair any TV... easy. Anyone can do it. Write RESEARCH, RR No. 3, Box 601BR, Colville,

KIT Catalog

FUNCTION GENERATOR KIT \$59.95

Auto-Ranging Cap-meter kit \$79.95 TEST & EXPERI-Phone 209-772-2076 MENTER'S FOUIP

Write or Phone for FREE CATALOG

DAGE SCIENTIFIC INSTRUMENTS BOX 144 VALLEY SPRINGS CA 95252

REPAIRS of all converters and cable boxes with prompt service. Deluxe sinewave kits \$95.00. 90% complete also available (quantity discounts) UHF converters of all types available. Send SASE (54 cents postage) for information. I-(312) 637-4408. HIGGINS ELECTRONICS, 6014 W. Nelson, Chicago. IL 60641.

ELECTRONIC touch light control pad. Write for free brochure. EXOTIC IDEAS, PO Box 446, Lake Bluff,

ENJOY satellite television. Save money with easy. guaranteed, do-it-yourself antenna plans/kits. Electronics knowledge not necessary. Send \$1.00 for catalog. GFI-22, Box 9108, Missoula, MT 59807.

BUSINESS OPPORTUNITIES

WHOLESALE MATV/CATV/VCR equipment, antennas, audio cables, adapters, original/replacement cartridges & styli, telephone accessories radios, cassette recorders, speakers, etc., send letterhead for free catalog (212) 897-0509 D&WR, 68-12 110th St., Flushing, NY 11375.

MECHANICALLY inclined individuals desiring ownership of small electronics manufacturing business—without investment. Write: BUSINESSES, 92-R, Brighton 11th, Brooklyn, NY 11235.

VIDEO game repair business. Start your own. Information/parts list \$5.00. BEST ELECTRONICS, 4440 Sheena, Phoenix, AZ 85032.

PROJECTION TV... Make \$\$\$'s assembling projectors... Easy... Results comparable to \$2,500.00 projectors... Your total cost less than \$20.00... Plans, 8" lens, & dealers information \$17.50... Illustrated information free... MACROCOMA-GIX, Washington Crossing, PA 18977. Creditcard orders 24 hours. (215) 736-2880.

RIG PROFITS

ELECTRONIC ASSEMBLY BUSINESS

Start home, spare time, investment knowledge or experience unnecessary, BIG DEMAND assembling electronic devices. Sales handled by professionals. Unusual business opportunity

FREE: Complete illustrated literature BARTA, RE-O Box 248 Walnut Creek, Calif. 94597

TECHNICAL writers make big money... writing short sentences! Free details: TEK PUBS, Box 2458-E, Oroville, CA 95965.

48K computer US\$380.00 and hundreds Applecompatible softwares. Details US\$1.00. RELIANT, PO Box 33610, Sheungwan, Hongkong.

SECURITY alarm industry booming. Get in now. Tremendous demand. Employment—business terrific. Information package \$2.00. (redeemable) SECURITY ELECTRONICS INTERNATIONAL, PO Box 1456-SE Grand Rapids, MI 49501

THE BEST PLACE to BUY, SELL of TRADE NEW and USED EQUIPMENT

NUTS & VOLTS MAGAZINE BOX 1111-E • PLACENTIA, CA 92670

(714) 632-7721 Join Thousands of Readers Nationwide

Every Month
ONE YEAR U.S. SUBSCRIPTIONS
\$7.00 - 3rd Class • \$12.50 - 1st Class \$25.00 - Lifetime - 3rd Class NUTS & VOLTS

SATELLITE TELEVISION

HOW to build a satellite-TV receiver, LNA, down-converter! Save hundreds! Satisfaction guaranteed! Free information! Send stamped enve-lope: XANDI, Box 25647, Dept. 21Y, Tempe, AZ

SATELLITE systems—quick assembly high quality antennas, LNA's, receivers, lowest prices anywhere. Catalog \$2.00. STATE SATELLITE, 5 Broadway, Troy, NY 12180 (518) 272-1130.

HOME satellite handbook and buyer's guide, tells everything about TVRO and may save you hundreds even thousands in your selection and installation of a system. \$10.00 H&G HOMESAT, Box 422, Seaford, NY 11783.

GEARMOTORS for motorized satellite antenna projects. 110VAC, 101RPM, reversible, straight, or right angle. \$32.50 plus \$4.00 shipping. TEM, 22518 97th, Corcoran, MN 55374 (612) 498-8014.

SATELLITE TV VIEWERS

Get the most complete weekly listings. Send \$1 for sample copy.



P.O. Box 308, Fortuna, California 95540 800-358-9997 (U.S.) • 800-556-8787 (Calif.) 707-725-2476 (all others)

SATELLITE locator and parabolic antenna design for Timex 1000. Send \$10.00 moneyorder to STEVE HOLL, RR No. 2, Gibsons, BC Canada V0N1V0.

DESCRAMBLERS

AMERICAN—CANADIAN

C-1000 / ZENITH TYPE

Descrambles ''over the air'' and ''cable'' sync suppressed active "cable" sync suppre video inversion signals

Ready to go C-1000. Complete Kit C-1000K Printed Circuit & Manual

C-100 / JERROLD TYPE

Cable Descrambler for in-band gated suppressed systems

Ready to go C-100 Complete Kit C-100K

SEND \$2 FOR COMPLETE INFORMATIVE CATALOG TO DETERMINE WHAT TYPE YOU NEED

FALL SPECIAL Buy 1 kit Get 2nd kit

at 1/2 price

J & D ENGINEERING P 0 Box 6099 Falmouth, Maine 04105

Dealers Wanted Special Quantity Pricing COD's—OK

All J & D products are engineered, not copied, all are guaranteed 90 days & we stand behind our products where others fail to

UHF CABLE TV UNITS

THE "Raider", new pulsewave kit. Completely deluxe, audio and video to TV. No internal TV connections. Completely aligned, requires only a soldering iron for assembly, comes with everything you need. (Replaces old speaker box type.) \$169.95. Also Zenith UHF, "Super Z" kit in stock at \$179.95. Put a sting in those faraway UHF stations with our 25dB preamp kit, the "Scorpion" \$22.95. Large quantities of cable units, N-12's, SB, notch filters. Dealers give us a call on quantity pricing. Add 3% shipping. Maryland residents 5% state tax. Information, COD's and dealer pricing call (301) 882-9362 or 9375. Send \$2.00 for complete catalog to SATELLITE ELECTRONICS Corp., PO 9534, Baltimore, MD

EDUCATION & INSTRUCTION

EARN your university degree through evaluation assessment, of existing education, experience, achievements. Call, (614) 863-1791, or write, AS-SESSMENT, Box 13130R, Columbus, OH 43213.

FCC general radiotelephone license. Home study. Fast, inexpensive! Free details. COMMAND, D-91, Box 2223, San Francisco, CA 94126.

ATTENTION ELECTRONIC TECHNICIANS



Highly Effective Home Study BSEE Degree Pro-gram for Experienced Electronic Technicians Our New Advanced Placement Program grants Credit for previous Schooling & Professional Ex-perience. Advance Rapidlyl Our 36th Yearl FREE DESCRIPTIVE LITERATURE!

Cook's Institute of Electronics Engineering DESK 15, P.O. BOX 20345, JACKSON, MS 39209

BE A COMPUTER PROGRAMMER
Train at home in spare time! Computer programming...computer applications...computer games!
No previous experience needed! Now you can
learn it all! Learn how to use different programs...budgeting, bookkeeping, expenses, investments, interest, taxes, shopping lists,
vacation planning, addresses, phone numbers...even foreign languages and graphics.
Everything explained in easy-to-understand
language with step-by-step directions.

**PUTTER TRAINING BORD EPE44 SCRAINING P. 48515

ICS COMPUTER TRAINING, Dept. DE#44 Scranton, PA 18515

BUY BONDS

64K D RAM (4164-200nS) 9 pcs for \$5000 16K D RAM (4116-200nS) 8 pcs for \$1295

REPEAT OF SELL-OUT 58 Key Unencoded Keyboard



Unencoded **Key Pad**





\$8995 Holds 4 EPROM's

CORCOM FILTER Popular CORCOM



SWITCHER SPECIAL

by ASTEC

Originally	designed	for	the	Apple	Ш
+5 @ 4.	0A			nlu	

+5 (a: 4.0A	
-5 @ .25A	
+12 @ 2.5A	
-12 @ .30A	

only \$4995

MISC. HI-TECH

MM5740AA	9.95	3341FIFO	\$4.75		
AY5 2376	13.75	2513-001UC	9.50		
AY5 3600	13.75	2513-002LC	9.50		
UPD7201	29.95	7107CPL	11.50		
ULN2003	2.25				
WE STOCK 74HC & 74C CMOS					

DAIC

PAL10H8	\$3.75	PAL14L4	\$3.95
PAL12H6	3.95	PAL16L8	9.95
PAL14H4	3.95	PAL16R8	7.75
PAL10L8	3.95	PAL16R6	7.75
PAL12L6	3.95	PAL16R4	7.75

FU	NCII	JN GE	Ν.
MC4024	\$3.75	LM566	\$1.95
ROBE	3.75	XR2206	3.75

AY5-1013A	\$3.95	2350	\$9.75
	TOTAL		39.75
AY5-1014A	6.75	8250	12.50
AY5-1015	6.75	IM6402	7.75
TR1602A	3.75	IM6403	8.75

BAUD RATE GEN. MC14411 \$11.50 BR1941 10.50 34702 12.75 COM5016 \$15.95 COM8116 11.95 MM5307 11.95

5	DUNL	CHIPS		1
76477	\$3.50	MC3340	\$1.95	Z
76488	5.90	SC-01/Votrax	39.95	14
76489	8.50	DT1050		16
AY38910	8.95	Digitalker	34.95	18
AY38912	12.50	MM54104	14.95	20

STEPPER MOTOR

and then reversing and then reversing polarity (or square wave). Uses 12VDC, Clock Wise Rotation, Rated 3 RPM at 4 P.P.S. with a 5 degree

ACP Price \$395 10 for \$34.95

RS232 SIGNAL TESTER



COEX RS232 LINE TESTER (7) LED Indicator

Only \$2495 Other Styles Also Available

CONNECTORS



400-0	DB25P (RS232)	\$2.95
ER	DB25S Female	3.25
LIL	Hood	1.49
lar	Set with Hood, Sale	6.95
MO	25:50 S/T, Apple	3.95
	25/50 W/W, Apple	4.95
er	31/62 S/T, IBM	4.95
A95	31/62 W/W, IBM	5.95
4	50/100 W/W, S-100 Connector	4.95
\$3.50	50/100 S/T, S-100 Connector	3.95

CHI	CON	IROLLE	:H5
6845	\$14.75	8275	\$34.95
68B45	17.50	7220	89.50
6847	11.50	COM5027	17.95
HD46505SP	15.75	COM5037	22.00
MC1372	6.75	8350	39.95
TMS9918	39.95	6545	21.50

DATA ACQUISITION				ON	
	DAC01	\$5.95	ADC0800	\$15.25	
	DAC08	7.50	ADC0804	3.95	
	DAC100	7.50	ADC0809	4.95	
	DAC0800	4.95	ADC0817	9.95	
	DAC0808	2.95	MC3470	4.95	

-1		01/ 01	UDDOD	-
	F9708	4.95	DAC86EX	8.95
	DAC1022	5.95	1408L8	2.95
	DAC1020	8.95	1408L6	1.50
۱	DAC0808	2.95	MC3470	4.95
4	DAC0800	4.95	ADC0817	9.95
	DAC100	7.50	ADC0809	4.95
	DAC08	7.50	ADC0804	3.95
	DACOI	40.00	MUCOULO	910,60

	DISK SI	UPPOR	T
1691	\$16.95	2791	\$49.50
1771	16.00	2793	49.50
1791	22.95	2795	55.50
1793	25.95	2797	55.50
1795	27.95	6843	31.50
1797	44.50	8272	36.00
2143	18.95	LIPOTESA	36.00

	000000			
		INTER	RFACE	
	75188	\$1.19	8T95	\$.85
	75189	1.19	8T96	85
	8T26	1.75	8T97	.85
	8T28	1.85	8T98	.85
i	8T31	2.75	75150	1.50

	CLOCK	CHIP	3
637	3.75		
636	3.75	75154	1.50
T31	2.75	75150	1.50
T28	1.85	8T98	.85

MM5369	\$3.50	MM58174	\$10.95
MM58167	11.95	MSM5832	3.95
C	SCILL	ATORS	3
1.000	\$10.95	8.000	\$10.95
1.8432	10.95	10.000	10.95
2.000	10.95	12.000	10.95
4.000	10.95	16.000	10.95
5 000	10.05	10 422	10.05

١	ZERO	INSER	RT SOC	KETS
	6.144	10.95	22,1184	10.95
ı	5.000 5.0688 6.000 6.144	10.95	20.000	10.95
l	5.0688	10.95	19.6608	10.95
ı	5.000	10.95	18.432	10.95

	The state of	11 000	
14PIN21F	\$5.75	24PIN21F	\$7.95
16PIN21F	5.95	28PIN21F	9.50
18PIN21F	7.75	40PIN21F	10.75
20PIN21F	7.95	64PIN21F	19.95



78M06 78M.G. LM108AH LM300H LM301CN LM304H LM305H

LM308CN

LM338K LM339N LM340K-XX* LM340T-XX* LM340H-XX* LM344H LM348N LM350K LM358CN

LM358CN LM360N LM372N LM376N LM377N LM380CN/N LM381N LM383T

M387N

NE531V/1 NE555V NE556N NE561T NE565N/H NE566H/V NE5667V/H

NE592N LM702H LM709N/H LM710N/H LM711N/H LM715N LM723N/H

LM733N H LM739N LM741CN H LM741CN-1 LM747N H LM748N H LM760CN LM1310N MC1330 MC1350 MC1358

M733N/H

LINEAR

74500

74S140 74S151 74S153 74S157 74S158 74S160 74S174 74S175 74S188 74S194 74S195 74S196 74S241 74S242

2.69 1.89 1.89 1.89 2.75 2.75 2.99 2.99

LM1414N LM1458CN/N MC1488N MC1489N LM1496M LM1556N LM1820N LM1820N LM1889N LM2111N LM2900N

\$2.99 1.35 1.35 1.29 75 2.79 2.99 2.55 3.10 3.10 2.75 7.95 7.95 7.95 5.75 8.95 8.95 2.90

745287

74S288 74S373 74S374 74S387 74S471 74S472 74S473 74S475 74S570 74S571 74S572 74S573 74S940 74S941

LILEZON LA LICENSIN L

Call Call 24 .19 .19 24 29 49 Call Call .19 35 29 1.19

	7.50	8035	8.95	Z-80A
12	20.95	8039	11.95	Z-80B
6	18.50	8080	3.50	Z8001
i i	13.50	8085	4.75	Z8002
E	12.95	8085A-2	11.00	F-8/3850
ODE:	27.95	8085	29.95	2650 -
Ú.	11.50	8087	199.00	1802
09	27.95	8088	29.95	8008-1
	4.75	8089	84.95	2901
:A	6.50	8741	34.95	2901A
B	9.75	8748	39.95	Z8671
	WES	STOCK I	N DEP	TH
(ALL FO	R VOLU	JME PF	RICING

EPROMS						
702	\$4.25	2732	\$4.75	2764-250	\$7.75	
708	3.85	2732-250	8.25	2764-200	16.50	
758	4.95	2732-200	9.95	68764	39.95	
716	3.85	2732A4	6.75	68765	41.95	
716-1	5.75	2732A	9.75	27128	27.95	
MS2716	7.50	2732A2	13.00	5203AO	14.50	
MS2516	5.25	2764	6.75	5204Q	13.50	
MS2532	5.75					

STATIC RAMS						
2101	\$2.75	2147	\$4.75	5516	\$11.95	
2102-1	.99	2016-200	4.95	6116-4	4.95	
2102L-4	1.29	2016-150	5.95	6116-2	8.75	
2102L-2	1.49	2016-100	6.95	6116LP-	4 5.90	
2111	2.75	4044-4	3.95	6116LP2	10.95	
2112	2.89	4044-2	6,50	Z6132	32.50	
2114	1.49	4118	9.50	HM6264	47.50	
2114L-2	1.89	5514	3.50	6167	9.95	

MK4027	\$1.85	4116-200	\$1.49
UPD410	8.95	4164-200	5.95
UPD411	4.95	4164-150	6.75
MM5280	2.95	MC6605	8.50
MM5290	1.49	TMS4164-15	8.50
MM5298	1.49	41256	79.95

8000 SUPPORT					
55	\$9.95	8238	\$4.75	8271	\$74.95
56	9.95	8243	5.50	8272	37.50
02	23.50	8250	10.50	8275	34.95
03	36.50	8251	5.95	8279	8.95
05	3.25	8251A	9.95	8279-5	9.95
12	1.95	8253	6.50	8282	7.95

	65	00 SI	JPPC	RT		
8237-5	21,50	8259-5	37.50			
8237	18.50	8259	7.25	8289	48.50	
8228	3.35	8257-5	9,95	8288	24.95	
8226	2.75	8257	7.25	8287	7.95	
8224	2.20	8255A	9.95	8286	7.95	
8216	1.95	8255	5.95	8284	7.95	
8214	4,50	8253-5	9.95	8283	7.95	
8212	1.95	8253	6,50	8282	7.95	
8205	3.25	8251A	9.95	8279-5	9.95	
8203	36.50	8251	5.95	8279	8.95	
8202	23.50	8250	10.50	8275	34.95	
8156	9.95	8243	5.50	8272	37.50	

6520 6522	\$4.25 6.75	6532 6532A	\$9.75 11.75	6545A 6551	\$26.50
6522A	8.50	6545	21.50	6551A	12.95
	68	00 S	UPPC	RT	
6810	\$2.75	68B40	\$17.95	68B50	\$5.75
68B10	6.75	6843	31.50	6852	5.50
6820	4.25	6844	25.00	6860	7.75
6821	3.75	6845	14.75	6875	6.25
68B21	6.75	68B45	17.50	6880	2.50
6828	12.50	6847	11.75	68047	22.95
6640	12.50	COED	2 50	60400	10.50

	18000	0000	0.00	00,100	100
-	Z-	-80 SL	IPPO	PRT	
ZEOCTC	\$3.95	ZBODART	\$10.75	Z80ASIO/1	\$12.50
ZBOACTC	4.75	ZBOADART	10.95	Z60SIO 2	11.50
ZEOBCTC	9.75	ZBOBDART	18.95	Z80ASIO 2	12.50
ZBOPIO	3.95	Z80SIO:0	11.50	Z80BSIO 2	36.00
Z80APIO	4.75	ZBOASIO O	12.50	Zeosio 9	11.50

SOCKETS

	W PRO	
1-24	24-49	50-100

	1740	54.40	20-10
8 pin LP	.16	.15	.1
14 pin LP	20	.19	- 1
16 pin LP	.22	.21	2
18 pin LP	.29	.28	2
20 pin LP	.34	32	3
22 pin LP	.29	.27	2
24 pin LP	.38	.37	.3
28 pin LP	.45	.44	4
40 pin LP	.60	.59	.5

3L WIREWRAP SOCKETS (GOLD)

0001101	, (,	11111111	
	1-24	25-49	50-100	
8 pin WW	.55	.54	49	
10 pin WW (Tin)	.65	.63	.58	
14 pin WW	.75	.73	67	
16 pin WW	.80	.77	.70	
18 pin WW	.95	90	81	
20 pin WW	1.15	1.08	.99	
22 pin WW	1.45	1.35	1.23	
24 nin WW	1 35	1 26	1 14	

DIP **SWITCHES**

74S113 74S114



MUFFIN® FAN



cost, largest selling fan for commercial cooling applications.

· 105cfm free air deli

SPECIAL PURCHASE

CDVCTALC +

		X Un		IAL			
32.768KHz	\$1.95	2.4576	\$2.95	5.7143	\$2.95	14.318MHz	\$2.95
1.000MHz	3.75	3.2768ZMHz	2.95	6.000MHz	2.95	15.000MHz	2.95
1.842MHz	3.75	3.5795MHz	1.95	6.144MHz	2.95	16.000MHz	2.95
2.000MHz	2.95	4.000MHz	2.95	6.5536MHz	2.95	18.000MHz	2.95
2.010MHz	2.95	5.000MHz	2.95	8.000MHz	2.95	18.432MHz	2.95
2.097152MHz	2.95	5.0688MHz	2.95	10.000MHz	2.95	32.000MHz	2.95

800-854-8230 910-595-1565

Mail Order: P.O. Box 17329 Irvine, CA 92713 Retail: 1310B E. Edinger, Santa Ana, CA 92705 (714) 558-8813

542 W. Trimble, San Jose, CA 95131 (408) 946-7010

74LS00	s	26	74LS113	\$ 39	74LS245 74LS247	\$2.9
74LS01		25	74LS114	.39	74LS247	1.1
74LS02		25	74LS122	.49	74LS248	1.1
74LS03	1	25	74LS123	1.19	74LS248 74LS249	13
					74LS251 74LS253	1.4
74LS05		25	74LS124 74LS125	.69	74LS253	1.4
74LS08		25	74LS126	.49	74LS257	. 8
74LS09		25	74LS132	.59	74LS257 74LS258 74LS259 74LS260	9
74LS10		.25	74LS136	49	74LS259	29
74LS11		39	74LS138	59	74LS260	6
74LS12		33	74LS139	59	74LS260 74LS261 74LS266 74LS273	24
74LS13		39	74LS145	1.25	74LS266	7/ 6
741 514		50	741 \$148	1.40	741 5273	1.7
741.515		33	741 5151	90	741 5275	44
741 520		26	741 5153	90	741 5270	-
741 521		20	741 5154	1.70	741 5202	5
741 522		20	74L0104	1.10	74LS273 74LS275 74LS275 74LS279 74LS283 74LS290 74LS293	- 5
TALCOE		20	741 5150	1.19	741.5230	
741 600		200	741.0150	1.49	74LS295 74LS298	1.0
741.020		-64	7410100	1.49	7413290	141
74LS30		25	74LS160	1.49	74LS324	1.7
74LS32		33	74LS161	1.49	74LS347	1,9
74LS33		55	74LS162	1.49	74LS298 74LS324 74LS347 74LS348 74LS352	1.9
74LS37		35	74LS163	1.49	74LS352	1,1
74LS38		.39	74LS164	1.49	74LS352 74LS353 74LS363 74LS365 74LS366 74LS367	1,1
74LS40		25	74LS165	1.49	74LS363	1.4
74LS42		.59	74LS166	2.48	74LS365	9
74LS47		79	74LS168	1.15	74LS366	.9
74LS48		.79	74LS169	1.15	74LS367	,9
74LS51		25	74LS170	1.99	74LS368 74LS373 74LS374 74LS375	.9
74LS54		29	74LS173	.89	74LS373	2.9
74LS55		.29	74LS174	.89	74LS374	2.9
74LS55		39	74LS175	.89	74LS375	.6
74LS74			74LS181	2.20	74LS377	1.9
74LS75		39	74LS190	1.15	74LS385	1.9
74LS76 74LS78		.39	74LS191	1.15	74LS377 74LS385 74LS386 74LS390	.6
74LS78		.45	74LS192	.98	74LS390	1.9
741.583		59	74LS193	98	74LS390 74LS393 74LS395	1.9
74LS85		69	74LS194	1.15	741 5395	1.7
74LS86		39	74LS195	95	741 5399	2.3
74LS90		57	741 5196	80	74LS399 74LS424	2.9
741 592		49	741 5197	89	74L S668	1.7
741 593		59	74I S221	115	74LS668 74LS670	2.2
741 505		70	741 9240	1.00	81LS95	1.6
741 506		90	74LS240 74LS242	1.00	011.508	
741 5107		99	741 5242	1.00	011.090	1.6
74L C100		30	741.0243	1.00	B11 CO0	1.6
741.0110		20	251 52521	2.05	81LS96 81LS97 81LS98 25LS2569	1.0
/4LS112		39	2DLS2521	2.95	25LS2569	4.5

89 .95 .65 .65 .65 1.45 1.90

74141 74142 74143 74144 74145 74147 74147 74151 74151 74153 74154 74156 74156 74157 74158 74158 74159 74160 2.95 4.50 2.95 5.99 1.69 1.09 4.9 6.7 4.9 1.19 7.8 4.9 1.65 2.49

74LS00

CMOS

000	\$ 29	4037	\$1.95	4089	\$2.95
001	.24	4040	.75	4093	.45
2000	.24	4041	75	4094	2.95
006	.79	4042	.65	4098	2.29
007	.25	4043	.85	4099	1.85
800	.95	4044	.69	14408	12.95
009	.39	4046	.80	14409	12.95
010	.39	4047	89	14410	12.95
011	.24	4048	.99	14412	12.95
012	.24	4049	.35	14415	8.95
013	.35	4050	34	14419	4.95
014	.75	4051	75	4501	39
015	.39	4052	.75	4502	.95
016	35	4053	.75	4503	.62
017	.65	4055	3.95	4505	8.95
018	79	4056	2.95	4506	.75
019	39	4059	9.25	4507	.95
020	.69	4060	85	4508	1.25
1021	.69	4066	39	4510	79
1022	.69	4069	28	4511	.79
1023	.25	4070	.35	4512	.79
1024	.59	4071	28	4514	1.18
1025	.25	4072	28	4515	1.79
1027	.45	4073	.28	4516	1.45
1028	.65	4075	28	4518	.85
1029	.75	4076	75	4520	75
1030	.45	4077	35	4555	.95
1031	3.25	4078	35	4556	.99
1032	2.15	4081	29	4566	2.25
1034	1.91	4082	29	80C95	1.50
1005	70	4005	me:	80007	1 05

TERMS: MO. Cashier's Check. Bank Wee, Personal allow 2 weeks for processing, include Drivers Like credit card with Seas. AMEX. CRI and 3% service and 3% subjecting 4 handling or \$2.50, whichever is great 10% for long-orders or U.S Prace Post. Include 7 number, NO CODs. Prices subject to change without Some items subject to price said. We reserve the substitute manufacturer. Retail prices may vary.

UNIVERSITY degrees by mail! Bachelors, Masters, Ph.Ds... Free revealing details. COUNSELING, Box 317-RE5, Tustin, CA 92680.

T/S1000 2K educational programs: Math, geometry, words. 8 listings, \$4.00. YORK, 1609 Summit St., Springfield, OH 45503.

TRAIN FOR A **GREAT CAREER IN ELECTRONICS**

LEARN AT HOME IN SPARE TIME... The fast-growing Electronics field offers excellent career opportunities...
even at the entry level. A knowledge of BASIC ELECTRONICS can help you get your foot in the door, qualify for good jobs like Inspector, Electronic Sales,
Junior Technician/Tester and more. Easy-to-

follow home-study course starts you at the very beginning... explains everything step by step with plenty of photos, charts, diagrams. Multimeter, parts kits, calculator, digital VOM included. Hands-on training lets you learn by doing. Get FREE FACTS. No salesman will call. MAIL COUPON TODAY!

BASIC ELECTRONICS COURSE DEØ 44 Dent. 00000 Scranton, PA 18515 City/State/Zip

CB EQUIPMENT

CB radio books, kits, modifications, catalog \$1.00 refundable, APS, POB 263RE, Newport, RI 02840.

PALOMAR/Pride electronics— exclusive repair facility. Service—update—improvements on these and similar equipment. PALOMAR-PRIDE RE-PAIR, 1320 Grand, San Marcos, CA 92069 (619) 744-0720

Increase channels, range, privacy! We specialize in frequency expanders, speech processors, FM converters, PLL & slider tricks, how-to books, plans, kits, Expert mail-in repairs & conversions 16-page catalog \$2.

CBC INTERNATIONAL, P.O. BOX 31500RE, PHOENIX, AZ 85046 (602) 996-8700

SPEECH SYNTHESIZER

SPEECH synthesizer— for Commodore-64 or VIC-20. Uses General Instruments SP0256-AL2 speech chip . Unlimited vocabulary— easy to build and use. Complete plans \$5.00 postpaid/SP0256-AL2 speech chip with data \$20.00. PC board (kit) \$12.00/chips—crystal, plans—board (partial kit) \$40.00. Add \$2.50 postage. Check or M.O./JAF ENTERPRISES, Box 12952, Rochester, NY 14612.

WANTED

WANTED: Old Western Electric & RCA tubes, speakers, amps, McIntosh, Marantz, tube amps, old Thorens, JBL, Altec, Garrard. (713) 728-4343. MAURY CORB, 11122 Atwell, Houston. TX 77096.

INVENTIONS, ideas, new products wanted for presentation to industry and exhibition at national technology exposition. Call 1-800-528-6050. Arizona I-800-352-0458, X831

HALLICRAFTERS S-40, S-52, S-77. Any condition. Paying \$20.00-\$40.00 each. FALA ELECTRONICS, Box 04134-2, Milwaukee, WI 53204.

DESCRAMBLER TROUBLES

SINE wave descrambler problems? Manual includes trouble shooting, alignment, antenna hookup, improvements, theory. \$10.00 SIGNAL, Box 2512-R, Culver City, CA 90230.

□ UAA-1000 UHF Amplifier Kit \$19.95 + \$3.00 S/H

FV-5

Phase Video Sync. Suppression

NOW READY! Our new catalog!

ZENITH MI

TI-99/4A SOFTWARE

TI-99/4A owners. Get your free catalog of new, exciting, low cost software. DYNA, Box 690, Hicksville, NY 11801.

SCANNERS

SCANNERS— discount prices Bearcat BC-100 \$279.99; Bearcat 210XL \$214.99; Bearcat 300 \$335.99; Regency MX3000 \$186.99; JIL SX100 \$138.99; JIL SX200 \$269.99; Bearcat 20/20 \$275.99; Spectrum radar detector \$214.99; plus 23.00 \$195.99; Free discount catalog Levent \$3.00 shipping. Free discount catalog. Lowest prices anywhere on scanners, radar detectors, marine radios, two-way accessories. SCANNER WORLD, 10-RE New Scotland, Albany, NY 12208 (518) 436-9606.

CABLE TV

DEALERS wanted: Channel 2, 3, and 4 notch filters. Money back guarantee. Send \$15.00 for sample and quantity price list. Specify channel(s). LEE KURTZ, PO Box 291394, Davie, FL 33329.

REEL-TO-REEL TAPES

AMPEX professional series open reel tape, 1800-or 2400-feet on 7-inch reels, used once. Case of 40, \$45.00. 10½ × 3600 feet and cassettes available. MasterCard/Visa. VALTECH ELECTRONICS, Box 6-RE, Richboro, PA 18954 (215) 322-4866.

BUY BONDS



35

GATED SYNC SUPER BOARD

KGS-3080 Gated Sync. Kit \$149.95 + \$5.95 S/H PCG-7000 Gated Sync. PCB only. \$30.00 +\$3.00 S/H



SINEWAVE SUPER BOARD

- ☐ KSW 1483 Sinewaye Kit \$119.95 + \$5.95 S/H
- KSO 1484 Sinewave Minus PCB \$99.95 + \$5.95 S/H ☐ PCS 6252 Sinewave PCB only \$20.00 + \$3.00 S/H

State of the art technology brings you this superior Sinewave Superboard. It has no internal connection to TV, RF modulator built on the board, AGC for stability and tunes the entire band with a varactor tuner and multi-turn pot. A high quality plated-thru circuit board with silk-screened parts layout, easy to follow, fully illustrated instructions and quality parts make this kit easy to assemble. The beautifully finished cabinet will add a touch of class to the many hours of enjoyment you will receive building and using this kit.

MICROWAVE PROBE

\$69.95

- ☐ KMP 2030 Micro Probe Kit \$24.95 + \$3.00 S/H
- ☐ MPD 2000 Micro 20" Dish \$14.95 + \$5.95 S/H PCM 2000 Micro PCB only \$4.95 +\$3.00 S/H
- ☐ KMP 1218 Micro Power Supply Kit \$19.95 + \$3.00 S/H
- | KZM 2083 M1 FV-5 Kit \$199.95 + \$6.95 S/H |
 | KZO 2084 FV-5 Kit (minus M1) \$149.95 + \$6.95 S/H |
 | PCZ 8000 FV-5 PCB only \$3.00 + \$3.00 S/H |
 | ZMO 9151 M1 Board only \$89.95 + \$5.95 S/H |
 | ZMO 9151 M1 Board only \$89.95 + \$5.95 S/H |
 | This advanced baseband video inversion/sync suppression system which is most often used nationwide is one of our most popular kits. It features AGC for stability, RF modulator built on the board, no internal connection to TV, and full band variable tuning. High quality parts, fully illustrated instructions, prepunched cabinet and plated-thru/solder-masked P.C. board make this kit a breeze to assemble. The M1 varactor tuner board is assembled and tested and need only be interconnected to the FV-5 board. The completed circuitry is then placed in the beautifully finished cabinet. Place your order today.

UNSURE? Order any manual for only \$9.95 post paid. Refundable with order of kit

HOBBY USE ONLY, NOT FOR UNAUTHORIZED RECEPTION OF TV SIGNALS AVAILABLE BY MAIL ONLY. • SEND FOR INFORMATION ON OTHER ITEMS COMPLETE REPAIR SERVICE. • CHECKS HELD 3 WEEKS FOR CLEARANCE

4218 S. 36TH PL. PHOENIX. ARIZONA 85040

ORDERS (800) 243-6700





Suppression

Inversion





Send for our FREE 1984 catalog of electronic components, kits, IC's, computer software, computer peripherals and unique items.

PARTS SUPER SPECIALS!

MICRO MINATURE SPEAKER
Only 9/16' digeneter mounted on
a 1 square PC board, With 2'
ming flexible brade.
C4532 44-44 KESTER PC TYPE SOLDER 6 foot coil of ultra thin dis-meter low melling tempera-ture 60/40 rosin core solder for IV work. This high qual-ity solder is perfect for soldering our kits. 250 ND EFFECTS GENERATOR KIT ling sound effects kit uses the popular T176477 to develop phasor, locomotive, siren, tweeting organ, Model T, etc. sounds. Uses dip switch and the generator. Operates SOLID CARBIDE PC DRILL BIT, # 85 .052" Diandard size for owe, organ, Model T, etc sounds. Uses o for simple programming of the generator. from 9V battery. Size of board. 3.25" x 2" C4422 \$14.95

BOX OF RESISTORS BOA UP RESISTION.

The mendous bargain assort ment contains all 1 year of resistors contains all 1 year of resistors, and the resistors of the resistor of the resistors of the resistor of the resi

Super assortment of disc capaci-tors, electrolytics, mylars, silver micas, etc. All marked and prime Some have ne leads. Bux contain Duper amort ment or one conjusts, silver micas, etc. All marked and prim Some have pe leads. Box contain at least 250 nices.

VALUABLE BURTHISE PALEATON
We have a tremendous quantity of various items have too few to advertise. We have packaged a gentlement of the package of the pac worth the price!



C3071 \$9.99

we ort-

TIME

4

(Will)

PAC TEC ELECTRONIC ENCLOSURE Professional booking case in magnetic state of the state

FASCINATION STAR KIT

(the 3 CHANNEL COLOR ORGAN KIT Handles up to 200W pcr channel and up to 25W input. Complete with all purts and pc board. C4530 59.50

NEGATIVE ION GENERATOR BOARD

CHANEY electronic P.O. BOX 27038 DENVER, COLORADO 80227

CIRCLE 34 ON FREE INFORMATION CARD



FORMULA INTERNATIONAL INC.

12603 Crenshaw Blvd., Dept. B, Hawthorne, CA 90250 For information (213) 973-1921 • Orders Only (outside Calif.) (800) 672-8758

MARK IV - 15 STEP LED POWER LEVEL INDICATOR KIT

LED POWER LEVEL INDICATOR KIT
This new stere indicator kit consists of 36 4-cotor
LED's (15 per channel) to indicate the sound level
output of your amplifier from — 36dB to + 3dB.
Comes with a well designed silk screen printed plastic panel and has a selector switch to allow floating or
gradual output indicating. Power supply is 6-12VDC
with THG on board input sensitivity controls. This unit
can work with any amplifier from 1W to 200W. Kit
includes 70 pcs driver transistors, 38 pcs matched
4-cotor LED's, all electronic components, PC Board
and front panel. MARK IV KIT S31.50





100W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low TIM stereo pre-

Specifications • Output power 100W RMS into 8Ω . 125W RMS into 4Ω • Frequency response 10Hz-100KHz • THD less than 0.01% • S/N ratio better than 800B • Input sensitivity 1V max. • Power works = 60V × 5.5N response = supply ±40V at 5A

No FCC License OUR PRICE \$49.50 Additional Microphone (Transmitter) Available at \$28.00 ea

CRYSTAL CONTROLLED SYSTEM

Transmitter: FET mic for flat 30Hz-18KHz response. Xtal controlled 49MHz AM Band for drift-free performance. 100mW output (range

approx. 1/4 mile) for re-liable long range transmission. Powered by a 9V radio battery. Receiver: X'tal con-trolled locks on

49MHz transmitter signal. On panel VU meter, monitors the signal strength from the microphone. Stan-dard phone jack outlet connection to a P.A. or other phone input. 9V battery included. This professional set is ideal for on stage, in field, church, in house or

LOW TIM DC STEREO PRE-AMP KIT TA-1020

Incorporates brand-new DC design that gives a fre-quency response from 0-100KHz ±0.5dB. Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuations!

Specifications: • THD/TIM less than .005% • Fre quency response DC to 100KHz ± 0.5 dB \bullet RIAA deviation ± 0.2 dB \bullet S/N ratio better than 70dB \bullet Sensitivity; Phone 2mV 47K Ω , Aux 100mV 100K Ω \bullet Output level 1.3V • Max output 15V • Tone controls; Bass ±10dB @ 50Hz, Treble ±10dB @ 15Hz • Power supply ±24VDC @ 0.5A. Kit comes with regulated power supply. All you need is a 48VCT transformer @ 0.5A.

Only \$44.50 Transformer \$4.50 ea.



pinecom ™ DP-64



- Dual Processor (6502 and Z80A)
- Detached Keyboard
- 64K RAM Expandable to 192K
- 25 Function Key Keyboard
- Auto Repeat Keys w/Upper/lower Case
- 2 Slim Disk Drives (optional)
- 100% Apple II Compatible
- 40/80 Column Display (optional)
- Runs Both Apple Soft and CP/M Software

Model DP-64 Fully Assembled ... \$650°°

60W + 60W O.T.L. AMP Stereo pre-amp + tone control + power amp. All in on unit, fully assembled Compact in size: 7'x4'4'x2'4'. Can be fitted into most cabinets. Power transistors

Can be littled into most cabinets. Power transistors using 25C1687 X 4 to give a max output of 66W+60W (8Ω)

Frequency response: 20Hz~85KHz(-1dB) • Total harmonic distortion: 0.02% (1KHz) · Signal/Noise Ratio: 88 dB (lopen loop) • Tone control: 100 Hz±16 dB 10 KHz±14dB • Dynamic range: 60 dB • Power Supply: 44W=70V5 Aro • Eller Canacitor 4700 u. 378 vc heters.

48V-70V5 Amp. • Filter Capacitor: 4700 µ 75V or bette



pinecom"

Pioneer of Low Cost Apple* Compatible Computer



Now with New **Improved** Keyboard and 64K RAM

No Copyright Problems!

Compare These Features with Our Competitors:

- Powerful Utility Program (100% Apple Compatible)
- 68-Key Upper & Lower Case Keyboard with Numeric Keypad
- 25 Pre-programmed Function Keys
- 2 Speed Auto Repeat Funtion
- 64K User Memory—expandable to 192K
- 5A Switching Power Supply (110/220VAC)
- All ICs Are Socketed for Easy Service
- Nation-wide Dealer Network for Convenient Technical Support

And best of all, the price Assembled and Tested is just..... \$499°°



* SPECIAL * **Excellent Price!** Model 001-0034 \$29.50 per Kit Transformer \$10.50 ea.

TA-322 30 WATTS TOTAL 15W + 15W STEREO AMP KIT

15W + 15W STEREO AMP KIT
This is a solid state all transistor circuitry with on
board stereo pre-amp for most microphone or phone
input. Power output employs a heavy duty Power
Hybrid IC. Four built on board controls for,
volume, balance, treble and bass. Power supply
requires 48VCT 2.5A transformer. THD of less than
0.1% between 100Hz-10KHz at full power (15 Watts
+ 15 Watts loaded into 8Ω).

Part #370-0350 . 1 Transformer Part #670-0230... \$22.50 ea. 2 Filter Capacitor 4700µF 70V \$6.50 ea.

MAGNETIC HEAD EQUALIZER Standard RIAA curve for all kinds of magnetic heads • 3 stages crossover circuit for best results • Output voltage guaranteed to be stable without any oscillation • Power Supply: 24 V.D.C.



MODEL: MA-142 Part #370-370 \$6.95 ea

STEREO MIC. AND ECHO MIXER FOR STEREO AMPLIFIER SYSTEM

MODEL: SA-4520

The circuitry employs all integrated circuits, BBD type echo circuit, echo time can be adjusted (max. .30 Msec.) Also with a microphone preamp on the board. Fully assembled.



. \$39.95 ea

MODEL: MX205

PROFESSIONAL REGULATED VARIBLE DC POWER SUPPLY KIT

All solid state circuitry with high efficiency power tran-sitor 2SD388 and IC voltage regulator MC1733. Output voltage can be adjusted from 0-30V at 1A current limited or 0-15V at 2A current limited. Internal resistance is less than 0.005Ω, ripple and noise less than 1mV, dual on panel meters for voltage and current reading, also with on board LED and audible over load indicator. Kit comes with pre-drilled PC Board, instructions, all necessary electronic components, trans-former and a professional looking metal cabinet. The best project for school and the most useful instrument for repairmen. Build one today!



Model TR88A 0-15VDC @ 2A

0-30VDC @ 1A

LOW T.I.M. TRANSISTORS 100W + 100W

• Employs Hitachi Iow noise I.C. for pre-amp • Max. output 16 V P-P (non distortion) • With hi-low filter, and tone defeat circuit • Rear power amp with short circuit protection • Giant heat sink for maximum results • Tone controls ± 14dB • All components (except pots for volume, and tone controls) are pre-assembled, the quality is guaranteed. • Power supply DC ±35V-50V



MODEL: SA802C Part #370-0340 \$85.00 POWER TRANSFORMER (68V-80V CT 6 AMP) Part #670-0220 \$24.50

SEND ONE DOLLAR FOR OUR DETAIL CATALOG

Inside California
Outside Calif. (incl. Mexico & Canada)

Shipping & Handling Charges Under \$50.00 Over \$50.00

Minimum Order \$10.00/Calif. Residents add 6.5% Sales Tax. Phone Orders Accepted on VISA or MC ONLY. NO C.O.D.'s. Prices sub-



STORE HOURS MON-FRI-10-7 SAT-10-6

*Apple and Apple II are the trademark of APPLE COMPUTERS, INC.

64K DYNAMIC 200 NS

TMM2016 2KX8 STATIC \$415 **\$595**

CT	ATI	CD	AMS	
2101		(450ns)		1.9
5101	256 x 4	(450ns)	(cmos)	3.9
2102-1	1024 x 1	(450ns)	Tarresson T	.8
2102L-4	1024 x 1	(450ns)	(LP)	.9
2102L-2	1024 x 1	(250ns)	(LP)	1.4
2111	256 x 4	(450ns)		2.4
2112		(450ns)		2.9
2114	1024 x 4	(450ns)		8/9.9
2114-25	1024 x 4			8/10.9
2114L-4	1024 x 4	(450ns)	(LP)	8/12.9
2114L-3	1024 x 4			8/13.4
2114L-2	1024 x 4	(200ns)	(LP)	8/13.9
TC5514	1024 x 4	(650ns)	(cmos)	2.4
TC5516	2048 x 8	(250ns)	(cmos)	9.9
2147	4096 x 1			4.9
TMS4044-4	4096 x 1			3.4
	4096 x 1			3.99
TMS4044-2	4096 x 1	(200ns)		4.45
MK4118	1024 x 8	(250ns)		9.9
TMM2016-200		(200ns)		4.1
TMM2016-150	2048 x 8	(150ns)		4.9
TMM2016-100		(100ns)		6.1
HM6116-4	2048 x 8	(200ns)	(cmos)	4.7
HM6116-3	2048 x 8	(150ns)	(cmos)	4.9
HM6116-2	2048 x 8	(120ns)	(cmos)	8.9
HM6116LP-4	2048 x 8	(200ns)	(cmos)(LP)	5.9
	2048 x 8	(150ns)	(cmos)(LP)	6.9
HM6116LP-2	2048 x 8	(120ns)	(cmos)(LP)	10.95
Z-6132	4096 x 8	(300ns)	(Qstat)	34.95
HM6264	8192 x 8	(150ns)	(cmos)	49.95
LP = Low	Power		t = Quasi-Sta	tic

YNAMI

4096 x 1 4096 x 1 4096 x 1

8192 x 1

8192 x

16384 x 1 16384 x 1 16384 x 1

16384 x

16384 x 1

32768 x 1

65536 x 1

65536 x 1

65536 x 1

D

TMS4027

UPD411 MM5280 MK4108

MM5298

4116-300 4116-250 4116-200 4116-150

4116-120 2118

MK4332

4164-200 4164-150 MCM6665

TMS4164-15

	EF	PROMS	
1702	256 x 8	(1us)	4.50
2708	1024 x 8	(450ns)	3.95
2758	1024 x 8	(450ns) (5v)	5.95
2716	2048 x 8	(450ns) (5v)	3.95
2716-1	2048 x 8	(350ns) (5v)	5.95
TMS2516	2048 x 8	(450ns) (5v)	5.50
TMS2716	2048 x 8	(450ns)	7.95
TMS2532	4096 x 8	(450ns) (5v)	5.95
2732	4096 x 8	(450ns) (5v)	4.95
2732-250	4096 x 8	(250ns) (5v)	8.95
2732-200	4096 x 8	(200ns) (5v)	11.95
2732A-4	4096 x 8	(450ns) (5v) (21vPGM)	6.95
2732A	4096 x 8	(250ns) (5v) (21vPGM)	9.95
2732A-2	4096 x 8	(200ns) (5v) (21vPGM)	13.95
2764	8192 x 8	(450ns) (5v)	6.95
2764-250	8192 x 8	(250ns) (5v)	7.95
2764-200	8192 x 8	(200ns) (5v)	19.95
TMS2564	8192 x 8	(450ns) (5v)	14.95
MCM68764	8192 x 8	(450ns) (5v) (24 pin)	39.95
MCM68766	8192 x 8	(350ns) (5v) (24 pin)(pwr dn.)	42.95
27128	16384 x 8	(300ns) (5v)	29.95
5v = Single 5	Volt Suppl	y 21vPGM = Program at 2	1 Volts

	32.
4.50	1.
3.95	1.
5.95	2.
3.95	2.
5.95	2.
5.50	3.
7.95	3.
5.95	4.
4.95	5.
8.95	5.
11.95	5. 5.
6.95	6.
9.95	6.
13.95	6.
6.95	8.
7.95	10.
100000000000000000000000000000000000000	10.
19.95	14.
14.95	15.
39.95	16.
.) 42.95	17.
29.95	18.
21 Volts	18.
	20.
- 5	22.
3	32.

32.700 KHZ	1.95
1.0 mhz	3.95
1.8432	3.95
2.0	2.95
2.097152	2.95
2.4576	2.95
3.2768	2.95
3.579545	2.95
4.0	2.95
5.0	2.95
5.0688	2.95
5.185	2.95
5.7143	2.95
6.0	2.95
6.144	2.95
6.5536	2.95
8.0	2.95
10.0	2.95
10.738635	2.95
14.31818	2.95
15.0	2.95
16.0	2.95
17.430	2.95
18.0	2.95
18.432	2.95
20.0	2.95
22.1184	2.95
32.0	2.95

AY3-1014

AY5-1013

CRYSTALS

4018	.79	74C00
4019	.39	74C02
4020	.75	74C04
4021	.79	74C08
4022	.79	74C10
4023	.29	74C14
4024	.65	74C20
4025	.29	74C30
4026	1.65	74C32
4027	.45	74C42
4028	.69	74C48
4029	.79	74C73
4030	.39	74C74
4034	1.95	74C76
4035	.85	74C83
4040	.75	74C85
4041	.75	74C86
4042	.69	74C89
4043	.85	74C90
4044	.79	74C93
4046	.85	74C95
4047	.95	74C107
4049	.35	74C150
4050	.35	74C151
4051	.79	74C154

.79 .89

.39

74C157 74C160

74C161

74C162 74C163

74C164

CMOS

.25

.89

.39 .45

25

.79

39

4528

4532

4538 4539

4541 4543

4553

4555

4556 4581

4582 4584 4585

4000

4001 4002

4006 4007

4008 4009

4010

1.19

1.95 1.95

1.95

2.64

.95 .95 1.95

1.95 .75 .75 12.95

.35 35 .35 .59 .35 39

1.29 1.99

.65

.65

.80

1.95 1.95

.39

4.50 1.19

1.75

.99

5.75

2 25

3.25

1.75

1.19

1.19

1.19

1.19

1.39

2.00 .79

1.19

1.19

1.49

1.49

1.39

5.75

1.75 2.25

2.45

2.45

.39

85

.95

1.00

2.00

2.75

9.95

8.95

8.95 1.95

1.19

2.75

4.49 4.95

5.95

7.95 7.95

19.95

74C928

74C929

1.95

17.95

10.95

AY3-1015	6.95	4035
PT1472	9.95	4040
100 March 200 Comp.	100000000000000000000000000000000000000	4041
TR1602	3.95	4042
2350	9.95	10 AGA1 (C.C.)
2651	8.95	4043
IM6402	7.95	4044
IM6403	8.95	4046
INS8250	10.95	4047
GENERA	TORS	4049
BIT-RA	TE	4050
MC14411	11.95	4051
BR1941	11.95	4053
	12.95	4060
COM5016		4066
COM8116	10.95	4068
MM5307	10.95	4069
FUNCT	ION	4070
MC4024	3.95	4071
LM566	1.49	4072
XR2206	3.75	4073
8038	3.95	4075
		4076

		4070	.00	140104	
MC4024	3.95	4071	.29	74C165	
LM566	1.49	4072	.29	74C173	
XR2206	3.75	4073	.29	74C174	
8038	3.95	4075	.29	74C175	
		4076	.79	74C192	
MINO		4078	.29	74C193	
MISC		4081	.29	74C195	
UPD7201	29.95	4082	.29	74C200	
TMS99532	29.95	4085	.95	74C221	
ULN2003	2.49	4086	.95	74C244	
3242	7.95	4093	.49	74C373	
3341	4.95	4098	2.49	74C374	
MC3470 MC3480	4.95	4099	1.95	74C901	
11C90	9.00	14409	12.95	74C902	
95H90	7.95	14410	12.95	74C903	
2513-001 UP	9.95	14411	11.95	74C905	
2513-002 LOW	9.95	14412	12.95	74C906	
2010 002 EOM	0.00	14419	7.95	74C907	
		14433	14.95	74C908	
CLOCK		4502	.95	74C909	
CIRCUIT		4503	.65	74C910	
MM5314	4.95	4508	1.95	74C911	
MM5369	3.95	4510	.85	74C912	
MM5375	4.95	4511	.85	74C914	
MM58167	12.95	4512	.85	74C915	
MM58174	11.95	4514	1.25	74C918	
MSM5832	3.95	4515	1.79	74C920	
THE REAL PROPERTY.	-	4516	1.55	74C921	
	-	4518	.89	74C922	
KEYBOA	RD	4519	.39	74C923	
CHIPS		4520	.79	74C925	
AY5-2376	11.95	4522	1.25	74C926	

EPROM ERASERS SPECTRONICS

	Timer	Capacity	Intensity (uW/Cm²)	
PE-14		9	8,000	83.00
PE-14T	X	9	8,000	119.00
PE-24T	X	12	9,600	175.00
PL-265T	X	30	9,600	255.00
PR-125T	X	25	17,000	349.00
PR-320T	X	42	17,000	595.00

- * Computer managed inventory virtually no back orders!
- Very competitive prices!

8200

- Friendly staff!
- Fast service most orders shipped within 24 hours!

680	10
68000	49.95
6800 6802	2.95 7.95
6802 6803	19.95
6808	13.90
6809E	14.95
6809	11.95
6810	2.95
6820	4.35
6821	2.95
6828	14.95
6840	12.95
6843	34.95
6844	25.95
6845	14.95
6847	11.95
6850	3.25
6852	5.75
6860 6875	7.95 6.95
6880	2.25
6883	22.95
68047	24.95
68488	19.95
6800 =	
68B00	10.95
68B02	22.25
68B09E	29.95
68B09	29.95
68B10	6.95
68B21	6.95
68B40	19.95
68B45	19.95
68B50	5.95
68B00 =	2 MHZ

	00 THZ
6502 N	4.95
6504	6.95
6505	8.95
6507	9.95
6520	4.35
6522	6.95
6532	9.95
6545	22.50
6551	11.85
	IHZ
6502A	6.95
6522A	9.95
6532A	11.95
6545A	27.95
6551A	11.95
	MHZ
6502B	9.95

C RAMS

(250ns)

(300ns) (300ns)

(200ns (250ns) (300ns) (250ns)

(200ns

(150ns (120ns

(200ns) (200ns) (150ns)

(200ns)

(150ns) (5v)

(150ns) (5v)

(5v) (5v) (5v)

6551A 3 I	MHZ 11.95
6502B	9.95
Total I	
D	ISC
CONTE	ROLLERS
1771	16.95
1791	24.95
1793	26.95
1795	29.95
1797	49.95
2791	54.95
2793	54.95
2795	59.95
2797	59.95
6843	34.95
8272	39.95
UPD765	
MB8876	
MB8877	34.95
1691	17.95 18.95
2143	18.95

800	0
8035	5.95
8039	5.95
INS-8060	17.95
INS-8073	49.95
8080	3.95
8085	4.95
8085A-2	11.95
8086	24.95
8087	CALL
8088	29.95
8089	89.95
8155	6.95
8155-2	7.95
8156	6.95
8185	29.95
8185-2	39.95
8741	29.95
8748	24.95
8755	24.95

1.99 3.00 3.00

1.95 1.85 8/11.75 8/7.95

8/12.95 8/14.95

8/29.95

4.95 9.95 5.95 6.95 8.95

8748	24.95
8755	24.95
0700	24.55
CRT	
CONTROL	LERS
6845	14.95
68B45	19.96
HD46505SP	15.95
6847	11.95
MC1372	6.95
68047	24.95
8275	29.95
7220	99.95
CRT5027	19.95
CRT5037	24.95
TMS9918A	39.95
DD8350	40 05

8203	39.95	2.5 Mr	ız
8205	3.50	Z80-CPU	3.95
8212	1.80	Z80-CTC	3.95
8214	3.85	Z80-DART	10.95
8216	1.75	Z80-DMA	14.95
8224	2.25	Z80-PIO	3.95
8226	1.80	Z80-S10/0	11.95
8228	3.49	Secretary Control of the Control of	
8237	19.95	Z80-SIO/1	11.95
8237-5	21.95	Z80-S10/2	11.95
8238	4.49	Z80-S10/9	11.95
8243	4.45	4.0 Mi	ız
8250	10.95	Z80A-CPU	4.49
8251	4.49	Z80A-CTC	4.95
8253	6.95	Z80A-DART	9.95
8253-5	7.95	Z80A-DMA	12.95
8255	4.49	Z80A-PIO	4.45
8255-5	5.25	Z80A-S1O/0	
8257	7.95		12.95
8257-5	8.95	Z80A-SIO/1	
8259	6.90	Z80A-S10/2	12.95
8259-5 8271	7.50 79.95	Z80A-SIO/9	12.95
8272	39.95	6.0 MI	1Z
8275	29.95	Z80B-CPU	9.9
8279	8.95	Z80B-CTC	12.9
8279-5	10.00	Z80B-PIO	12.9
8282	6.50	The second secon	
8283	6.50	Z80B-DART	19.9
8284	5.50	Z80B-SIO/2	39.9
8286	6.50	ZILO	G
8287	6.50	100 March 200 Co. (1)	92.9//
8288	25.00	Z6132	34.9
8289	49.95	Z8671	39.9

Z-80

OR Microdevices

1224 S. Bascom Avenue, San Jose, CA 95128 800-538-5000 · 800-662-6279 (CA) (408) 995-5430 • Telex 171-110

Copyright 1984 JDR Microdevices

4527 VISIT OUR RETAIL STORE

AY5-3600 PRO 11.95

HOURS: M-W-F, 9-5 T-Th., 9-9 Sat. 10-3 PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order \$10. For shipping and handling include \$2.50 for UPS Ground and \$3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax. Bay Area and LA residents include 6%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

2114 450 NS 8/\$995 2114 250 NS 8/\$1095

	741	S00	
74LS00	.24	74LS173	.69
74LS01 74LS02	.25	74LS174 74LS175	.55
74LS03	.25	74LS181	.55 2.15
74LS04	.24	74LS189	8.95
74LS05 74LS08	.25	74LS190 74LS191	.89
74LS09	.29	74LS192	.79
74LS10 74LS11	.25	74LS193 74LS194	.79
74LS12	.35	74LS195	.69
74LS13 74LS14	.45	74LS196 74LS197	.79 .79
74LS15	.35	74LS221	.89
74LS20 74LS21	.25	74LS240 74LS241	.95
74L\$22	.25	74LS242	.99
74LS26 74LS27	.29	74LS243 74LS244	.99 1.29
74LS28	.35	74LS245	1.49
74LS30 74LS32	.25	74LS247	.75
74LS33	.55	74LS248 74LS249	.99
74LS37	.35	74LS251	.59
74LS38 74LS40	.35	74LS253 74LS257	.59
74LS42	.49	74LS258	.59
74LS47 74LS48	.75 .75	74LS259 74LS260	2.75
74LS49	.75	74LS266	.55
74LS51 74LS54	.25	74LS273 74LS275	1.49 3.35
74LS55	.29	74LS279	.49
74LS63 74LS73	1.25	74LS280 74LS283	1.98
74LS74	.35	74LS290	.89
74LS75 74LS76	.39	74LS293 74LS295	.89
74LS78	.49	74LS298	.89
74LS83 74LS85	.60	74LS299 74LS323	1.75 3.50
74LS86	.39	74LS324	1.75
74LS90 74LS91	.55	74LS352 74LS353	1.29
74LS92	.55	74LS363	1.35
74LS93 74LS95	.55 .75	74LS364 74LS365	1.95
74LS96	.89	74LS366	.49
74LS107 74LS109	.39	74LS367 74LS368	.45
74LS112	.39	74LS373	1.39
74LS113 74LS114	.39	74LS374 74LS375	1.39
74LS122	.45	74LS377	1.39
74LS123 74LS124	.79 2.90	74LS378 74LS379	1.18
74LS125	.49	74LS385	3.90
74LS126 74LS132	.49 .59	74LS386 74LS390	.45 1.19
74LS133	.59	74LS393	1.19
74LS136 74LS137	.39	74LS395 74LS399	1.19
74LS138	.55	74LS424	2.95
74LS139 74LS145	.55 1.20	74LS447 74LS490	.95 1.95
74LS147	2.49	74LS624	3.99
74LS148 74LS151	1.35	74LS640 74LS645	2.20
74LS153	.55	74LS668	1.69
74LS154 74LS155	1.90	74LS669 74LS670	1.89
74LS156	.69	74LS674	14.95
74LS157 74LS158	.65	74LS682 74LS683	3.20
74LS160	.69	74LS684	3.20
74LS161 74LS162	.65	74LS685 74LS688	3.20 2.40
74LS163	.65	74LS689	3.20
74LS164 74LS165	.69 .95	81LS95 81LS96	1.49
74LS166	1.95	81LS97	1.49
74LS168 74LS169	1.75	81LS98 25LS2521	1.49
74LS170	1.49	25LS2569	4.25

		74S	00		
74500	.32	745132	1.24	745225	7.95
74502	.35	745133	.45	745240	2.20
74503	.35	745134	.50	745241	2.20
74504	.35	74S135	.89	745244	2.20
74805	.35	745138	.85	74S251	.95
74508	.35	745139	.85	74S253	.95
74509	.40	745140	.55	748257	.95
74510	.35	74S151	.95	74\$258	.95
74511	.35	74S153	.95	745260	.79
74S15	.35	74S157	.95	745273	2.45
74520	.35	74S158	.95	745274	19.95
74522	.35	748161	1.95	748275	19.95
74530	.35	745162	1.95	745280	1.95
74532	.40	745163	1.95	745287	1.90
74537	.88	745168	3.95	745288	1.90
74538	.85	74S169	3.95	745289	6.89
74540	.35	745174	.95	745301	6.95
74851	.35	748175	.95	748373	2.45
74564	.40	745181	3.95	745374	2.45
74865	.40	745182	2.95	745381	7.95
74874	.50	745188	1.95	745387	1.95
74585	1.99	745189	6.95	745412	2.98
74586	.50	74S194	1.49	745471	4.95
745112	.50	74S195	1.49	748472	4.95
745113	.50	74S196	1.49	745474	4.95
74S114	.55	74S197	1.49	745482	15.25
745124	2.75	745201	6.95	748570	2.95
				748571	2.95
100					_

REC	GUL	ATOR	S
7805T 78M05C 7808T 7812T 7815T 7824T	.75 .35 .75 .75 .75	7905T 7908T 7912T 7915T 7924T	.8 .8 .8
7805K 7812K 7815K 7824K	1.39 1.39 1.39 1.39	7905K 7912K 7915K 7924K 79L05	1.4 1.4 1.4 1.4
78L05 78L12 78L15	.69 .69	79L12 79L15 LM323K	.7
78H05K 78H12K	9.95 9.95	UA78S40	1.9
C, T	= TO-220 L = TO	K = TO-3	3

	14	UU	- 13
7400	.19	74123	.49
7401	.19	74125	.45
7402	.19	74126	.45
7403	.19	74132	.45
7404	.19	74136	.50
7405	.25	74143	4.95
7406	.29	74145	.60
7407	.29	74147	1.75
7408	.24	74148	1.20
7409	.19	74150	1.35
7410	.19	74151	.55
7411	.25	74153	.55
7413	.35	74154	1.25
7414	.49	74155	.75
7416	.25	74157	.55
7417	.25	74159	1.65
7420	.19	74160	.85
7421	.35	74161	.69
7425	.29	74163	.69
7427	.29	74164	.85
7430	.19	74165	.85
7432	.29	74166	1.00
7437	.29	74167	2.95
7438	.29	74170	1.65
7442	.49	74173	.75
7445	.69	74174	.89
7446	.69	74175	.89
7447	.69	74177	.75
7448	.69	74181	2.25
7451	.23	74184	2.25
7473	.34	74185	
7474	.33	74191	2.00
7475	.45	74191	1.15
7476	.35	Total and distriction of	.79
7482	.95	74193	.79
7483	.50	74194	.85
7485	.59	74195	.85
7486		74197	.75
7489	.35	74198	1.35
7489	2.15	74221	1.35
	.35	74246	1.35
7492 7493	.50	74247	1.25
	.35	74259	2.25
7495	.55	74273	1.95
7497	2.75	74276	1.25
74100	1.75	74279	.75
74107	.30	74366	.65
74109	.45	74367	.65
74116	1.55	74368	.65
74121	.29	74393	1.35
74122	.45		
			11
-	DO	Α	
	RC	A	
	PERSONAL PROPERTY.	264 0000000	THE PERSON

7400

.85 .85 .85 .85

1.49 1.49 1.49 1.49

.79 .79 .79 4.95 1.95

	DATA ACC	UISITION	1 1 1 1 1 2
ADC0800	15.55	DAC0808	2.95
ADC0804	3.49	DAC1020	8.25
ADC0809	4.49	DAC1022	5.95
ADC0817	9.95	MC1408L6	1.95
DAC0800	4.95	MC1408L8	2.95

INTERF	ACE	
8T26	1.59	
8T28	1.89	
8T95	.89	
8T96	.89	
8T97	.89	
8T98	.89	
DM8131	2.95	
DP8304	2.29	
DS8833	2.25	
DS8835	1.99	
DS8836	.99	
DS8837	1.65	
DS8838	1 30	

ICM7207A ICM7208

9316

9602 96S02

9000

5.59

1.00 2.50 3.95

.75 1.50 1.95

CENTRONICS

IDCEN36 Ribbon Cable IDCEN36/F	36	Pin	Male	8.95
Ribbon Cable CEN36	36	Pin	Female	8.95
Solder Cup	36	Pin	Male	7.95





MICROCOMPUTER HARDWARE HANDBOOK FROM ELCOMP - \$14.95

Over 800 pages of manufacturers data sheets on most commonly used IC's. Includes:

- * TTL 74/74LS and 74F * CMOS
- * Voltage Regulators
- * Memory RAM, ROM, EPROM * CPU's 6800, 6500, Z80, 8080,
- 8085, 8086/8
- * MPU support & interface 6800, 6500, Z80, 8200, etc.

FEDERAL EXPRESS SERVICES AVAILABLE!

CONNECTO RS232 Male	ORS 2.50		7 700	L	IN	EAR	
RS232 Female RS232 Female RS232 Hood S-100 ST		LM301 LM301H LM307 LM308	.34 .79 .45	LM340 (see LM348 LM350K LM350T	7800) .99 4.95 4.60	LM565 LM566 LM567 NE570	1780
A SECOND		LM308H	1.15	LM358	.69	NE571	3
EXAR		LM309H LM309K	1.95	LM359 LM376	1.79	NE590 NE592	
XR 2206	3.75	LM310	1.75	LM377	1.95	LM709	
XR 2207	3.75	LM311	.64	LM378	2.50	LM710	
XR 2208	3.75	LM311H	.89	LM379	4.50	LM711	
XR 2211	5.25	LM312H	1.75	LM380	.89	LM723	
XR 2240	3.25	LM317K	3.95	LM380N-8	1.10	LM723H	
-	-	LM317T	1.19	LM381	1.60	LM733	
-	1	LM318	1.49	LM382	1.60	LM741	
INTERS	The same	LM318H	1.59	LM383	1.95	LM741N-14	Į.
ICL7106		LM319H	1.90	LM384	1.95	LM741H	
	9.95	LM319	1.25	LM386	.89	LM747	
	12.95	LM320 (see	7900)	LM387	1.40	LM748	
ICL7660	2.95	LM322	1.65	LM389	1.35	LM1014	100
ICL8038	3.95	1 M323K	4 95	LM390	1 95	LM1303	8

LM301	.34	LM340 (see	7800)	LM565	.99	LM1558H	3.10	CA 302		CA 3082	1.65
LM301H	.79	LM348	.99	LM566	1.49	LM1800	2.37	CA 303		CA 3083	1.55
LM307	.45	LM350K	4.95	LM567	.89	LM1812	8.25	CA 304		CA 3086	.80
LM308	.69	LM350T	4.60	NE570	3.95	LM1830	3.50	CA 305	9 2.90	CA 3089	2.99
LM308H	1.15	LM358	.69	NE571	2.95	LM1871	5.49	CA 306	0 2.90	CA 3096	3.49
LM309H	1.95	LM359	1.79	NE590	2.50	LM1872	5.49	CA 306	5 1.75	CA 3130	1.30
LM309K	1.25	LM376	3.75	NE592	2.75	LM1877	3.25	CA 308	0 1.10	CA 3140	1.15
LM310	1.75	LM377	1.95	LM709	.59	LM1889	1.95	CA 308	1 1.65	CA 3146	1.85
LM311	.64	LM378	2.50	LM710	.75	LM1896	1.75		CA 3160	1.19	
LM311H	.89	LM379	4.50	LM711	.79	ULN2003	2.49				
LM312H	1.75	LM380	.89	LM723	.49	LM2877	2.05		100	7.0	
LM317K	3.95	LM380N-8		LM723H	.55	LM2878	2.25				
LM317T	1.19	LM381	1.60	LM733	.98	LM2900	.85	TL494	4.20	75365	1.95
LM318	1.49	LM382	1.60	LM741	.35	LM2901	1.00	TL496	1.65	75450	.59
LM318H	1.59	LM383	1.95	LM741N-14	.35	LM3900	.59	TL497	3.25	75451	.39
LM319H	1.90	LM384	1.95	LM741H	.40	LM3905	1.25	75107	1.49	75452	.39
LM319	1.25	LM386	.89	LM747	.69	LM3909	.98	75110	1.95	75453	.39
LM320 (se		LM387	1.40	LM748	.59	LM3911	2.25	75150	1.95	75454	.39
LM322	1.65	LM389	1.35	LM1014	1.19	LM3914	3.95	75154	1.95	75491	.79
LM323K	4.95	LM390	1.95	LM1303	1.95	LM3915	3.95	75188	1.25	75492	.79
LM324	.59	LM392	.69	LM1310	1.49	LM3916	3.95	75189	1.25	75493	.89
LM329	.65	LM393	1.29	MC1330	1.69	MC4024	3.95		75494	.89	
LM331	3.95	LM394H	4.60	MC1349	1.89	MC4044	4.50	1			
LM334	1.19	LM399H	5.00	MC1350	1.19	RC4136	1.25		DI		
LM335	1.40	NE531	2.95	MC1358	1.69	RC4151	3.95		DII	FET	
LM336	1.75	NE555	.34	MC1372	6.95	LM4250	1.75	TL071	.79	TL084	2.19
LM337K	3.95	NE556	.65	LM1414	1.59	LM4500	3.25	TL072	1.19	LF347	2.19
LM337T	1.95	NE558	1.50	LM1458	.59	RC4558	.69	TL074	2.19	LF351	.60
LM338K	6.95	NE561	24.95	LM1488	.69	LM13080	1.29	TL081	.79	LF353	1.00
LM339	.99	NE564	2.95	LM1489	.69	LM13600	1.49	TL082	1.19	LF355	1.10
3 10 -				LM1496	.85	LM13700	1.49	TL083	1.19	LF356	1.10
	H = TO-	5 CAN	T	= TO-220	1	K = TO-3			LF357	1.40	
				100000000000000000000000000000000000000		TAX DESCRIPTION					- 4

	DIO		
LED	DIS	PLAYS	
HP 5082-7760	.43"	CC	1.29
MAN 72	.3"	CA	.99
MAN 74	.3"	CC	.99
FND-357 (359)	.375"	CC	1.25
FND-500 (503)	.5"	CC	1.49
FND-507 (510)	.5"	CA	1.49
TIL-311 4x7	.270"	HEX W/LOGIC	9.95

LED LAMPS		
	1-99	100-up
JUMBO RED	.10	.09
JUMBO GREEN	.18	.15
JUMBO YELLOW	.18	.15
LED MOUNTING HARDWARE	.10	.09

BYPASS	CAPS
.01 UF DISC	100/6.00
.01 UF MONOLITHIC	100/12.00
.1 UF DISC	100/8.00
1 UF MONOLITHIC	100/15.00

DIP	
SWITCH	ES
4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95

ALL MERCHANDISE 100% GUARANTEED

MAY 1984

CABINET #1 \$29.95

- * DIMENSIONS 8% x 5156 x 3156" ★ COMPLETE WITH POWER
- * COLOR MATCHES APPLE
- * FITS STANDARD 51/4" DRIVES, INCL. SHUGART
- * INCLUDES MOUNTING HARDWARE AND FEET

NOTE: Please include sufficient amount for hipping on above items.

CABINETS FOR 51/4" DISK DRIVES CABINET #2 \$79.00

- SUPPLY, SWITCH, LINE CORD, FUSE & STANDARD POWER CONNECTOR
- * DIMENSIONS: 111/2 x 53/4 x 315/16"
- * +5V @ 1 AMP, +12V @ 1.5 AMP
- * FITS STANDARD 51/4" DRIVES
- * PLEASE SPECIFY **GRAY OR TAN**

IC SOCKETS

10 300		13
	1-99	100
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
64 pin ST	4.25	call
ST = SOL	DERT	AIL
8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW		1.28
04 -1- 11011	4.40	4 05

1.80 ill

NEW UN-USED MUFFIN FANS

4.68" Square 14.95 3.125" Square 14.95

HEAT SINKS

.95 TO-220 style

SWITCHES

OPTO-ISOLATORS

1.00

1.10

.69

1.75

1.25

1.25

1.00

1.50

4N27

4N28

4N33

4N35

4N37

MCT-2

MCT-6

SPDT mini-toggle 1.25 DPDT mini-toggle SPST mini-pushbutton 1.50 .39

MCA-7

ILA-30

ILQ-74

H11C5

TIL-111

TIL-113

IL-1

MCA-255

1.75

1.25

1.25

2.75

1.25

1.00

1.75

TRANSISTORS

2N918	.50	MPS3706	.15
MPS918	.25	2N3772	1.85
2N2102	.75	2N3903	.25
2N2218	.50	2N3904	.10
2N2218A	.50	2N3906	.10
2N2219	.50	2N4122	.25
2N2219A	.50	2N4123	.25
2N2222	.25	2N4249	.25
PN2222	.10	2N4304	.75
MPS2369	.25	2N4401	.25
2N2484	.25	2N4402	.25
2N2905	.50	2N4403	.25
2N2907	.25	2N4857	1.00
PN2907	.125	PN4916	.25
2N3055	.79	2N5086	.25
3055T	.69	PN5129	.25
2N3393	.30	PN5139	.25
2N3414	.25	2N5209	.25
2N3563	.40	2N6028	.35
2N3565	.40	2N6043	1.75
PN3565	.25	2N6045	1.75
MPS3638	.25	MPS-A05	.25
MPS3640	.25	MPS-A06	.25
PN3643	.25	MPS-A55	.25
PN3644	.25	TIP29	.65
MPS3704	.15	TIP31	.75
The state of the s		TIP32	.79

DISK DRIVES TANDON

TM100-1 5%" (FOR IBM) SS/DD	229.00
TM100-2 54" (FOR IBM) DS/DD	259.00
SHUGART	
SA 400L 51/4" (40 TRACK) SS/DD	199.95
SA 400 54" (35 TRACK) SS/DD	189.95
PERTEC	
FD-200 5%" ss/DD	179.95
ED-250 54" DS/DD	100 05

MP-52 5%" (FOR IBM) DS/DD

MPI

ZIF = TI	EXTOC	
28 pin ZIF		ca
24 pin ZIF	7.95	ca
16 pin ZIF	5.95	ca

CONNECTORS

3.95

4.95

6.95

7.95

2.95

S-100 ST

S-100 WW

72 pin ST

72 pin WW

50 pin ST

44 pin ST

RESISTORS 1/4 WATT 5% CARBON FILM ALL STANDARD VALUES FROM 1 OHM TO 10 MEG OHM .025

50 PCS. SAME VALUE 100 PCS. SAME VALUE .02 1000 PCS. SAME VALUE .015

TE:	Please include g on above iten	sufficient	amount f
	DIOD	EC	1/0

	DIODES	
N751	5.1 volt zener	.25
N759	12.0 volt zener	.25
N4148	(1N914) switching	25/1.00
N4004	400PIV rectifier	10/1.00
BP02	200PIV 1.5amp bridge	.45
BP04	400PIV 1.5amp bridge	.55
M48	Dip-Bridge	.35



249.00

OUR BUYER BLEW IT... & BOUGHT TOO MANY OF THESE!

4116 250NS 8/7.95

RIBBON CABLE

	SINGLE	COLOR	COLOR CODED	
CONTACTS	1'	10'	1'	10'
10	.50	4.40	.83	7.30
16	.55	4.80	1.00	8.80
20	.65	5.70	1.25	11.00
25	.75	6.60	1.32	11.60
26	.75	6.60	1.32	11.60
34	.98	8.60	1.65	14.50
40	1.32	11.60	1.92	16.80
50	1.38	12.10	2.50	22.00

D-SUBMINIATURE

DESCRIPTION	SOLDI	ER CUP		ANGLE		CABLE	нос	DDS
DECOMM THOM	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	BLACK	GREY
ORDER BY	DBxxP	DBxxS	DBxxPR	DBxxSR	IDBxxP	IDBxxS	HOOD-B	HOOD
CONTACTS 9	2.08	2.66	1.65	2.18	3.37	3.69		1.60
15	2.69	3.63	2.20	3.03	4.70	5.13	-	1.60
25	2.50	3.25	3.00	4.42	6.23	6.84	1.25	1.25
37	4.80	7.11	4.83	6.19	9.22	10.08		2.95
50	6.06	9.24	-		-		S	3.50

For order instructions see "IDC Connectors" below.

MOUNTING HARDWARE 1.00

IDC CONNECTORS

DESCRIPTION	SOLDER HEADER	RIGHT ANGLE SOLDER HEADER	WW HEADER	RIGHT ANGLE WW HEADER	RIBBON HEADER SOCKET	RIBBON HEADER	RIBBON EDGE CARD
ORDER BY	IDHxxS	IDHxxSR	IDHxxW	IDHxxWR	IDSxx	IDMxx	IDExx
CONTACTS 10	.82	.85	1.86	2.05	1.15	_	2.25
20	1.29	1.35	2.98	3.28	1.86	5.50	2.36
26	1.68	1.76	3.84	4.22	2.43	6.25	2.65
34	2.20	2.31	4.50	4.45	3.15	7.00	3.25
40	2.58	2.72	5.28	4.80	3.73	7.50	3.80
50	3.24	3.39	6.63	7.30	4.65	8.50	4.74

ORDERING INSTRUCTIONS: Insert the number of contacts in the position marked "xx" of the "order by" part number listed. Example: A 10 pin right angle solder style header would be IDH10SR.

OR Microdevices

1224 S. Bascom Avenue, San Jose, CA 95128 800-538-5000 • 800-662-6279 (CA) (408) 995-5430 • Telex 171-110

VISIT OUR RETAIL STORE

HOURS: M-W-F, 9-5

T-Th., 9-9

Sat. 10-3

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order \$10. For shipping and handling include \$2.50 for UPS Ground and \$3.50 for UPS Air. Orders over 1 lb. and 52:30 for UPS Ground and \$3.30 for UPS Air. Orders over 1 to, and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax. Bay Area and LA residents include 6%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

Copyright 1984 JDR Microdevices

FOR APPLE COMPUTER USERS



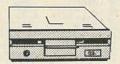
JDR 16K RAM CARD FOR APPLE II+

- * Expand your 48K Apple to 64K
- * Fully compatible with Apple Language System Use
- in place of Apple Language card

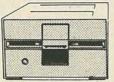
 * Highest quality card features: gold edge connector,
- sockets for all IC's. * 2 YEAR WARRANTY

Kit with Instructions \$40.95 Bare PC Card \$14.95

- * 35 Track if used with Apple Controller
- * 40 Track Controller and DOS Available (Call for Price)



MA SYSTEMS FD-35 DISK DRIVE



- Shugart Mechanism Made in U.S.A.
- Direct Replacement for Apple Disk II
- Compatible with Apple Controller or other Apple compatible controllers
- Specially designed electronics with low power consumption
- * DOS 3.3 and 3.2 compatible * One Year Warranty

CONTROLLER CARD \$69.95





APPLE COMPATIBLE

- * Use To Power Apple-Type Systems
- * +5V @ 5A +12V @ 3A -5V @ .5A -12V @ .5A
- * Instructions Included

BMC BMX-80 PRINTER

- * 80 CPS Dot Matrix Printer
- * Prints Bi-Directional in 40, 80, 71 or 142 Columns in Normal, Double Width or Compressed
- Print Superscript As Well As Superb Graphics in Character



micromax

VIEWMAX-80 NOW ONLY \$15995

- * 80 Column Card for Apple II+
- * Video Soft Switch
- * Inverse Video
- * 2 Year Warranty

VIEWMAX-80e NEW \$12995

- * 80 Column Card for Apple IIe
- ★ 64K RAM Expandable to 128K 64K RAM Upgrade

GRAPHMAX \$12995

- * Hi Resolution Graphics
- * Printer Card
- * Centronics Parallel Interface

Graphmax with Color & Zoom Options ... \$14995

NASHUA DISKETTES

5¼" WITH HUB RING	
MD1 SOFT SECTOR, SS/SD	19.95
MD1D SOFT SECTOR, SS/DD	26.25
MD2D SOFT SECTOR, DS/DD	30.75
MD2F SOFT SECTOR, DS/QUAD DENSITY	
MD110 10 SECTOR HARD, SS/SD	19.95
MD210D 10 SECTOR HARD, DS/DD	
9" WITHOUT HUB DING	

WITHOUT HUB RING 30.00 FD2D SOFT SECTOR, DS/DD

OTHER ACCESSORIES

THUNDERCLOCK \$129.95

- * Real-Time Clock Calendar
- Software Included
- * Mountain Software Compatible
- * BSR Control Options Available

KRAFT JOYSTICK

VERBATIM DATALIFE DISKETTES

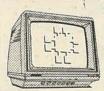
SS/DD SOFT SECTOR

\$29.95

SS/DD 10 HARD SECTOR \$29.95

51/4" DISKETTE FILE

- ATTRACTIVE FUNCTIONAL 75 DISK STORAGE
- MOLDED FROM' DURABLE SMOKED PLASTIC WITH \$1699 ING HANDLE



BMC MONITOR STAND **MODEL PA-900**

Your Display Will \$29.95 Tilt & Swivel

MONOCHROME

BMC BM 12AUW GREEN 12"	. \$89.95
BMC BM 12EUY 18 MHZ AMBER	\$139.95
BMC BM 12EUN 18 MHZ HIGH RES GREEN	\$115.00
NEC JB1201M - 20 MHZ GREEN	\$169.00
ZENITH ZVM-121 - 15 MHZ GREEN	. \$99.00

COLOR

BMC BM-AU9191U COMPOSITE 13" \$279.00

NO C.O.D. ORDERS PLEASE

JDR Microdevices

1224 S. Bascom Avenue, San Jose, CA 95128 800-538-5000 • 800-662-6279 (CA) (408) 995-5430 • Telex 171-110

Apple is a trademark of Apple Computer Corporation

VISIT OUR RETAIL STORE

HOURS: M-W-F, 9-5

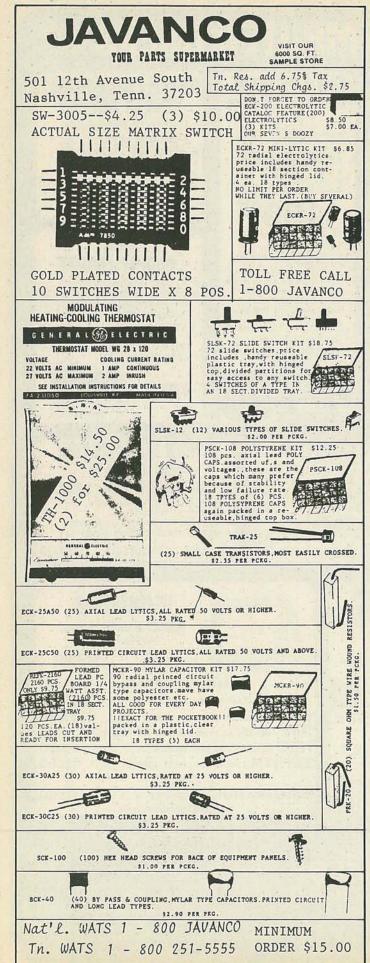
T-Th., 9-9

Sat. 10-3

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order \$10. For shipping and handling include \$2.50 for UPS Ground and \$3.50 for UPS Air. Orders over 1 lb. and \$2.50 for UPS Ground and \$3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax, Bay Area and LA residents include 6%%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

Copyright 1984 JDR Microdevices



\$ TECHNICIANS & SERVICEMEN COMPONENTS FOR YOUR MAINTENANCE & REPAIR WORK SPECIAL: OUR LOW LOW PRICES REPLACEMENT FOR ECG® TYPES TYPE NO \$ 125 FOUR for .99 102A FIVE for .99 123A FIVE for .99 123AP SIX for .99 159AP.... FOUR for .99 177 EIGHT for .99 199 FIVE for .99 SUPER SPECIAL (MIN. 5 PC. EACH) \$ YOUR COST TYPE NO. YOUR COST TYPE NO. 555 124 128 .90 \$.65 506 500A. 523.. 526A. 45 . . 2.25 10.20 13.75 \$.40 6.95 291 .95 JAPANESE TYPES (MIN. 5 PC. EACH) \$ HA1366W HA1377A LA4102 2SC867A 2.75 STK0029 STK0080 TA7205AP 3.80 9.99 2SC1114 2SC1308K AN214Q AN239A BA532... GH3F... 2.90 1.25 3.25 1.95 999999 2.95 1.45 M51515BL TA7208P STK433 STK435 TA7222AP UPC1181H UPC1182H 3.95 4.60 1.95 \$\$ 1.25 3.95 .89 6.25 HA1342A 2.30 STK439 UPC1185H 2.99 6.50COD ORDERS WELCOME (\$25 MIN. ORDER) \$ For Complete Component Catalog Call or Write \$\$\$

*ECG IS A TRADE MARK OF PHILIPS ECG.
DIGITRON ELECTRONIC IS NOT ASSOCIATED IN ANY WAY WITH PHILIPS ECG.

DIGITRON ELECTRONIC

110 HILLSIDE AVENUE, SPRINGFIELD, N.J. 07081

Toll Free: 800-526-4928 In NJ: 201-379-9016

CIRCLE 11 ON FREE INFORMATION CARD



No costly School, No commuting to class. The Original Home-Study course that prepares you for the FCC Radiotelephone license exam in your spare time! An FCC Government license is your "ticket" to thousands of exciting jobs in Communications, Radio & TV. Mobile two-way, Microwave, Computers, Radar, Aerospace and more. You don't need a college degree to qualify, but you do need an FCC License. No need to quit your job or go to school! You learn how to pass the FCC License exam at home at your own pace with this easy-to-understand, proven course. It's easy, fast and low cost! GUARANTEED PASS - You get your FCC License or money refunded. Write for free details. Soon you could be on your way to being one of the highest workers in the electronics field. Send for FREE facts now. MAIL COUPON TODAY!

COMMAND PRODUCTIONS FCC LICENSE TRAINING, Dept. 90 P.O. Box 2223, San Francisco, CA 94126

Rush FREE facts on how I can get my FCC License in spare time. No obligation. No salesman will call. NAME

ADDRESS

WE HAVE QUALITY PARTS, DISCOUNT PRICES AND FAST SHIPPING!



6 VOLTS @ 750 MA 6 VOLTS @ 150 MA \$1.25 12 VCT @ 200 MA 16.5 V. @ 3 AMPS 18 V. @ 650 MA \$2.00 18 VOLTS @ 1 AMP 24 VOLTS @ 250 MA \$4.50 \$2.50 24 VCT @ 1 AMP 42 VCT @ 1.2 AMP \$4.50

WALL TRANSFORMER

ALL ARE 115 VAC PLUG IN

6 VDC @ 100 MA 6 VDC @ 500 MA \$2.50 \$5.00 VDC @ 225 MA 4 VDC @ 300 M 15 VAC @ 300 MA \$3.00

SPRING LEVER **TERMINALS**

自自

EASILY HOOKS INTO STEREO SPEAKERS AND ALLOWS 110 VAC LIGHTS TO DANCE WITH MUSIC TWO SEPARATE 110 VAC

OUTPUTS FOR HIGH AND LOW FREQUENCY

\$6.50 PER UNIT

IDIO SIGNALS USE TWO ORGANS FOR

FREE! FREE! FREE!

REAT FOR SPEAKER ENCLOSURES OR POWER SUPPLIES

16.5 VAC @ 10 VA

\$1.00 EACH 10 FOR \$9.00

MULTI-

SWITCHES

3 STATION

NON-INTERLOCKING

3 - 2PDT SWITCHES. EACH OPERATES INDEPENDENTLY

MOUNTING CENTERS

134" BETWEEN

\$1.75 EACH

5 STATION

INTERLOCKING

MADE BY ALPS.
3 - 2PDT AND
2 - 6PDT

314" BETWEEN

MOUNTING CENTERS

\$2.50 EACH

5 STATION

NON-INTERLOCKING

SAME AS ABOVE EXCEPT

EACH SWITCH OPERATES \$2.50 EACH

INTERLOCKING ASSEMBLY

SWITCHES ON FULLY

HELPING HAND

WILL HOLD P.C. BOARD OR OTHER SMALL ITEMS AND ALLOW BOTH YOUR HANDS FREEDOM TO WORK.

MIKE CONNECTOR

5 CONDUCTOR IN-LINE PLUG AND CHASSIS MOUNT JACK TWIST LOCK STYLE, SAME AS SWITCHCRAFT 12CL5M

> METER 0 - 15 V.D.C.



SQUARE METER MEASURES \$4.50 EACH

SUB-MINIATURE D TYPE CONNECTOR

O THE PROPERTY OF

SOLDER TYPE SUB-MINIATURE CONNECTORS USED FOR COMPUTER HOOK UPS.

DB-15 PLUG DB-15 SOCKET DB-15 HOOD DB-25 PLUG DB-25 SOCKET DB-25 HOOD

"PARALLEL" PRINTER CONNECTOR

SWITCH

6 POSITION

75° EACH 10 for \$6.00

RELAYS

MINIATURE

6 VDC RELAY

RATED 1 AMP AT 30 VDC

DIRECT DRIVE POSSIBLE

1 3/16" × 13/32" × 7/16"

AROMAT # RSD-6V

FROM 43

COIL RES 220 OHM

開

OPERATES

SUPER SMALL SPDT RELAY: GOLD COBALT

\$3.50

LDER STYLE SS.50 EACH WANTER STATE OF THE STATE OF THE

SEND FOR



GRAIN OF WHEAT

T1 SIZE 125" DIA (3.15mm)

3 to 6 VOLTS 3 for \$1.00 Rated 55ma @ 5 VOLTS 6 to 12 VOLTS 3 for \$1.00

12 to 24 VOLTS 3 for \$1.00 Rated 45ma @ 14 VOLTS

T1 SIZE WITH WIRE LEADS

3 to 6 VOLTS 2 for \$1.00 6 to 12 VOLTS 2 for \$1.00 Rated 55ma @ 8 VOLTS

12 to 24 VOLTS 2 for \$1.00 Rated: 45ma @ 14 VOLTS

T1 - 3/4 SIZE WITH WIRE LEADS

163" DIA. (4.14mm)

3 to 6 VOLTS 2 for \$1.00 Rated: 45ma @ 6 VOLTS

6 to 12 VOLTS 2 for \$1.00 ted: 55ma @ 8 VOLTS 12 to 24 VOLTS 2 for \$1.00 Rated: 45ma @ 14 VOLTS

NEON W/ RESISTOR

DIRECT OPERATION 7 for \$1.00 FROM 120 VOLT

120V INDICATOR Of man

NEON INDICATOR, RATED 120 V 1/3 W. MOUNTS IN 5/16" HOLE RED LENS. 75¢ FACH

SOLDERING **IRON STAND**

SPRING STEEL IRON HOLDER ON WEIGHTED BASE

\$5.00 EACH

BATTERY OPERATED SMOKE DETECTOR

BRK MODEL = 79R UL APPROVED 9 VOLT BATTERY OPERATION FOR CEILING OR WALL MOUNT.

\$8.00 EACH 2 FOR \$15.00



EDGE CONNECTORS

Communication and the communication of the communic iimmmmmmmm ALL ARE 156" SPACING

15 PIN GOLD SOLDER EYELET \$1.75 EACH

15/30 GOLD SOLDER EYELET \$2.00 EACH

18/36 GOLD SOLDER EYELET \$2.00 EACH

22/44 TIN P.C. STYLE: NO MOUNTING FARS \$1.50 EACH 10 FOR \$14.00

22/44 GOLD \$2.00 EACH 10 FOR \$18.00 P.C. STYLE

28/56 GOLD

28/56 GOLD PLATED CONTACTS .156 CONTACT SPACING \$2.50 EACH 10 FOR \$22.00

50/100 GOLD STANDARD S-100 CONNECTOR .125" SPACING, GOLD PLATED P.C. MOUNT

\$3.75 EACH 10 FOR \$35.00

SWITCHES MINI-PUSH BUTTON

35¢ EACH

100 FOR \$30.00

KEY SWITCH



RED LIGHTED 120 VAC

7/8" SQUARE HOLE

COLOR LIGHT STRING AVAILABLE \$1.75 EA

LINE CORDS

TWO WIRE

THREE WIRE

2 for \$1.00

8 FOOT 18ga THREE WIRE

\$2.00 EACH

MOTOROLA #MP 12002

#MP 120D2

RATED:
CONTROL—3.6-6VDC
LOAD—120VAC 2 AMPS
T.T.L COMPATIBLE
SIZE: 1 V (= × % × 1" HIGH

\$3.50 EACH 10 FOR \$32.00

SOLID STATE

RELAYS

2 AMP

TWO WIRE 18ga TWO WIF 3 FOR \$1.00

2 CHANNEL LIGHT ORGAN

10 POSITION ROTARY SCREWDRIVER ADJUST: FITS 6 PIN DIP.

\$1.85 EACH

KEY **ASSEMBLY**

5 KEY

6 KEY

\$1.25 EACH

CONTAINS 6 SINGLE-POLE NORMALLY OPEN SWITCHES MEASURES 4 1/4" LONG

TRANSISTORS

2N706 2N2222A PN2222

5 for \$1.00 4 for \$1.00 8 for \$1.00 4 for \$1.00

2K 10 TURN MULTI-TURN POT

SPECTROL #MOD 534-74



#MOD 534-7161 \$5.00 EACH

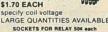
\$1.50 EACH 10 FOR \$13.50 13 VDC RELAY

OPEN CONTACT
COIL 13 VDC 650 OHMS
SPECIAL PRICE \$1.00 EACH

4 PDT RELAY

3 amp contacts

· 24 volt d.c. or 120 volt a c. coil • Used but fully tested \$1.70 EACH



COMPUTER GRADE CAPACITORS

2,000 mfd. 200 VDC 1 3/4" DIA 5" HIGH 3,600 mfd. 40 VDC 6,400 mfd. 60 VDC 1 3/8" DIA - 4 1/4" HIGH 21,000 mfd. 50 VDC 21/2" DIA. - 5" HIGH 22,000 mfd. 40 VDC 2" DIA * 6" HIGH 31,000 mfd. 15 VDC

44,000 mfd. 35 VDC 72,000 mfd. 15 VDC

CLAMPS TO FIT CAPACITORS 50¢ ea.

GH \$1.00 \$2.50 \$4.00 \$3.00 \$2.50

185,000 mfd. 6 VDC 2 1/2" DIA . 4 1/2" HIGH \$1.50

SLIDE | POTS

100K linear tape

1 5/8" TRAVEL 75¢ EACH 500K linear taper LONG 3/4" TRAVEL 75¢ FACH

DUAL 100K audio taper 2 1/2" TRAVEL. \$1.50 EACH

CRYSTALS CASE STYLE HC33/U

COLORBURST 3579,545 KC 2 MHZ \$3 50 FACH \$1.00 EACH

METAL OXIDE VARISTOR

50 VOLTS, NOMINAL D.C. VOLTAGE

2 FOR \$1.50 MINIATURE TOGGLE SWITCHES

S.P.D.T. (on-on)

P.C. STYLE. NON-THREADED BUSHING 75¢ EACH 10 FOR \$7.00

(on-off-on)

NON-THREADED 際 STYLE 75¢ EACH 10 FOR \$7.00

(on-on) SOLDER LUG TERMINALS \$1.00 EACH 10 FOR \$9.00 100 FOR \$80.00

D.P.D.T. (on-on)

SPST MOMENTARY NORMALLY OPEN 1/4" BUSHING

SPECIFY COLOR RED. BLACK, WHITE. GREEN, YELLOW

KEY REMOVES BOTH POSITIONS \$3.50 EA



10 AMP SPST

POWER" PRINTED ON

\$1.50 EA 10 FOR \$13.50

48 PAGE CATALOG FREE! FREE! FREE!

BCD DIP SWITCH

ENDOUGH \$1.00 EACH CONTAINS 5 SINGLE-POLE MEASURES 3 3/4" LONG



1-800-826-5432 (ORDER ONLY)

ALASKA HAWAII

ORINFORMATION (213) 380 8000

AN 8 TRACK/CASSETTE UNIT, IT WILL SUPPLY APPROX 18 VDC AND INCLUDES A SMALL PRE-AMP TO BOOST SIGNAL LEVEL RCA PLUGS FOR LINE IN/OUT

\$4.50 EACH



CONTACT: S.P.N.C. ENERGIZE COIL TO

14 pin style



ALL ARE RATED 5 AMPS @ 125 VAC

\$4.00

S.P.D.T. (on-on) P.C. LUGS. \$1.00 EACH 10 FOR \$9.00 V V 100 FOR \$80.00

Los Angeles, Calif. 90006

S.P.D.T. (on-off-on) SOLDER LUG

L.E.D.'S STANDARD JUMBO DIFFUSED RED 10 FOR \$1.50 GREEN 10 FOR \$2.00 YELLOW 10 FOR \$2.00

FLASHER LED 5 VOLT OPERATION RED JUMBO SIZE

\$1.00 EACH BI POLAR LED

SUB MINI LED

.079" × .098" RED 10 FOR \$1.00 200 FOR \$18.00

GREEN 10 FOR \$1.50

LED HOLDERS TWO PIECE HOLDER FOR JUMBO LED 10 FOR 65¢ 200 FOR \$10.00

PHOTO-FLASH CAPACITORS

35 MFD 330 VOLT 5/8" DIA 9

45¢ EACH... 10 FOR \$4.00 170 MFD 330 VOLT

2 FOR \$1.50 10 FOR \$7.00

750 MFD 330 VOLT \$1.25 EACH 10 FOR \$11.00

POWER SUPPLY W/ PRE-AMP



THIS SUPPLY WAS USED TO POWER

OLL FREE ORDERS ONLY (IN CALIFORNIA: 1-800-258-6666)

905 S. Vermont Ave. PO BOX 20406 MINIMUM ORDER \$10.00 USA: \$2.50 SHIPPING FOREIGN ORDERS INCLUDE SUFFICIENT SHIPPING CALIF RES. ADD 6 1/2 NO COD!

MAY

1984



ORDER TOLL FREE

(800) 538-8800

(CALIFORNIA RESIDENTS)

(800) 848-8008





TERMS: For shipping include \$2.00 for UPS Ground or \$3.00 for UPS Blue Air. \$10.00 minimum order. Bay Area and Los Angeles Counties add 6½% Sales Tax, other California residents add 6% Sales Tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice.

VISIT OUR RETAIL STORE

2100 De La Cruz Blvd. Santa Clara, CA 95050 (408) 988-0697



STATIC RAMS

5101	256 x 4 (450ns) (cmos)	3.90	
2102-1	1024 x 1 (450ns)	.88	
2102L-4	1024 x 1 (450ns) (LP)	.98	
2102L-2	1024 x 1 (250ns) (LP)	1.45	
2111	256 x 4 (450ns)	2.45	
2112	256 x 4 (450ns)	2.95	
2114	1024 x 4 (450ns)	8/9.90	
2114-25	1024 x 4 (250ns)	8/9.95	
2114L-4	1024 x 4 (450ns) (LP)	8/11.95	
2114L-3	1024 x 4 (300ns) (LP)	8/12.45	
2114L-2	1024 x 4 (200ns) (LP)	8/12.95	
2147	4096 x 1 (55ns)	4.90	
TMS4044-4			
TMS4044-4	4096 x 1 (450ns)	3.45	
	4096 x 1 (300ns)	3.95	
TMS4044-2	4096 x 1 (200ns)	4.45	
MK4118	1024 x 8 (250ns)	9.90	
TMM2016-200	2048 x 8 (200ns)	4.10	
TMM2016-150	2048 x 8 (150ns)	4.90	
TMM2016-100	2048 x 8 (100ns)	6.10	
HM6116-4	2048 x 8 (200ns) (cmos)	4.70	
HM6116-3	2048 x 8 (150ns) (cmos)	4.90	
HM6116-2	2048 x 8 (120ns) (cmos)	8.90	
HM6116LP-4	2048 x 8 (200ns) (cmos)(LP)	5.90	
HM6116LP-3	2048 x 8 (150ns) (cmos)(LP)	6.90	
HM6116LP-2	2048 x 8 (120ns) (cmos)(LP)	9.95	
Z-6132	4096 x 8 (300ns) (Qstat)	33.95	
18/05		-	

LP = Low Power

Qstat = Quasi-Static

DYNAMIC RAMS

TMS4027	4096 x 1 (250ns)	1.95
UPD411	4096 x 1 (300ns)	2.95
MM5280	4096 x 1 (300ns)	2.95
MK4108	8192 x 1 (200ns)	1.90
MM5298	8192 x 1 (250ns)	1.80
4116-300	16384 x 1(300ns)	8/10.75
4116-250	16384 x 1(250ns)	8/10.95
4116-200	16384 x 1(200ns)	8/11.95
4116-150	16384 x 1(150ns)	8/13.95
4116-120	16384 x 1(120ns)	8/28.95
2118	16384 x 1(150ns) (5v)	4.90
4164-200	65536 x 1(200ns) (5v)	CALL
4164-150	65536 x 1(150ns) (5v)	CALL

5V = single 5 völt supply

EPROMS

1.00		
1702	256 x 8 (1us)	4.45
2708	1024 x 8 (450ns)	3.90
2758	1024 x 8 (450ns) (5v)	5.90
2716	2048 x 8 (450ns) (5v)	3.90
2716-1	2048 x 8 (350ns) (5v)	5.90
TMS2516	2048 x 8 (450ns) (5v)	5.45
TMS2716	2048 x 8 (450ns)	7.90
TMS2532	4096 x 8 (450ns) (5v)	5.90
2732	4096 x 8 (450ns) (5v)	4.90
2732-250	4096 x 8 (250ns) (5v)	8.90
2732-200	4096 x 8 (200ns) (5v)	10.95
2764	8192 x 8 (450ns) (5v)	9.90
2764-250	8192 x 8 (250ns) (5v)	13.95
2764-200	8192 x 8 (200ns) (5v)	23.95
TMS2564	8192 x 8 (450ns) (5v)	16.95
MC68764	8192 x 8 (450ns) (5v)(24 pin)	38.95
27128	16384 x 8Call	Call

5v = Single 5 Volt Supply

74LS00

74LS00	.23	74LS92	.54
74LS01	.24	74LS93	.54
74LS02	.24	74LS95	.74
74LS03	.24	74LS96	.88
74LS04	.23	74LS107	.38
74LS05	.24	74LS109	.38
74LS08	.27	74LS112	.38
74LS09	.28	74LS113	.38
74LS10	.24	74LS114	.38
74LS11	.34	74LS122	.44
74LS12	.34	74LS123	.78
74LS13	.44	74LS124	2.85
74LS14	.58	74LS125	.48
74LS15	.34	74LS126	.48
74LS20	.24	74LS132	.58
74LS21	.28	74LS133	.58
74LS22	.24	74LS136	.38
74LS26	.28	74LS137	.98
74LS27	.28	74LS138	.54
74LS28	.34	74LS139	.54
74LS30	.24	74LS145	1.15
74LS32	.28	74LS147	2,45
74LS33	.54	74LS148	1.30
74LS37	.34	74LS151	.54
74LS38	.34	74LS153	.54
74LS40	.24	74LS154	1.85
74LS42	.48	74LS155	.68
74LS47	.74	74LS156	.68
74LS48	.74	74LS157	.64
74LS49	.74	74LS158	.58
74LS51	.24	74LS158	.58
74LS54	.28	74LS161	.64
74LS55	.28	74LS161	.68
74LS63	1.20	74LS162	
74LS73	.38		.64
74LS74	.34	74LS164 74LS165	.68
74LS75	.38	74LS165	1.90
74LS76			1.90
74LS78	.38	74LS168	1.70
74LS78		74LS169	1.70
	.59	74LS170	1.45
74LS85	.68	74LS173	.68
74LS86	.38	74LS174	.54
74LS90	.54	74LS175	.54
74LS91	.88	74LS181	2.10
			10.15

74LS189 74LS190 74LS191 74LS192 74LS193 74LS194 74LS195 74LS195 74LS196 74LS240 74LS240 74LS241 74LS243 74LS243 74LS245 74LS245 74LS245 74LS245 74LS255 74LS257 74LS257 74LS258 74LS258 74LS257 74LS258 74LS275 74LS280 74LS280 74LS280 74LS280 74LS280 74LS280 74LS293 74LS293 74LS298 74LS298 74LS298 74LS298 74LS323 74LS323 74LS323	8.90 .88 .88 .78 .68 .68 .78 .68 .88 .98 .98 .98 .98 .98 .98 .9	74L9363 74L9364 74L9365 74L9365 74L9367 74L9377 74L9378 74L9377 74L9378 74L9378 74L9385 74L9390 74L9395 74L9395 74L9395 74L9395 74L9395 74L9395 74L9395 74L9396 74L9490 74L9604 74L9604 74L9606 74L9608	1.33 1.94 4.4 4.4 4.3 1.33 1.33 1.3 1.1 1.1 1.1 1.1 1.1 1.1
	1MHZ		
6522 6532 6545	2 MHZ		4.30 7.90 9.90 . 21.50
6522A 6532A 6545A 6551A	3 MHZ		9.90 . 10.95 . 26.95 . 10.95
6502B	6000		. 13.95
6802 6808 6809E 6809 6810 6820 6821 6828 6840 6843 6844 6845 6847 6850 6860 6862 6860 6862 6880 6880 6883 68047	6800	1MHZ	3.90 7.90 12.90 18.95 10.95 4.30 13.95 11.95 33.95 13.95 10.95 32.90 15.70 10.95 6.90 21.95 23.95 18.95
68B09E 68B09 68B10 68B21 68B45 68B50	8000		. 28.95 . 28.95 6.90 6.90 . 18.95 5.90
8080			6.90 16.95 49.95 5.90 5.90 10.95 28.95 CALL 38.95 6.90 7.90 6.90 28.95 6.90

THE RESERVE OF THE PARTY OF THE			
8200 1202 23.95 1203 38.95 1205 3.45 1212 1.75 1214 3.80 1216 1.70 1224 2.20 1226 1.75 1228 3.45 1237 18.95 18.95			
1237-5 20.95 1238 4.45 1243 4.40 1250 9.95 3251 4.45 3253 6.90 3253-5 7.90 3255 14.95 3255-5 18.95 3257-7 7.90			
3257-5 8.90 3259 6.85 3259-5 7.45 3271 38.95 3272 38.95 3275 28.95 3279 8.90 3279-5 9.00 3283 6.45 3284 14.95			
3286 6.45 3287 6.45 3288 24.00 3289 48.95			
2.5 Mhz			
Z80-CPU 3.90 Z80-CTC 4.45 Z80-DART 9.95 Z80-DMA 13.95 Z80-PIO 4.45 Z80-SIO/0 15.95 Z80-SIO/2 15.95 Z80-SIO/9 15.95			
4.0 Mhz Z80A-CPU 4.90 Z80A-CTC 4.90 Z80A-DART 10.95 Z80A-DMA 15.95 Z80A-PIO 4.90 Z80A-SIO/0 15.95 Z80A-SIO/1 15.95 Z80A-SIO/2 15.95 Z80A-SIO/9 15.95			
6.0 Mhz Z80B-CPU 12.95 Z80B-CTC 12.95 Z80B-PIO 12.95 Z80B-DART 18.95 ZILOG			
Z6132			
DISC CONTROLLERS 1771 15.95 1791 23.95 1793 25.95 1795 48.95 1797 48.95 2791 53.95 2795 58.95 2797 58.95 6843 33.95 8272 38.95 UPD765 38.95 MB8876 28.95 MB8877 33.95 1691 16.95			
2143			
UARTS AY3-1014 6.90 AY5-1013 3.90 AY3-1015 6.90 PT-1472 9.90 TR1602 3.90 2350 9.90 2651 8.90 TMS601 5.90 IM6402 7.90 IM6403 8.90 INS8250 9.95			
### INTERFACE ST26			

1			
	VOLTAGED	FOUL ATOR	
	VULIAGE H	EGULATORS	>
	7805T .74	7905T	.84
	78MO5C .34 7808T .74	7908T	.84
	7808T .74 7812T .74	7912T 7915T	.84
	7815T .74	7924T	.84
	7824T .74	7905K	1.44
	7805K 1.34	7912K	1.44
	7812K 1.34 7815K 1.34	7915K 7924K	1.44
	7824K 1.34	79L05	.78
	78L05 .68	79L12	.78
	78L12 .68	79L15	.78
	78L15 .68	LM323K	4.90
	78H05K 9.90 78H12K 9.90	UA78S40	1.90
	78H12K 9.90		
	C,T = TO-220 K	= TO-3 L =	TO-92
	202 200		
		ITCHES	14
	4 POSITION		84
	5 POSITION		
	7 POSITION		
	10.00	CVETC	
	10 50	CKETS	
		1-99	100
	8 pin ST	.12	.10
	14 pin ST 16 pin ST	.14	.11
	16 pin ST 18 pin ST	.19	.17
	20 pin ST	.28	.17
	22 pin ST 24 pin ST	.29	.26
	28 pin ST	.39	.31
	40 pin ST	.48	.38
	64 pin ST	4.20	call
		LDERTAIL	
	8 pin WW	.58	.48
	14 pin WW 16 pin WW	.68	.51 .57
	18 pin WW	.98	.89
	20 pin WW	1.04	.97
	22 pin WW 24 pin WW	1.34 1.44	1.23
	28 pin WW	1.64	1.44
	40 pin WW	1.94	1.75
	CONTRACTOR OF THE PROPERTY OF	IREWRAP	
	16 pin ZIF	6.70	call
	24 pin ZIF 28 pin ZIF	9.90 9.95	call
		(ero Insertion Force)	
	ZIF = TEXTOOL (Z	ero msertion roice)	
	CRYS	TALS	
	32.768khz		
	1.0 mhz		. 1.90
			. 4.90
	1.0422		. 4.90
	1.0422		. 4.90
	1.0422		. 4.90
	1.0422		. 4.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0		. 4.90 . 4.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0		. 4.90 . 4.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90
	1.8432		. 4.90 . 4.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0		. 4.90 . 4.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143		. 4.90 . 4.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144		. 4.90 . 4.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0688 5.185 5.7143 6.0 6.144 6.5536		. 4.90 . 4.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0		. 4.90 . 4.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.068 5.185 5.7143 6.0 6.144 6.5536 8.0		. 4.90 . 4.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818		4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818		4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430		4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430		4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432		4.90 4.90 3.00 3.00
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184		4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.088 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0		4.90 4.90 3.00 3.00
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.088 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0		4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0	STORS	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0	STORS WALL STANDARD VA	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 1	STORS	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.0 18.0 18.0 19	STORS M ALL STANDARD VA TO 10 MEG OHM	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.1 10.0 10.1 10.0 10.1 10.0 10.1 10.0 10.1 10.0 1	STORS M ALL STANDARD VA TO 10 MEG OHM	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS 4.6401 18.7430 18.	STORS M ALL STANDARD VA TO 10 MEG OHM	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS 4.6401 18.7430 18.	STORS M ALL STANDARD VA TO 10 MEG OHM	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS 4.0 WATT 5 * CARBON FILLIFROM 1 OHM 150 FROM 1 OHM 150 100 PCS. 1000 PCS. 1000 PCS.	STORS MALL STANDARD VA TO 10 MEG OHM	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS 14 WATT 5* CARBON FILL FROM 1 OHM 50 PCS. 100 PCS. 1000 PCS. 1000 PCS.	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS 4.0 WATT 5 * CARBON FILLIFROM 1 OHM 150 FROM 1 OHM 150 50 PCS. 1000 PCS. 1000 PCS.	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SR NASHUA	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS 14 WATT 5* CARBON FILL FROM 1 OHM 50 PCS. 100 PCS. 1000 PCS. 1000 PCS.	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SR NASHUA	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS 14 WATT 5* CARBON FILL FROM 1 OHM 1 50 PCS. 100 PCS. 100 PCS. 100 PCS. 114" DIS ATHANA O	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SR NASHUA	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS WANTT 5* CARBON FILLY FROM 1 OHM 50 PCS. 100 PCS. 100 PCS. 100 PCS. 100 PCS. 100 PCS. SSDD. SSDD.	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SKETTES	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS WANTT 5* CARBON FILLIFROM 1 OHM 50 PCS. 100 PCS. 100 PCS. 100 PCS. 100 PCS. 100 PCS. 100 PCS. SSDD. SSDD. SSDD. DSDD	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SKETTES SKETTES	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS WANT 5 * CARBON FILL FROM 1 OHM 50 PCS. 1000 PCS. 1000 PCS. 1000 PCS. 1000 PCS. SSDD SSDD DSDD 51/4" DIS	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SKETTES	4.90 4.90 3.90 3.90 3.90 3.90 3.90 3.90 3.90 3
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 17.430 18.0 18.432 20.0 22.1184 32.0 RESIS WANT 5 * CARBON FILLY FROM 1 OHM 50 PCS. 1000 PCS. 1000 PCS. 1000 PCS. 1000 PCS. SSSD. SSDD. DSDD. 51/4" DIS NO L	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SKETTES SKETTES SKETTES	. 4.90 . 4.90 . 3.90 . 3.90
	1.8432 2.0 2.097152 2.4576 3.2768 3.579535 4.0 5.0688 5.185 5.7143 6.0 6.144 6.5536 8.0 10.0 10.738635 14.31818 15.0 16.0 17.430 18.432 20.0 22.1184 32.0 RESIS 4 WATT 5 * CARBON FILL FROM 1 OHM 50 PCS. 1000 PCS. 1000 PCS. 1000 PCS. 1000 PCS. SSDD DSDD 51/4" DIS ATHANA O SSSD. SSDD DSDD 51/4" DIS NO L SINGLE SIDED D	STORS MALL STANDARD VA TO 10 MEG OHM SKETTES SKETTES SKETTES SKETTES	. 4.90 . 4.90 . 3.90 . 3.90

APPLE ACCESSORIES

80 Column Card	129.95
16 K Card	42.50
Fan	38.95
Power Supply	
RF Mod	
Joy Stick (Apple II)	
Paddles Apple	
Z80 Card	
SCRG Switch A-Slot	
Paddle Adapple	
Extend-A Slot	
Disk Drive	
Controller Card	

Disk Drive





The Flip Sort Plus™

The Flip Sort Plus™ adds new dimensions to storage. Designed with similar elegant lines as the original Flip SortTM, in a transparent smoked acrylic. The Flip Sort Plus™ has a storage capacity of over 100 diskettes and has all the outstanding features you have come to expect from the flip sort Family. 24.95 each



2100 De La Cruz Blvd. Santa Clara, CA 95050

(WITH JACKETS AND HUB RING)

Pack of 100\$149.00

126



CIRCLE 27 ON FREE INFORMATION CARD



A superb learning tool for students, instructors, hobbyists.

Nothing else needed. Just plug in and start learning! Complete experimenters manual, easy instructions. 18 experiments. Fully expandable for Z80-CTC, Z80-PIO, EPROM, Breadboarding and prototyping. Invest with confidence. Now only \$129.95, two for only \$239.95.

2KB BASIC interpreter now available, only \$19.00. Full money back guarantee!

*Plus-*FREE GIFT

☐ Check this box for FREE Z-80 Microprocessor Programming and Interfacing textbook when you order within 7 days. \$12.95 value.



For immediate action call TOLL FREE Dept. RE-054 1 000 426

Redmond, V	N.E. 40th I TO NA 98052	UU-44	20-1044
NAME			
ADDRESS			me" L
CITY		ST	ZIP
□ VISA	☐ MSTCRD	EXP	
ACCT NO.			

CIRCLE 39 ON FREE INFORMATION CARD

HIGH QUALITY # 55dB GAIN Varible from 1.9 to 2.5 GHz The latest advance in microwave

technology with a SNOW-FREE PICTURE.

> Two Models to choose from. Both Models Include:

- 20" Parabolic Dish
- Pre-assembled Probe with Down Converter
- Power Supply and Coax Switch
- 60' of RG-59/U Coax with Connector
- Transformer for 75 to 300 Ohms All Mounting Hardware for Fast and
- Easy Installation

20" Fiberglass Dish Up to 55dB Gain Special \$9895

20" Aluminum Dish Up to 55dB Gain \$9895

Low Priced Add 10% for Foreign orders or U.S. Parcel Post

High Gain Yagi Antenna with Down Converter and \$8995
Power Supply, Complete System, Ready to Use. Power Supply. Complete System, Ready to Use.

Send \$2.00 for Catalog. Refundable with first purchase
Available thru Mail and Phone Orders Only
20% deposit for COD. CA Res add 65% Tax.
Send Cashiers Check or Money Order to:
(Personal Checks, allow 2-5 weeks to clear)

PROFESSIONAL VIDEO, Inc. 4670 Hollywood Blvd., Hollywood, Calif. 90027

For C.O.D. Orders Call (213) 352-9681 219-0227

CIRCLE 21 ON FREE INFORMATION CARD

Our Isolators eliminate equipment interaction, clean up interference, curb damaging power line spikes



ISO-1 ISOLATOR

3 isolated sockets; quality spike suppression; basic protection. . \$81.95

ISO-3 SUPER-ISOLATOR

3 dual isolated sockets; suppressor; commercial protection. \$122.95

ISO-17 MAGNUM ISOLATOR

4 quad isolated sockets; suppressor; laboratory grade protection. . \$213.95

Electronic Specialists, Inc.

171 S. Main, Natick, MA 01760 (617) 655-1532

Toll Free Order Desk 1-800-225-4876 MasterCard, VISA, American Express

CIRCLE 6 ON FREE INFORMATION CARD

ELECTRONIC KITS FROM HAL-TRONIX

2304 MHZ DOWN CONVERTERS. TUNES IN ON CHANNELS 2TO 7 ON YOUR OWN HOME T.V. HAS FREQUENCY RANGE FROM 2000 MHZ TO 2500 MHZ. FASY TO CONSTRUCT AND COMES COMPLETE WITH ALL PARTS INCLUDING A DIE-CAST ALUM CASE AND COAX FITTINGS, REQUIRE A VARIABLE POWER SUPLY AND ANTENNA (Antenna can be a dish type or coffee can type depending on the signal strength in your area.)

2304 MOD 1 (Basic Kit) 2304 MOD 2 (Basic Pre-amp) \$29.95 2304 MOD 3 (Hi-Gain Pre-amp) \$39.95 POWER SUPPLY FOR EITHER MODEL ABOVE IS AVAILABLE. COMES COMPLETE WITH ALL PARTS, CASE, TRANSFORMER, ANTENNA SWITCH AND CONNECTORS (Kit) \$24.95 \$34.95

Slotted Microwave Antenna For Above Downverters .. \$39.95

PREAMPLIFIERS

HAL PA-19—1.5 mhz to 150 mhz. 19db gain operates on 8 to 18 volts at 10ma. Complete unit \$8.95. HAL PA-1.4—3 mhz to 1.4 ghz. 10 to 12 db gain operates on 8 to 18 volts at 10 ma. Complete unit \$12.95.

(The above units are ideal for receivers, counters, etc.)

12 LINE TOUCH TONE DECODER KIT WITH P.C.

BOARD AND PARTS \$39.95 16 LINE ENCODER KIT. COMPLETE WITH CASE, PAD AND COMPONENTS \$39.95 \$39.95

12 LINE ENCODER KIT, COMPLETE WITH CASE, PAD AND COMPONENTS....

Complete Sets of P.C. Boards Available For: Unicorn Robot Project and Heart-A-Matic Project MANY, MANY OTHER KITS AVAILABLE Send 20 cents stamp or S.A.S.E. for information and figer on of HAL-TRONIX products. To order by phone: 1-313-285-1782.



HAL-TRONIX P.O. Box 1101 Southgate, MI 48195

INFORMATION.

DALBANI CORPORATION



AN SER	A STATE OF THE PARTY OF THE PAR	BU SER	
AN-124Q AN-203C	\$.88	BU-205A BU-208A	\$.94
AN-210	.81	CX SERI	
AN-214P AN-214O	.77	CY-130	\$3.65
AN-225	1.90	CX-143A	5.46 5.46
AN-228W	1.76	CX-130 CX-143A CX-186 CX-187	5.46 5.46
AN-236	1.29	HA SERI	
AN-239Q	2.68	HA 1125	\$.61
AN-241P	.55	HA-1137W	.58
AN-245 AN-247	2.00	HA-1156	.54
AN-252	1.14	HA-1306W	1.13
AN-253	.71	HA-1319	1.21
AN-262	.78	HA-1339	1.13
AN-264	1.00	HA-1339A	1.13 1.21 1.25 1.13 1.13 1.16
AN-274	1.24	HA-1366W	.66
AN-277	1.00	HA-1366WF	.66
AN-303	2.30	HA-1368R	.94
AN-313 AN-315	1.55	HA-1371	1.58
AN-316	1.98	HA-1377A	.66 .94 .94 1.58 1.20 1.20
AN-318	3.25	HA-1388	1.41
AN-331U	1.41	HA-1389R	.95 .95 1.28 1.67 1.71 1.63 .57 2.14 1.60
AN-360	.31	HA-1392	1.28
AN-366P	.61	HA-1394	1.71
AN-610	.64	HA-1398	1.63
AN-5111	2.23	HA-11215	2.14
AN-5132	1.46	HA-11221	1.60
AN-5230	1.72	HA-11229	.46 .83 1.05
AN-5320	1.27	HA-1125 HA-1137W HA-1156 HA-1199 HA-1306W HA-1319 HA-1339A HA-1339A HA-1366W HA-1366W HA-1366W HA-1368W HA-1368W HA-1368W HA-1368W HA-1377A HA-1377 HA-1377A HA-1392 HA-1392 HA-1391 HA-1391 HA-1392 HA-1394 HA-1397 HA-1394 HA-1397 HA-1397 HA-1397 HA-1397 HA-1397 HA-1397 HA-1397 HA-1397 HA-1397 HA-1397 HA-1398 HA-1397 HA-1397 HA-1398 HA-1397 HA-1398 HA-1397 HA-1398 HA-1399 HA-1398 HA-1399 H	1.05
AN-5510	1.41	LA SERI	ES
AN-5722	.55	LA-1111P	\$.48
AN-5732	.50	LA-1150	.35
AN-5753	.69	LA-1201	.40
AN-6100	1.79	LA-1210 LA-1222	.61 .25
AN-6120	1.50	LA-1230	.59
AN-7110	.50	LA-1240	.69 .63
AN-7114E	.58	LA-1245	.85
AN-7120	.61	LA-1352	.98
AN-7130	.63	LA-1354	.98 .53 1.34
AN-7146M	1.23	LA-1363	.64
AN-7150 AN-7151	1.17	LA-1364	.71
AN-7154	1.10	LA-1367	1.53
AN-7156N AN-7254	1.55	LA-1368	1.27
AN-7311	.35	LA-1385	.78
AN-124Q AN-203C AN-210 AN-214P AN-214Q AN-225 AN-228W AN-236 AN-236 AN-236 AN-240P AN-247 AN-252 AN-253 AN-253 AN-259 AN-262 AN-253 AN-253 AN-253 AN-253 AN-253 AN-253 AN-262 AN-264 AN-274 AN-274 AN-277 AN-303 AN-318 AN-316 AN-318 AN-316 AN-318 AN-316 AN-318 AN-310 AN-318 AN-310 AN-318 AN-310 AN-318 AN-310 AN-318 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-319 AN-3110 AN-31110 A	1.22	LA-1387	1.84
BA SER	155	LA-1390	1.61
BA-301 BA-311	\$.34 .36 .39 .79	LA-1460	50 1.53 1.27 1.17 .78 1.84 1.61 1.16 1.48 1.14 1.16 .75 .60
BA-313	.39	LA-2100	1.14
BA-511A	.79	LA-2101	1.16
BA-521	.68	LA-3101	.60
BA-526 BA-527	.50 .61	LA-3110	.32 .35 .35
BA-532	.65	LA-3120	.35
BA-1310	.65 .97 .72	LA-3122	.60
BA-1320	.64	LA-1130 LA-11130 LA-1210 LA-1220 LA-12210 LA-12230 LA-1231N LA-1240 LA-1245 LA-1352 LA-1354 LA-1355 LA-1363 LA-1365 LA-1366 LA-1367 LA-1368 LA-1369 LA-1368 LA-1369 LA-1388 LA-1390 LA-1460 LA-2100 LA-2101	.60
BA-301 BA-311 BA-313 BA-511A BA-514 BA-521 BA-526 BA-532 BA-532 BA-536 BA-1310 BA-1320 BA-1330	.77	LA-3150	.30

3	Japa	anese C	omp	onents	5
LA-3155 LA-3160 LA-3161 LA-3201 LA-3210	.59 .29 .30 .33 .26	M-51514 M-51515BL M-51516 M-51517 M-51518	.86 1.43 1.16 1.21 1.08	STK-2028 STK-2029 STK-2030 STK-2129 STK-2139	4.55 4.08 5.78 4.92 5.38
LA-3300 LA-3301 LA-3350 LA-3361 LA-3365	.76 .68 .23 .45	MB SER MB-3705 MB-3712M MB-3715A	\$.96 .68 1.01	STK-3041 STK-3042 STK-3062 STK-3082	2.92 3.46 3.57 3.85
LA-3370	.64	MB-3730M	1.29	TA SER	
LA-3375 LA-3380 LA-4030	.78 1.20 .75	MB-3731M MB-3756M MB-8719	1.33 .94 2.35	TA-7054P TA-7063 TA-7070	\$1.56 .28 1.21
LA-4031P LA-4032P	.55	STK SER	IES	TA-7072 TA-7073A	1.50
LA-4050 LA-4051P	1.09	STK-0025 STK-0029	\$2.57 2.37	TA-7092 TA-7108P	2.92
LA-4100 LA-4101 LA-4102	.35 .41 .41	STK-0030 STK-0039 STK-0040	2.75 2.37 3.28	TA-7109A TA-7119P TA-7120P	1.41 1.29 .28
LA-4110 LA-4112	.49	STK-0049 STK-0050	4.14	TA-7130P TA-7133	.29
LA-4120 LA-4121	1.14	STK-0059 STK-0060	4.95 5.14	TA-7137 TA-7142	.32
LA-4125 LA-4126 LA-4135	1.09 1.07 .75	STK-0080 STK-011 STK-013	5.02 2.99 5.07	TA-7146 TA-7157 TA-7193	1.32
LA-4137 LA-4140	.73	STK-013 STK-014 STK-015	4.95 2.75	TA-7200 TA-7201	2.55 .79 1.29
LA-4160 LA-4170	.63	STK-016 STK-020	3.64	TA-7202 TA-7203P	1.82
LA-4175 LA-4182 LA-4185	.53 .88 1.14	STK-022 STK-027	4.40 4.54	TA-7204P TA-7205	.66
LA-4190 LA-4200 LA-4201	.89 .64 .70	CALL	TO	ILE	RE
LA-4220	.59	11		C A	

MB-3705 \$.96 STK-3062 3.87 MB-3712M .68 STK-3082 3.87 MB-3715A 1.01 MB-3730M 1.29 MB-3731M 1.33 TA-7063 2.87 MB-3756M .94 TA-7063 2.87 TA-7072 1.50 STK-0025 \$2.57 TA-7072 1.50 STK-0029 2.37 TA-7108P .95 STK-0030 2.75 TA-7108P .95 STK-0049 3.28 TA-7130 .28 TX-0049 3.28 TA-7130 .29 STK-0049 4.14 TA-7130 .29 STK-0050 3.38 TA-7130 .25 STK-0050 5.14 TA-7142 .55 STK-0050 5.14 TA-7142 .55 STK-0050 5.02 TA-7168 1.32 STK-015 2.97 TA-7197 2.95 STK-016 3.64 TA-7201 1.29 STK-014 4.95 TA-7201 1.29 STK-015 2.75 TA-7201 1.29 STK-016 3.64 TA-7204 .66 STK-022 4.40 TA-7204 .66 STK-027 4.54 TA-7205 .77	MB SERIES	STK-3041 STK-3042	2.92
MB-3731M 1.33 TA-7054P \$1.56 MB-3756M 94 TA-7063 28 MB-8719 2.35 TA-7070 1.21 STK SERIES TA-7072 1.50 STK-0025 \$2.57 TA-7073A 75 STK-0029 2.37 TA-7108P 75 STK-0030 2.75 TA-7109A 1.41 STK-0030 2.37 TA-71108P 1.29 STK-0040 3.28 TA-7120P 2.85 STK-0040 3.28 TA-7130P 2.95 STK-0050 3.38 TA-7133 65 STK-0050 4.95 TA-7137 32 STK-0050 5.14 TA-7142 5.5 STK-0050 5.14 TA-7142 1.55 STK-0050 5.14 TA-7142 1.55 STK-013 5.07 TA-7198 1.32 STK-014 4.95 TA-7200 79 STK-015 2.75 TA-7201 1.29 STK-016 3.64 TA-7202 1.29 STK-020 3.03 TA-7203P 1.22 STK-020 3.03 TA-7203P 1.22 STK-022 4.40 TA-7204P 666	MB-3712M .68 MB-3715A 1.01	STK-3062 STK-3082	3.57 3.85
STK-0029 2.37 TA-7073A 9.38 STK-0029 2.37 TA-7108P 9.99 STK-0039 2.37 TA-7109A 1.43 STK-0049 3.28 TA-7120P 2.92 STK-0049 4.14 TA-7130P 2.99 STK-0059 4.95 TA-7137 3.65 STK-0059 4.95 TA-7137 3.55 STK-0060 5.14 TA-7146 1.32 STK-0080 5.02 TA-7146 1.32 STK-013 5.07 TA-7193 2.55 STK-011 2.99 TA-7157 .71 STK-013 5.07 TA-7193 2.55 STK-014 4.95 TA-7200 7.99 STK-015 2.75 TA-7201 1.29 STK-016 3.64 TA-7202 1.82 STK-020 3.03 TA-7203P 1.22 STK-020 4.40 TA-7204P 6.66 STK-027 4.54 TA-7205 .77	MB-3731M 1.33 MB-3756M .94 MB-8719 2.35	TA-7054P TA-7063 TA-7070	\$1.56 .28 1.21
STK-027 4.54 TA-7205 .77	STK-0025 \$2.57 STK-0029 2.37 STK-0030 2.75 STK-0049 2.37 STK-0049 3.28 STK-0059 4.95 STK-0059 4.95 STK-0060 5.14 STK-0080 5.02 STK-011 2.99 STK-011 2.99 STK-014 4.95 STK-014 4.95 STK-015 3.64 STK-016 3.64 STK-016 3.64 STK-010 3.03	TA-7092 TA-7109P TA-7109A TA-7119P TA-7130P TA-7130 TA-7137 TA-7142 TA-7146 TA-7157 TA-7193 TA-7200 TA-7201 TA-7202 TA-7203P	2.92 .99 1.41 1.29 .28 .65 .32 .55 1.32 .71 2.55 .79 1.29 1.82
		n novemental	745655

CALL TOLL FREE U.S.A.

uPC SERIES UPC-16C UPC-20C UPC-554C UPC-554C UPC-555H UPC-566H UPC-5774 UPC-5774 UPC-5776H UPC-5776H UPC-595C UPC-596C UPC-1023 UPC-1023 UPC-1023 UPC-1025 UPC-1181 UPC-1182 UPC-1181 UPC-1182 UPC-1185 UPC-1230 UPC-1363 C UPC-1363 C UPC-1363 C UPC-1364 UPC-1447 UPC-1447 UPC-1458 C .94 1.16 1.19 .86 .28 .23 1.13 .25 .50 1.14 .33 1.68 .29 .65 .66 1.16 1.10 20 1.38 .43 .32 .69 .50 .50 1.12 1.11 .61 1.65 2.22 .34 .39

SA-1105 SA-1106	1.44	2SC-1956	4.05
	1.82	2SC-1960	4.02
2SB SE	RIES	2SC-1968	12.84
		2SC-1972	4.05
SB-22	\$.17	2SC-1975 2SC-2026	.86
SB-324	.26	2SC-2026	.24
SB-411	1.78	2SC-2028	.60
SB-507	.34	2SC-2029	.71
SB-539	2.14	2SC-2073	.32
SB-554	2.85	2SC-2075	.41
SB-557	1.57	200-2073	3.28
SB-560	.16	2SC-2098 2SC-2120	
	2.22	2SC-2120 2SC-2131	.07
SB-563			1.85
SB-595	.45	2SC-2153	.22
SB-596	.39	2SC-2166	.50
SB-616	.61	2SC-2237	2.56
SB-618A	.96	2SC-2238	.34
SB-633	.45	2SC-2278	.23
SB-636	.07	2SC-2365	3.42
SB-681	1.65	2SC-2369	.78
SB-754	.42	2SC-2369	.78
SB-755	1.14	2SC-2407	.23
SB-844	67	2SC-2458	.06
		2SC-2502	.79
2SC SE	RIES	2SC-2540	9.40
SC-373	\$.08	2SC-2577	
		250-2511	.74
SC-398	.50	2SC-2578	.99
SC-460	.06	2SC-2579	.99
SC-461	.06	2SC-2580	1.17
SC-495	.21	2SC-2581	1.44
SC-710	.06	2SC-2582	.28
SC-730	1.33	2SC-2695	9.79
SC-792	1.58	2SC-3019	.84
SC-828	.06	2SC-3021	5.61
SC-829	.06	2SC-3022	12.84
SC-867A	2.04	- And the last the same	
SC-867A SC-940	.95	2SD SEF	TIES
SC-945	.06	2SD-24Y	\$.62
SC-980	.32	2SD-188	.36
SC-998	2 43	2SD-198R	1.09

2SA-1105 2SA-1106

2SB-411

2SB SERIES 2SB-22 2SB-324

5	2SC-3022	12.84
50 1 50 1 50 1 50 1 50 1 50 1 50 1 50 1	2SD SE	
3	2SD-24Y	\$.62
2	2SD-188	1.09
3	2SD-198R	1.09
	2SD-287	2.85
	2SD-313 2SD-325	.24
	2SD-348	2.44
3	2SD-350	2.00
£.	2SD-371	.35
)	2SD-388	.96
3	2SD-401A	.41
	2SD-424 2SD-425	2.00 1.69
	2SD-427	1.64
3	2SD-470	1.47
3	2SD-478	.32
	2SD-495	.21
2	2SD-525	.43
	2SD-526 2SD-587	.36
	2SD-588	.36 .68
)	2SD-612	18
)	2SD-613	.32
2	200 626	4.5

	2SD-4/8	.34
	2SD-495	.21
	2SD-525	.43
	2SD-526	.36
	2SD-587	.68
	2SD-588	.88
	2SD-612	.18
	2SD-613	.32
	2SD-636	15
É	2SD-638	.12
	2SD-665	2.53
	2SD-667	2.00
	2SD-668	.14
		.20
	2SD-669	.25
	2SD-712	.36
	2SD-718	.83
	2SD-733	1.36
	2SD-746	1.73
	2SD-824	.36 .71 1.25
	2SD-844	.71
9	2SD-870	1.25

2SD-87	0 1.25
2SK	SERIES
2SK-19 2SK-49 2SK-11 2SK-16 2SK-24	8 .3

1.05	
RIES	
\$.48 .71 .35 .40 .61 .25 .59 .69 .63 .85 .54 .98 .53 .1.34 .61 .1.53 .1.27 .78 .1.84 .1.61 .1.161 .1.48	
.98 .53 1.34 .64 .71	
1.53 1.27 1.17 .78 1.84 1.84 1.61	
1.16	Ī

LA-4250 LA-4400 LA-4420 LA-4422 LA-4430 LA-4460 LA-4461 LA-5110 LA-5112 LA-5700	1.17 1.50 .64 .75 .53 1.20 1.38 1.38 .71 .56	STK-032 STK-035 STK-040 STK-050 STK-058 STK-075 STK-075 STK-077 STK-078 STK-080G STK-0802	7.54 8.82 5.29 14.03 6.33 16.10 3.97 4.26 6.05 4.47 5.61
LA-7003 LA-7802	1.29	STK-083 STK-084	8.11
LB SER		STK-086 STK-415	8.25
LB-1405	\$.49	STK-430II	3.49
LB-1409	.90	STK-430M	3.49
LB-1415	.49	STK-433	2.75
LB-1416 LB-1426	.52	STK-435 STK-436	2.92
LB-1551	1.02	STK-437	3.74
A STATE OF THE STA		STK-439	3.41
LC SER	IE2	STK-441	5.52
LC-7120	\$1.78	STK-443	6.06
LC-7130	1.64	STK-467	4.82
LC-7200	5.03	STK-459	4.56
LC-7250 LC-7800	3.79	STK-461 STK-463	5.29
	- Control	STK-465	5.99
M SERI	ES	STK-1039	2.92
M-5102	\$.77	STK-1040	3.71
M-5115	2.61	STK-1049	4.42
M-5152	.39	STK-1070	5.17
M-5155	.86	STK-1070II	5.70
M-51513L	.77	STK-2025	4.07

LA-4230

TA-7205AP	.77	UPD SEF	III-O
TA-7207	.57	OLD SEL	IIE9
TA-7208P	.68	UPD-416D	\$1.10
TA-7209	1.16	UPD-2716D	
TA-7210	1.76	UPD-2764	
TA-7212	.77		1000
TA-7214	1.69	2SA SER	IES
TA-7215P	1.28	2SA-564	\$.07
TA-7217A	.73	2SA-634	.25
TA-7220P	.79	2SA-683	.17
TA-7222AP	.77	2SA-684	.20
TA-7223P	1.10	2SA-699	.35
TA-7224	1.64	2SA-712	
			.06
TA-7226P	.86	2SA-715	.21
TA-7227P	1.35	2SA-720	.17
TA-7230P	.99	2SA-733	.06
TA-7232P	.73	2SA-771	.78
TA-7310	.51	2SA-773	.12
TA-7312P	,55	2SA-777	.19
TA-7313P	.45	2SA-899B	.21
TA-7315	.66	2SA-913	.48
TA-7325P	.38	2SA-916	.07
TA-7328A	.71	2SA-940	.42
TA-7607A	1.46	2SA-950	.08
TA-7608CP	2.21	2SA-953	.06
TA-7609	1.41	2SA-984	.11
TA-7615	2.04	2SA-992	.09
TA-7619	2.51	2SA-1015	.12
TA-7644BP	3.65	2SA-1048	.06
THE RESERVE OF THE PERSON NAMED IN	A THE RESERVE	2SA-1075	1.39
TBA SERI	E9	2SA-1076	1.57
TBA-800 \$.83	2SA-1095	1.82
TBA-810SH	.70	2SA-1102	.91
TBA-820M	.85	2SA-1103	1.00
		2SA-1104	1.13

UPD-2716D UPD-2764 2SA SER	\$1.10 2.70 4.95 \$.07 .25 .17 .20 .35 .06 .21 .17 .06 .78 .12 .19 .21 .48 .07 .42 .08 .06 .11 .09 .12 .06	2SC-980 2SC-988 2SC-988 2SC-1034 2SC-1060 2SC-1060 2SC-1074 2SC-1074 2SC-1162 2SC-1114 2SC-1162 2SC-1162 2SC-1172B 2SC-1172B 2SC-1172B 2SC-1306 2SC-1306 2SC-1306 2SC-1307 2SC-1317 2SC-1318 2SC-1317 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1318 2SC-1384 2SC-1384 2SC-1384 2SC-1384 2SC-1419 2SC-1507 2SC-1507 2SC-1675 2SC-1675 2SC-1675 2SC-1675 2SC-1675 2SC-1675 2SC-1675
2SA-992 2SA-1015 2SA-1048	.09	2SC-1507 2SC-1675
101	NIVO	HUE WAR

2.566 .144.266 .269.434 .2.155 .544.188 .2.155 .311.388 .766 .311.399 .311.50

ADDITIONAL ITEMS*

We also carry micro motors, telescopic antennas, AC/DC adaptors, transformers, splitters, magnetic tape heads, cartridges, car antennas, car equalizers, car stereos, speakers, and other items that are added

TERMS

- 1. C.O.D.
- Company and personal checks accepted.

- 3. Purchase orders from government and accredited schools accepted.
- 4. Minimum order 50 pcs. per line item, and minimum purchase \$75.00.

*We can handle any order from Japan direct to you, with competitive prices.

* SANYO UHF VARACTOR TUNER *

-1678 -1815GR

For channels 14-83 • Tuning voltage + 1 to + 28VDC • Input impedance 75Ω • IF band width 7-16MHz • Size 258 x 11/4 x 3/4 Supply voltage 15VDC

P/N 115-B-403A for 45.0MHz P/N 115-B-405A for 62.5MHz

\$12.95 ea.



785 EAST 14TH STREET • LOS ANGELES, CALIFORNIA 90021 • U.S.A. • TELEPHONE: (213) 747-6830 747-6856 TELEX: 194654 DELBANI USA

THINKING THE PARTY OF THE PARTY	Number of Pics of each I.C. for easy Sockel purchase	MICROPROCESSOR COMPONENTS Digitalker
Part Na - Press Pr	Second S	Part No.
74L574 14 39 74L5168 6 1.19 74L574 14 49 74L5169 15 1.19 74L575 15 39 74L5770 16 1.49 74L576 15 39 74L5773 16 69 74L578 14 39 74L5774 15 69 74L583 16 65 74L5775 15 69	741.5172 20 1 46 741.5174 20 1 47 741.5174 20 1 47 741.5174 20 1 47 741.5174 20 1 47 741.5179 1 6 1 47 741.5179 1 6 1 47 741.5179 1 6 1 47 741.5179 1 6 1 47 741.5179 1 6 1 47 741.5179 1 6 1 47 741.5179 1 6 1 47 741.5179 1 7 47 741.5179 1	PRINCE 1997
CA3038H 14 1.35 CA3028H 16 19 CA3038H 14 2.35 CA3028H 16 119 CA3038H 16 1.39 CA3028H 16 119 CA3038H 16 1.39 CA	CA1100E 8 89 79 CA1100E 8 79 70 CA1100E 1 99 70 70 70 70 70 70 70 70 70 70 70 70 70	16 pin LP 17
CD4027 16 45 C0-5977 14 29 C04073 16 1,19 C04073 14 49 C04035 16 1,19 C04081 14 29 C04035 16 1,19 C04081 14 29 C04081 14 49 C04081 14 29 C04081 14 29 C04081 14 49 C04081 14 4	MC14410 16 13.95 MC14411 24 11.95 MC14412 18 13.95 MC14419 16 7.95 MC14433 24 13.95 MC14538 16 1.19 MC14541 14 1.19	MasterCard Company Co

KEYBOARDS — POWER SUPPLIES

VOICE SYNTHESIZER FOR APPLE AND COMMODORE



Over 250 word vocabulary-affixes allow the formation of more than 500 words - Bull-in amplifler, speaker, volume control, and audio jack - Recreates a clear, natural male voice - Plug-in user rady with documentation and sample software - Case size: 74″L x 33″W x 1-3.6°H

JE520CM

APPLICATIONS: • Security Warning • Telecommunication • Handicap Aid • Games

The JE520 VOICE SYNTHESIZER will plug right into your computer and allow you to enhance almost any application. Utilizing National Semiconductor's DIGITALKER** Speech Processor IC (with four custom memory chips), the JE520 compresses natural speech into digital mem-ory, including the original inflections and emphases. The result is an extremely clear, natural vocalization.

JE520CM For Commodore 64 & VIC-20 JE520AP For Apple II, II+, and I/e \$114.95 \$149.95



JE664 EPROM PROGRAMMER 8K to 64K EPROMS – 24 & 28 Pin Packages

empletely Self-Centained — Requires Ne Additional Systems for Operation ograms and validates EPROMs - Checks for properly grased EPROMs nutates PROMs or EPROMs - R5232C Computer Interface for editing and • Emulsise PROMs or ERPOMs - RS323C Computer interface for editing and program loading - Loads data into RAM by systopact - Changes data in RAM by keyboard - Loads RAM from an EPROM - Compares EPROMs for containing differences - Copies EPROMs - Power Input: 115 VAG, 60Hz, less than 10W power consumption - Enclosure: Color-coordinated, light lan panels with moided and places in mocha brown - Stact 15°NL* 48°D x 3°N H* Weight.

5-% to b.

The 2564 EPROM Programmer envolutes and grogiums various 0-58 Movel EPROMs from 16 to
646-68 enemyly opposity float can be extended in the 1564-54 where 66 to -86 Movel errors
646-68 enemyly capacity float can be extended in the 1564-54 where 66 to -86 Movel errors
646-69 Mo

JE664-A EPROM Programmer. \$995.00 Assembled & Tested (Includes JM16A Module)

JE655 — ISS23C INTERFACE OPTION — The RESCAL history Option implements computer access to the JE64's RAM. The allows the computer for manipulate, store and transite EPROM data to and from the JE64's A sorride renormalisation is provided in MARIS for ORM computers. Somementation is provided to study the scheduler to their compositers with an RE222 port, 4500 Bland, 8-bit word, odd purely and 2 storp bits.
POR A LIMITED TIME A SAMPLE OF SOFTWARE WRITTEN IN BASIC FOR THE TRS-80's MODEL | LEVEL II COMPUTER WILL ALSO BE PROVIDED.

JE664-ARS EPROM Prog. w/JE665 Option. \$1195.00 Assembled & Tested (Includes JM16A Module)

EPROM JUMPER MODULES — The JESS'S JUMPER MODULE (Personally Module) is a play-in Module that pre-sets the JESS's for the proper programming piles to the EPROM and configures the EPROM socket connections for that puricular EPROM.

PRICE	EPHON MUNICIPALITY	Programming Solinge	EPRON	JUDGE EPROM Jumper Med. Str.
\$14.95	AMO, Motorola, Nat., Irlail, Tl.	25V	2708	JACOA
\$1495	intel, Motorolle, Rut, MEG, TI. AMD, Hitachi, Mostein	21V	2716, TMS2516 (TI)	JAHIGA
\$14.55	Motoroia, Ti	-5V,+5V,+12V	TMS2716 (3-VX)	JM168
\$14.95	Motorpia, TJ, Hitachi, DKI	15V	TMS2532	JMSZA
\$14.00	AMD, Fujitto, NEC, Hitachi, Intel. Mitsubsphi, National	257	2732	JASSES
\$14.95	Furtou, Intel	217	2730A	_M30C
\$14.95	Motoreia.	SIA	MCM68764, MCM68L764	JA#64A
\$14.95	Intel, Fairchild, DKL	217	2764	JM548
\$14.95	The Control Control of	25V	TM52564	SAME

4-Digit Fluorescent Alarm Clock Kit





Bright 4-digit 0.5" high display • 10 minute snooze alarm
 AM/PM indicator • Automatic display dimmer

• AMPM Indicator • Automatic display dimmer
The JETSO Clock Kit is a versatille 12-hour digital clock with 24-hour alarm. The clock has a bright 0.5° high-blue-green fluorescent display. The display will eutomatically dim with changing light conditions. The 24-hour alarm allows the user to disable the alarm and immediately re-enable the alarm to activate 24 hours later. The kit includes all documentation, components, case and wall transformer. Size: 6%"L x 3% "W x 1¾" D.

JE750 Alarm Clock Kit. \$29.95

13%"L x 4%"W x %"H



-----21%"L x 9.8"W x 316"H

Mitsumi 54-Key Unencoded Matrix All-Purpose Keyboard

SPST keyswitches • 20 pin ribbon cable connec-tion • Low profile keys • Features: cursor controls, control, caps (lock), function, enter and shift keys • Color (keycapa): grey • Weight: 1 lb.

KB54.....\$14.95

71-Key ASCII Cherry Keyboard

7. bit parallel ASCII with strobe • 11 key numeric keypad • SPST mechanical keyswitches • 15/30 card-edge connector • Features: escape, control, cursor controls, plus 10 addrl. special function keys • Color: white • Weight: 2 lbs. • Spec. included

KB1801.....\$29.95

106-Key 8-Bit Serial ASCII Keyboard Numeric and cursor keypad • 10 user defina-ble keys • 7 LED function displays • Security lock • N-key rollover • Uses Intel 8048/8748 • Color: white w/black panel • Documentation included · Weight: 61/2 lbs.

KB139.....\$59.95

Power/Mate Corp. REGULATED POWER SUPPLY

Input: 105-125/210-250 VAC at 47-63 Hz • Line regulation: ±0.05% • Three mounting surfaces • Overvoltage protection • UL recognized • CSA certified Part No. Output Size Weight Price Weight Price

EMA5/6B 5V@3A/6V@2.5A 4%"L.x.4"W.x.2%"H 2 lbs. \$29.95 EMA5/6C 5V@6A/6V@5A 5%"L.x.4%"W.x.2%"H 4 lbs. \$39.95



POWER SUPPLY +5VDC @ 7.6 AMP. 12VDC @ 1.5 AMP SWTTCHING Input: 115WC, 56-60Hz @ 3 amp/230WC, 50Hz @ 1.5 amp - Fan voll /power supply select switches 115/330WC) - 01puts /VDC @ 7 amp, 12VDC @ 1.5 amp - 8 foot black power cord - Size: 119-W x 134 'D x 34'H - Weight: 6 lba

PS94VOS.....\$39.95



KEPCO/TDK 4-OUTPUT SWITCHING POWER SUPPLY
Ideal for disk drive needs of CRT terminals, microcomputers and
video games Input:115/230VAC; 50/60Hz - Output:+5V @ 5 Amp, +12V @
1.8 Amp, +12V @ 2.4 Amp, +12V @ 0.5 Amp - UL recognized - CSA certified
Size: 73H1 x 6-3/16 W x 14-H - Weight: 2 lbs.

MRM 174KF..... \$59.95



4-CHANNEL SWITCHING POWER SUPPLY

Microprocessor, mini-computer, terminal, medical equipment and process control applications - Input: 90-130/MC, 47-440/Hz · Output: +5/DC @ 5A, -5/VDC @ 1A, +1z/VDC @ 1A, -1z/VDC @ 1A · Line regulations: =9.2% · Ripple: 30mV p-p · Load regulation: =1% · Overcurrent protection - Adj: 5V main output =10% · Size: 63HL x · 18 W x -4.15/16 H · Meight : 1% ba.

FCS-604A.....\$69.95 each Switching Power Supply for APPLE II, II+ & IIeTM - Can drive four floppy disk drives and up to eight expansion cards
- Short circuit and overload protection - Fits inside Apple computer
- Fully regulated +5V e 5A, +12V e 3A, -5V e .5A, -12V e .5A
- Direct plug-in power cord included - Size: 9% L x 3% W x 2% H
- Start Start

Weight: 2 lbs. KHP4007.....\$79.95





DISKETTE ACCESSORIES

Disk Minder



Attractive, functional disk storage system • 50 (8 °) or 75 (5 % °) disk storage capacity • Easy filing and retrieving • Protects disk from dust contamination • Molded from durable smoked plastic with front carrying handle • Size: 7*W × 6 % °H × 9 % °D • Weight: 2 lbs.

Part Ne. Description.

contamination • Durable smoked pl 5½"H × 1½,"D Part No. Description MP-10 Stores 10 (514") Diskettes \$10.00 Minimum Order — U.S. Funds Only California Residents Add 6½ % Sales Tax Shipping — Add 5% plus \$1.50 Insurance Send S.A.S.E. for Monthly Sales Flyer!

Diskette Envelopes
Sleaves for Bulk-Purchased Diskettes
I - Linitronfaminant has - Anti static protect - West * Tear proof * Indicontament has * Anti-static pro-Part Na. Description

MP\$201 10 White 5 % * Envelopes

MP\$201-100 100 White 5 % * Envelopes

MP\$201 10 White 5 * Envelopes

MP\$201-100 100 White 8 * Envelopes 10 for \$ 1.49 100 for \$10.95 10 for \$ 1.95 100 for \$17.95



Mall Pak**

Price MP-05 Holds 3 ea. 5 % Diskettes MP-08 Holds 3 ea. 8 Diskettes ... \$2.49 each \$3.95 each

Spec Sheets — 30e each Send \$1.00 Postage for your FREE 1984 JAMECO CATALOG Prices Subject to Change





1355 SHOREWAY ROAD, BELMONT, CA 94002 5/84 PHONE ORDERS WELCOME — (415) 592-8097 Telex: 176043

DISK DRIVES AND SUPPLIES

FLOPPY DISK DRIVE



- 77 Tracks 400/800K Bytes Capacity
- Industry Standard

The FDD100-8 s* Floppy Disk Drive (Industry Standard) features single or double density. Recording mode: FM single, MFM double double density. The FDD100-8 is designed to work with the single-sided soil sectored IBM Diskette I, or eq. disk cartridge. Power ISVAC § 56.564t. + 42VDC § 17 amps max. +5VDC § 12 amps

FDD100-8 . . \$169.95 ea.

5¼" APPLE™ Direct Plug-In Compatible Disk Drive

Uses Shugari 8A399 mechanies * 143K formatted starege * 35 tracks — compatible with Apple confroller * Complete with connector and cable — just plug into your disk controller card * 515z: 6** L × 31**W × 8-9/16**D * Weight: 41% lbs.

ADD-514...\$195.95

+5VDC @ 6 Amps +12VDC @ 4 Amps -12VDC @ 0.5 Amps

1347 x 64W x 5H CP167.....\$59.95

Microcomputer Power Inc. Regulated

Power Supply

Perfect for computer or disk
drive systems - Supply has AMP
connectors for direct connection to two 5%" disk drives
- Cooling fan - Input: 100/115/
200/230VAC, 47-63Hz - Output
(above) - Weight: 9 lbs.

INDUSTRIES Protect Yourself...

DATASHIELD





DATASHIELD® Back-Up **Power Source**

Provides up to 30 minutes of continuous 120 VAC 60Hz power to your computer system (load dependent) when you have a black out or voltage say - Output rating: 200 watts - Six month warranty - Weight: 19 lbs.

Model 200 (PC200). \$349.95

IBM MEMORY EXPANSION KIT COMPAQ COMPATIBILITY

SAVE HUNDREDS OF \$\$\$ BY UPGRADING MEMORY BOARDS YOURSELF!

Most of the popular memory boards allow you to add an additional 64K, 126K, 192K, or 256K. The IBM64K kit will populate these boards in 64K byte increments. The bit is simple to install — just insert the nine 64K RAM chips in the provided sockets and set the two groups of switches. Directions are included.

IBM64K (Nine 200ns 64K RAMs) \$49.95

TRS-80 MEMORY EXPANSION KIT

TRS-80 to 16K, 32K, or 48K

11 = From 4K to 16K Requires (1) One Kit

13 = From 4K to 48K Requires (3) Three Kits

From 4K to 16K Requires (1) One Kit

TRS-16K4 *250ns for Model I...

TRS-80 Color 32K or 64K Conversion Kit

Easy to install kits comes complete with 8 ea. 4164-2 (200ns) 84K dynamic RAMs and conversion documentation. Converts TRS-80 color computers with D. E. ET, F and NC circuit boards to 32K. Also converts TRS-80 color computer II to 64K. Flex DOS or OS-9 converts TRS-80 color computer in a computers.

TRS-64K2.....\$44.95

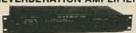
UV-EPROM Eraser



Frases 2708, 2716, 2732, 2764, 2516, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes), Maintains constant exposure distance of one inch. Special context. We have a constant exposure build-up. Built-in-asfety lock to prevent UV exposure. Compact — only 80.07 x 30° x 20° x 20°

DE-4 UV-EPROM Eraser ... \$79.95 UVS-11EL Replacement Bulb ..\$16.95

REVERBERATION AMPLIFIER

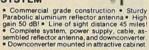


Specifications: * Total harmonic distortion less than .05% * Frequency response 10 Hz to SOK Hz +1dB * S/N Ration 90dB * Reverberation time 0 to 3 sec * Input 150MV50K ohm * Max. input 2V * Accepts input from tape, phono, or aux. Includes and LED Reverb Level display. Kit comes with all electronic components, transformer and instructions, and 19" rack mount rabinet.

Model TA-2400 \$89.95

AMATEUR MICROWAVE Receiver System 1.9-2.5 GHZ

MICROWAVE RECEIVER SYSTEM



90 day warranty on PS-5! Assembled ... \$109.95 Kit Form \$ 79.95

Microwave Preamp!

NEW KIT

Use with PS-3 Kit. Adds 20-25 db gain to boost Use with PS-3 Kit. Adus acres
eception distance.
• Low Noise
• High Gain
• Can be used with all existing stop sign board receivers!
• 1.9-2.5 gHZ Freq. Range

PS-4 (Kit)..... \$34.95

SOLID STATE STEREO **GRAPHIC EQUALIZER** PRE AMP KIT



TA-2500 (Kit) \$119.00

20 STEP LED POWER LEVEL INDICATOR KIT

This new stere o level indicator kit consists of 40 3-color LED's to indicate sound level output of your amplifier from -57 dB to 0 dB. Comes with an attractive silk screen printed panel. Has selector switch to allow floating or gradual output indicting. Kit includes all parts, Front panel and power supply

TY-45 (Kit) \$34.95



A very popular device designed to listen to sounds & voices through rooms or 3 It. thick concrete walls. Place listening sensor against wall and earphone in ear. Adjust volume control! Clearly hear things you may not want to!

CM-8.....\$89.95

INFRA-RED REMOTE CONTROL SWITCH KIT



Infra-red Remote Control switch can be used to control appliances up to 500 W
meters. No antenna needed. Features latest IC controller which excludes interferences from light or AC pulse signal
TK-41 Kit.

STEREO AMP KIT 160 Watt Total 80W + 80W

This is a solid state all transistor circuitry board stereo amplifier. Power output emplo 2 pairs of matching Darlington transisto TH.D. less tham .05% between DC to 200 KP Power supply requires 30 VCT 2 amp × FM

TA-802 \$39.95

Transformer (optional) \$9.95



LOW TIM DC STEREO PRE-AM KIT TA-2800

Incorporates state of D.C. design that gives a frequency response from OHz-100KHz-5dB.

Features tone defeat switch loudness treble, midrange, bass, balance • Contains quad BFet op-amp to develop T.H.D. of .005% at rated output • Input sensitivity: phone 2.5 MV tuner, aux, tape play 100MV/100K • Power supply • 15 volt. D.C. at .2A. Kit. comes with regulated power supply, all you need is a 15-20 VCT, 2 amp. XFMR.

TA-2800 ONLY \$44.50 \$4.50 ea.



UHF TV PREAMP



FEATURES: • 25 dB gaint • Kit

Your reception will dramatically improve! This unit will enable you to pull insignals you never knew were there! For both indoor and outdoor use. Input and output impedance 75 ohm. No adjustment! Easy assembly.

JH-0 Kit \$23.95



TA-1500 **200 WATT** CHANNEL STEREO AMP & PREAMP KIT

More power for stereo blaster! 100 watts/ More power for stereo blaster! 100 watts/ channel, stereo preamp built-in. Trebel, midrange, bass, mic volume. Balance and volume are standard controls on the pre-amp. Mic input allows you to use if as a P.A. Specifications: 100 w x 2 into 8 Ohms. Free, Range: 0-100Khz ±, 3dB. Thd: .01%, S/N Ratio: 80 dB. Sensitivity: 3 mu into 42K. Power Requirements: 24-40 VAC.

TA-1500 \$72.00

160 WATT DC STEREO AMP/PREAMP KIT

The TA-800 is an 80 watt/channel preamp and power amp with tone control, high, middle and bass controls. Volume and balance control are built-in. On board power supply requires only 60 volt C.T. XFMR. Specifications: 50W x 2. into 8 Ohms. Freq. Range: OHZ-100 Khz±3dB. Thd: 01% S/N Ratio: 80 dB. Sensitivity: 3 mu into 47 K. Power Requirements: 24-40 VAC.

TA-800 \$65.00



Add 10% shipping on orders under \$35.00. Orders over \$35.00, add 5%. Catalog-\$1.00. Visa & Mastercharge accepted.

VISA

CIRCLE 60 ON FREE INFORMATION CARD

AMERICAN RESEARCH & ENGINEERING K-40

WORLD'S SMALLEST DIP SWITCHES

Same Size as an I.C.!











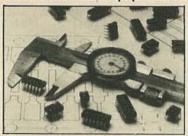
You Can Use Automatic Insertion Equipment

The 8-position programmable SPST K40 uses a bifurcated slide contact that allows two point contacts for each switch contact, doubling the contact reliability. The bifurcated contact travel of 026" eliminated many of the intermittent problems that plague dip switches. The K40 shows excellent

Electrical, Mechanical and Physical specifications.

1 THRU 8 POSITION DIP SWITCHES AVAILABLE

8 POSITION DIP SWITCHES \$1.95 100 ea. \$1.30 \$1.60 1000 ea. \$.95 Include \$2.50 For Shipping



Call or Write For Quotes Over 1.000 Pieces







STOCKING DISTRIBUTOR



ELECTRONICS CORPORATION SEMICONDUCTOR PARTS AND PRODUCTS

1043 N. STADEM DRIVE **TEMPE, ARIZONA 85281**

RADIO-ELECTRONICS

130

(602) 967-6945

Call or Write for FREE Semiconductor Parts & Products Catalog

CIRCLE 83 ON FREE INFORMATION CARD

MICROWAVE TV ANTENNA SYSTEMS

Freq. 2.1 to 2.6 GHz • 34 db Gain +





COMPLETE SYSTEMS (as Pictured)

Commercial 40" Rod Style \$ 89.95 Parabolic 20"

Dish Style \$ 79.95 COMPONENTS

Down Converters (both types) \$ 34.95

Power Supplies [12V to 16V] \$ 24.95 Data Info (Plans) \$ 9.95

CALL OR WRITE FOR KITS, PARTS, INDIVIDUAL COMPONENTS

We Repair All Types Down Converters & Power Supplies

Phillips-Tech Electronics P.O. Box 34772 Phoenix, AZ 85067 (602) 967-6972

Special Quantity Pricing **Dealers Wanted**





COD'S

Which



HANDY HB-1000 Socket

- 640 Tie Points
- 9-I.C. Capacity
- · Alphanumeric Grid Labeling
- · Both Horizontal and Vertical Expansion
- Self-Adhesive Mounting



f you have two similar products, both designed for the same function...and one offers you MORE features for LESS money...which would YOU buy? The answer is obvious!

Just look at all these EXTRAS built into every HANDY test socket and buss strip...

- ... Total contact labeling... simplifies circuit design/layout
- Self-adhesive backing...for one-step simplified alignment and mounting
- . Full 9 14-Pin I.C. Capacity
- Expands both horizontally and vertically...interlocks can't break or twist off
- High temperature plastic housing... to 80° C... no warping or melting ever!
- Prices always up to 25% less than other leading brands

To all these add: Long Life, low resistance and wide range contacts that accept combinations of resistors, capacitors, diodes, transistors, I.C.s, etc. with leads from .012 - .032" or 20 - 29 AWG. Clear, easy-to-read-and-identify contact markings simplify layout, wiring and documentation. Socket rows are labeled 1-to-64, and columns are marked A-to-E and F-to-J. Mating buss strip rows are labeled

A-to-D and consist of 25 contacts each. Bold red and blue lines show where contact strips begin and end.

Finally, we have a full line of breadboarding equipment, from discrete sockets and buss strips to multi-board assemblies. available at comparable lower-than-low

Let's face it. If you get all this...and the prices are ALWAYS to 25% less... there's no doubt which you'll buy. HANDY. It's our name...and it tells you

What are you waiting for? Order your HANDY breadboarding products today. A toll-free call is all it takes!

Here's how to order...

HANDY Sockets and Buss Strips

Part Number	Socket Strips	Buss Strips	Ground Plate	Tie Points	14 pin IC Capty.	Price
HB-0100	N/A	- 1	no	100	N/A	2.25
HB-1000	1	N/A	no	640	9	9.95
HB-1110	1	1	yes	740	9	11.95
HB-1210	1	2	yes	840	9	13.95

HANDY Breadboard Assemblies

Part Number	Socket Strips	Buss Strips	Binding Posts	Tie Points	14 pin IC Capty.	Price
HB-2112	2	1	2	1380	18	25.95
HB-2313	2	3	3	1980	18	31.00
HB-3514	3	5	4	2420	27	47.95
HB-4714	4	7	4	3260	36	63.95

Mail Orders: Please add \$3 (Canada & Int'l add \$5) to cover cost of shipping/handling. Sorry! No C.O.D. orders. Charge Cards: (Min. \$15). Please include Acct. No., Exp. Date, Bank No. (M/C only) and your signature. Checks: Drawn in U.S. Dollars on U.S. banks only. Connecticut Residents: Add 71/4% Sales Tax.



To order...call 1-800-34-HANDY .charge with VISA, MasterCard or American Expres All items off-the-shelf for Immediate Shipment!

a division of RSP Electronics Corp.

7 Business Park Drive • P.O. Box 699 • Branford, CT 06405 • (203) 488-6603 • TWX: (910) 997-0684 Easy Link Mail Box: 62537580 • CompuServe: 71346, 1070

RADIO-ELECTRONICS

DIGI-KEY 800-346-5144

NATIONALS	EY • MOLEX • AAVID • E F. JI UNGAR • GC CHEMICALS • A MICONDUCTOR • PANASONIC • SAVINU IGI KEY — DIGI KEY — DIGI KEY		" Big Price Difference (188 BLOW)		SSEY MOLEXCE
DIGHTY DIGHTY DIGHTY INTEGRATED CIRCUITS	Fiss Ret Fiss Part Fiss Ret S	TEXAS INSTRUMENTS I.C. SOCKETS Body - B V O palyesis with Cappe Aby consent Accommodates standard Claudit up to 04" thick and CS" with. Constit is designed and ceited to the stantar to group the broad "fee" of the Clead standard designed in a folializer restaurch designed on the con- stantar to group the broad "fee" of the Clead standard designed in a folializer restaurch designed on the con- stantar to group the broad "fee" of the Clead standard designed in a folializer restaurch designed on the con- stantar to group the con- stant	a Big Peice Difference BE 81.000 Col. No. Posco Difference BE 81.000	DISC CAPACITORS VEW KIT 310 DISC CAPACITORS OCHE TO COMPANY CAT NO. DHANT DHANT CAT NO. DHANT PASSESSES SIMPLE FOR COMPANY PASSESSES SIMPLE FOR COMPANY PASSESSES F	PARASONIC RISIN DIPPED TANTALUM REAL STATE OF THE STATE
2003 44 2012 200 20 20 20 20 20	1	15 C8040 40 pin solder tall, tin 46 4.20 39.00 20 GOLD INLAY SOLDER TAIL No. 16 Microbine Call	250 4.5 3 25 25 485 22 172 112 150 150 150 150 150 150 150 150 150 150	Part Cop. Vash. 28 Pere Pere Vash. 28 Pere Pe	
2-22 4-6 20.500 10.0 20.501 20.0 2	20	WIRE WRAP DIP SOCKETS * Enveloper profile * Dip Sockets * Enveloper profile * Dip Sockets * Enveloper profile * VOUN CHOICE: THE OR GOLD* * TUAN ENVELOPER PROFILE *	100 1 23 20 1 20 1 20 1 20 1 20 1 20 1 2	No.	200 10 10 10 10 10 10 10
1	1	Call 1 2 pin wife wing, pin 0 0 70 60.00	137 752 18 124 128 13 11 17 17 17 17 17 17	PAGE 2 pt 600 pt 607 02.21 PAGE 2 pt 600	2009 2-72 3-71 1-75
Temporary Temp	46 6408 3 23 LU20094 111 AVIDOR 14 6408 12 20 LU201960 111 AVIDOR 14 6408 12 20 LU201960 111 AVIDOR 14 6408 12 20 LU201960 12 AVIDOR 14 6408 12 AVIDOR	Ealder Teb Sudder For Wire Wire Wire Wire Wire Wire Wire Wir	220 160 67 57 57 57 57 57 57 57	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	TANTALUM SUBSTITUTES PANSONIC K-SERIS CAPACITORS THE Famework K-Series are inhibitors, then cost information of the control of the cost information of the cost of the cost information of the cost of the cost control to tension to many against one CAPACITANCE TOLERANCE, 2016 C. LIARAGE CURRENT, MAY, 001 C V or JAA AS K-SERIES CAPACITORS WE Carry Are Rankel British
74251N 1.03 74L5353N 1.45 74C95N 74L5353N 1.45 74C107N 74L5355N 62 74C107N 74C107N 74C107N	1.36 ProcEash 1.89 1.785 1.69 1.575 1.3 50 4.00 NSC Data Books	Preliaded, carriery parties Preliaded, carriery againg design. Castacts are user remarkle. NIT. Securious below as the placement operation securious for the placement of the securious securious for the parties.	220 /63 76 6.90 54.14 76 6.61 56.02 530 6.30 530 6.30 52 7.67 56.55 32 7.67 56.00 54.14 70 6.61 56.02 52 52 52 52 52 52 52 52 52 52 52 52 52	E1474 100	February
1	1.00 receiped 1.00 1.705 1.00 1.755 1.20 1.755 1.00 1.755 1.00 1.755 1.00 1.755 1.00 1.755 1.00 1.0	Bindered center pents	285 78 8.00 8.1 78 8.81 8.10 9.10	1856 00 2. 2. 36 48 411 370 11 11 11 11 11 11 11 11 11 11 11 11 11	PROS. 47 17 152 1272 1146 1478
1	100 1/26 1	Before de service periode Property Pro	Convenient Transporter Convenient Co	1856 00 2. 2. 36 48 411 370 11 11 11 11 11 11 11 11 11 11 11 11 11	PROS. 17 152 1272 1146 1272 1146 1272 1146 1272 1146 1272 1146 1272 1146 1272 1146 1272 1146 1272 1272 1146 1272 1272 1146 1272 12
1	100 1785 Li0 1785 17	Before the destrete periods Property P	Convenient Transporter Convenient Co	1856 00 2. 2. 36 48 411 370 11 11 11 11 11 11 11 11 11 11 11 11 11	PROD 100 20 177 152 1272 1146 1248

134



CABLE TV MIDBAND Converter



NO NEW PRODUCTION AEL UNIT S. THE 'HIDDEN CHANNELS' ON DOBAND AND MOVES THEM TO INELS 7-13. SWITCH SELECTS MALL OR 'HIDBAND', JUST PUT LINE WITH YOUR CABLE AND OF BACK BOOTH, 115 VAC WITH CET FOR YOUR TV. ONLY TWO DECTIONS IN B GUT, OVERALL IZE IS 6 X 4-5/8 X 2* HIGH



LM 384 5W AUDIO AMP Po = 5.5 w THD=25% 39¢ BW = 450 KHz Av - 34 db VCC . 28 VDC MAX

STOCK UP NOW!



POPULAR CHIPS

SPECIALS

ON

PRIME IC's

NE564

\$2.75 ea, 10/\$25, 100/\$195

\$1.75 ea, 10/16.50, 100/\$150

\$1.00 ea, 10/\$9, 100/\$75

2200 mfd 40V Axial Cap 79¢

28 Pin IC Socket 10/1.00

MISC. SPECIALS

470 mfd 16V Radial Cap 10/1.00

10 mfd 35V Radial Cap 12/1.00 7808 8 volt Regulator 49¢

NE564 LM 301

LM 565

MC 1330

MC 1350

MC 1458

MC 1496

LM 1889

MV 2109

MC 1349

2N2222

7805

7808

7812

7815

2.75

95

49

1.00

1.75

80

BO

80

69

30

1.79

1.25



ADAPTERS DEAL ON ADAPTERS FOR YOUR ERS AND PROJECTS SIZES ARI X. 2 X 2 X 1-1/2" YOUR CHOICE

12 VAC 300 MA 6 FOOT CABLE TERMINATED IN A 2.5 mm PLUG

18 VAC 250MA 24 VAC . 46 AMP

SCREW TERMINAL OUTPUTS. T-0120 CHOICE \$ 2.95 C EACH WT 0.5 LB

WT 1.2 LB 95 0 8 OHM 5 Watt WEATHERPROOF 5" PAGING HORN
SUPER QUALITY ANODIZED ALUMINUM
HORN AT A BARGAIN PRICE! B OHM,
5 WATT, INDIVIDUALLY PACKAGED

Ammonium Persulfate AMMONIUM PERSUA STATE AND WATER & ETCH ANT STATE & ASY TO USE JUST ADD WATER & ETCH TURNS-BLUE WHEN FULL OF COPPER I LB MAKES 2 GALLONS H-2240 LO / 1750

RED LEDS 1405 WT 0.1 10 PRIME, BRIGHT UNIFORM LED'S ARE GREAT FOR LIGHTING UP YOUR PROJECTS. 0,175' DIA, 0,250' LONG. FULL LEADS, FLANGELESS DESIGN.

8/16 TRACK TAPE HEADS
INSTRUMENTATION MFR PAID OVER 1,000 PER N
WITH A RESPONSE > 50,000 Hz AT 71/2 1PS, TI
HONEYS PERFORM' B TRACKS ON 17 TAPE, TWO
HEADS CAN BE STAGGERED TO GET 16 TRACKS NEW 535 EACH R-8 8 TRK RECORD

HIS BATCH IS NEW, REMOVED RP-7 1/2 DIGITAL REC/PLAY NOM EQUIPMENT (A LITTLE E.7 1/2 ERASE ALL IN RASH, NOTHING SERIOUS) R-7 I RECORD 7 TRK CHOICE 5 15 EACH S-1 3 HEAD SURPRISE ASST

5 VOLT IS AMP 549 P-1206 WT 12 LI

OWERTEC MODEL 2005-18AB EATURES ADJUSTABLE VOLTAGE, URRENT LIMIT, OVERVOLTAGE PROTECTION. BRAND NEW

WIREWRAF

SOCKETS

DIP RELAY

1 10 100 -1405 14 PIN 55 49 41 -1605 16 PIN 60 54 45 -1805 18 PIN 75 68 57

N 5 VDC SPST NORMALLY OPEN R-1210 \$ 95



24 VDC 2.3 AMP POWER SUPPLY

10/09

126 D

12 AMP SCR TO-220 CASE

99 ¢

400 VOLT

6

AMBDA TYPE LOS-Y-24 LAMBDA TYPE LOS-7-24
FEATURE 120/240 VAC OPER
ATION, VOLTAGE B CURRENT
LIMIT ADJ. REMOVED FROM
TION GREAT FOR DISC
DRIVES ORDER TODAY!!
P-1220 \$ 29
WT 5 LB

ELECTRONIC BARGAINS

IF YOU'RE NOT ON OUR MAILING LIST, YOU'RE MISSING OUT-STANDING BUYS ON THE FINEST IN ELECTRONIC PARTS FOR THE BULLDER. IN 8 YEARS OVER 250,000 HOBBYISTS HAVE DISCOVERED WHERE TO FIND USEFUL, UNIQUE OR DOWNRIGHT STRANGE ELECTRONICS AT GIVEAWAY PRICE WHY NOT SEND FOR OUR CATALOG TODAY - IT'S FREE!

PIAMONDBACK ELECTRONICS COMPANY PO BOX 12095 Dept 102

SARASOTA, FLA. 33578 Phone Orders (813) 953-2829

CONTINENTAL US ADD 1160 FOR THE FIRST LB 8
50° FOR EACH ADDITIONAL LB. FLA ADD 5% TAX
WEST COAST ADD 11.80 FOR THE FIRST POUND 8
50° FOR EACH ADDITIONAL POUND.
MAIL ORDER *7 MINIMUM COD & CREDIT CARD \$15 MINIMUM

QUALITY SPECIALS

SOPHISTICATED I.C.'S

DATA SHEETS ARE PROVIDED FREE WITH ALL INTEGRATED CIRCUITS LISTED BELOW DESCRIPTION

PART #

\$1737

PRICE (ea.)

CMOS DIVIDER LC. HAS TRUTH TABLE SELECTABLE INPUT TO YIELD DIVIDE BY 18: 100: 1000 OR 10000 OUTPUTS

D.C. TO SMHZ SIX DECADE MOS UP COUNTER WITH DECADE LATCH AND MULTIFICEXED BIOD OUTPUTS AN DIGIT STROBES ACCESS TO LIST LATCHES ALLOW ATTACHMENT OF PRESCALERS FOR COUNTING TO SOOME

14 PINDIPAUTOMOTIVE MARINE ANTI-THEFT DIGITAL LOS GIRCUIT HAS 3.040 4-DIGIT COMBINATIONS WITH MICROAMP STANCBY SAVE MODE FOR VALET PARKIN

PRECISION WAVEFORM GENERATOR I C. PRODUCES SINE SQUARE: TRANSICE SAWTOOTH OR PLESS WAVEFORMS WITH MINIMUMEXTERNAL COMPONENTS FROM 801N/2TO I MYZ FOR PRECISION PLL. TEST INSTRUMENTS.

HIGH EREDIENCY PHASE-LOCKED LOOP IPLLI IC FOR BOTH ANALOG AND DIGITAL COMMUNICATIONS 25H TO MANNE LIBER INCLUDE WE DEMOCRATION FREQUENCY SYNTHESIS FOR CODING DECODING (MODEM) OTL TILL ECLILLOC COMPATIBLE.

HALL EFFECT DEVICES

HALL EFFECT SINESINFOR MOUNT TO TELL DO HANGES TOO SMALL TO GOTTAGE THE HALL SHOTCHES DISTRICT AS LINKER FUNCTION OF MAGNITIC FIELD INTERSTATE MONOCITHIC OF INCLUDES HALL CELL MARTHER HAND VOLTAGE REDULATOR FOR A 15 TO 24 YEC SOLINGE HIGH SENSITIVITY AND FLAT RESPONSE 2 PIN T NACK

SAME AS UGN 35017 BUT WITH PROVISION FOR NULLING \$2.80. THE OUTPUT OFFSET VOLTAGE 8 PIN DIF

HALL EFFECT SENSOR WITH DIFFERENTIAL OUTPUT A LINEAR FUNCTION OF MAGNETIC FLUX SUPPLIED WITH IN-DIVIDUAL CALIBRATION CHARTAT 25 DECREES CESSIOS AS VOLTS FOR CALIBRATING TESTING AND ALIGNING MAGNETIC SENSING DEVOICES & PIN DIP

FREE CATALOG OF NEW DEVICES

GOLDSMITH SCIENTIFIC

CORPORATION

CORPORATION
P.O. BOX 318R, COMMACK, NY 11725
PHONE ORDERS WELCOME—(516) 979-7944
MASTER CAND AND VISA ACCEPTED
MONE STATE RESIDENTS ADD SALES TAX
POSTAGE ADD 5% PLUS 51:50 INSUBANCE, CO. D. 25:00 EXTRA
AVAILABILITY OF CERTAIN TEMS MAY BE LIMITED

CIRCLE 24 ON FREE INFORMATION CARD

WORK SALES, INC

DELUXE PARTS ASSORTMENTS

#1 Resistors & Trimpots 68 ¼ watt, 5% resistors & 5 PT-15 10K trimpots, 1 each - 51, 75, 100, 470, 1.5K 3.6K 51K 470K 13-1.2K, 2-220, 3-100K, 6-330, 6-12K, 7-910, 9-3.3K, & 14-4, 7K \$4,50 ea, 10/40.00

#2 Capacitor "A"

Monolythics - 1-560pf,
7-1 mfd, & 1-.22 mfd.
Silver Micas - 2-10pf, & 1
each of 43pf, 110pf, 560pf, 1200pf, 3000 or 3300pf

\$4.95 ea, 10/45.00 #3 Capacitor "B"

Mylars 4-.001, 2-.047, 29-.01, Radial lytics 3-10 mfd 16V, 1-1000 mfd 50V, 1-2200 mfd 35V. Disc Caps 1 each of 5, 12, 27, 36, 110, 330pf, 2-120pf, 3-39pf, 3-220pf, and 1 \$7.50 ea. 10/70.00

Pri: 115V AC

POWER TRANSFORMERS

Sec: 24 volts @ .350 A

Dim: 24 x 14 x 2 H \$1,95 ea. 10/\$15.00 100/\$125.00

#4 Coll & Chokes

1 each of 15, 33, and 100 (uh) micro henries chokes. 1-variable RF coil (same as #49A537MPC)

\$3.25 ea. 10/30.00 #5 IC's Sockets, & Semi's 1 each of: NE564, LM565.

MC1330, MC1350, MC1496, LM1889, 7812, 7818, 2N2222A, MV2109, heat sink 2-MC1458, 4-1N4002, 4-8 pin, 2-14 pin, 1-16, & 1-18 pin socket

\$13.50 ea, 10/125.00 #6 Misc Hardware

LED & holder, fuse & holder, line cord. grommet, SPST switch, DPDT switch, 2-F61 conn. & lugs, knob, 4-spacers, 6-screws & nuts. 2'RG-174, matching transformer w/nut \$5.95 ea. 10/57.50

ASTEC VIDEO MODULATOR

Video & Audio Inputs Chan 3 or 4 Output. Model UM1285-8. W/specs. \$8.25

UHF TUNER

ASTEC

Mechanical Detent Tuning Chan 14-83. 12 VDC. 300 Ohm input. 45 MHZ output. \$2.95 ea. 4/10.00

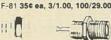
SILVER MICA CAPS 10 PF, 43 PF, 110 PF, 560 PF, 1200 PF. 35¢ ea, 10/3.00, 100/25.00 3000 PF 80¢ ea, 10/7.00, 100/69.00

VOLUME DISCOUNT

\$ 10.00 - 499.00 NET 1000.00 - 4999.00 - 5% 500.00 - 999.00 - 2% 5000.00 & up - 10%

"F" CONNECTORS F-59 20¢ ea, 10/1.50, 100/10.00 F-61 35¢ ea. 4/1.00, 100/22.00

1110



10 TURN POT 10K ohm. Panel Mt.





NETWORK SALES, INC. 2343 W. BELMONT AVE. **CHICAGO, IL. 60618** 312/248-3202

Phone Orders Welcome QUANTITIES MAY BE LIMITED

©COPYRIGHT 1984 NETWORK SALES, INC.

TERMS: Visa, M.C., Check Money Order or COD (addit. \$3.00). Min. Order \$10.00. Add \$2.50 S&H for USA. III. add 8% Tax. MAIL ORDER ONLY.

Prices subject to change without notice.

WRITE FOR OUR MONTHLY UN-ADVERTISED SPECIALS

MATCHING TRANSFORMERS UHF/VHF 75/300 Outdoor/Indoor

300/75 Push-on/Indoor Your choice 89¢ ea, 10/7.00, 100/55.00



SOLID CARBIDE PC DRILL USE WITH DREMEL TOOL Special 79¢ ea 10/5.00

UHF AMP KIT

25db Gain stripline PC board using (2) BFR-90's

Complete (no enclosure) Power supply for above

\$10.95 \$3,49

THUMBWHEEL TRIMMER POTS VERTICAL MOUNT

OHMS 500. 1K, 2K, 5K, 10K, 25K 50K, 100K, 200K, 500K, 1 MEG. 4/\$100 100/\$20.00

FUNCTION GENERATOR KIT

Uses XR-2206 IC. 1 Hz to 100 kHz Complete with PC Board & all parts except power supply and enclosure \$19.95

BYPASS CAP SPECIAL 1 MFD - 50vDC 100/\$5.00 1000/37.50

VERNIER PANEL POTS Multi-turn, "4" shaft. 500 ohm, 1K, or 10K, \$4,49



BRIDGE RECTIFIERS 35A 200 PIV \$2.00 25A 100 PIV \$1.50 3A 400 PIV \$1.00



MYLAR CAPS 50 volts

10¢ ea 001 mfd .01 mfd .047 mfd 100/7.00 1000/48.00



\$24.95

DIGITAL VOLTMETER KIT 3 DIGIT. 0 to 99.9 VDC. Uses CA3161E & CA3162E. Complete with PC Board and parts, except power supply and enclosure.

4 TURN TRIM POTS BOURNS #3339B 1K - 6K R/A - 10K

99¢ ea.





THERE'S MORE FOR BUILDERS AT THE SHACK®

Low Prices!

Huge Selection!

No Mail-Order Hassles!

Sale! Low-Cost Computer Talk!



AY-3-1015 Single-Supply UART. Full-duplex universal transceiver accepts asynchronous serial characters and converts to a parallel format, and vice versa. Selectable baud rate, bits per character, stop bits and parity. 4.75-5.25VDC. 40-pin with specs, data. Reg. \$5.95. 276-1794 ... Sale 3.69

AY-5-8116 Dual Baud Rate IC. Generates the full spectrum of asynchronous/synchronous data communication frequencies for use with UARTs such as #276-1794, above. On-chip oscillator requires crystal, available separately. Single 5 VDC supply. 18-pin with specs, data. Reg. \$8.95. Sale 5.55

Voltage Regulator ICs

Туре	Adjustable	Cat. No.	Each
LM723	0 to 40 VDC	276-1740	.89
LM317T	1.2 to 37 VDC	276-1778	2.79
Туре	Fixed Output	Cat. No.	Each
7805	+5 VDC	276-1770	1.59
7812	+ 12 VDC	276-1771	1.59
7815	+ 15 VDC	276-1772	1.59
7905	-5 VDC	276-1773	1.59
7912	-12 VDC	276-1774	1.59

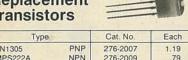
4000-Series CMOS ICs

Туре	Cat. No:	Each
4001	276-2401	.79
4011	276-2411	.79
4013	276-2413	.99
4017	276-2417	1.49
4023	276-2423	.99
4049	276-2449	.99
4066	276-2466	.99

TTL Digital ICs

Туре	Cat. No.	Each
7400	276-1801	.59
7404	276-1802	.79
7408	276-1822	.79
7447	276-1805	1.19
7490	276-1808	.89

Replacement **Transistors**



Туре		Cat. No.	Each
2N1305	PNP	276-2007	1.19
MPS222A	NPN	276-2009	.79
PN2484	NPN	276-2010	.89
MPS3904	NPN.	276-2016	.69
TIP31	NPN	276-2017	.99
TiP3055	NPN	276-2020	1.59
MPS2907	PNP	276-2023	.79
MJE34	PNP	276-2027	1.49
2N3053	NPN	276-2030	.89
MPS3638	PNP	276-2032	.79
TIP120	NPN	276-2068	1.29
2N3055	NPN	276-2041	1.99
MJ2955	PNP	276-2043	2.19
2N4124	NPN	276-2057	.59
2N4401	NPN	276-2058	.59
MPSA06	NPN	276-2059	.59
MPSA13	NPN	276-2060	.59
MPSA42	NPN	276-2061	.69
MU4891	UJT	276-2029	.99
2SD313	NPN	276-2048	1.79
2SC945	NPN	276-2051	.79
2SC1308	NPN	276-2055	7.95
2N3819	N-FET	276-2035	.99
MPF102	N-FET	276-2062	.99

Operational Amplifiers

Ту	Туре		Each
741	(Single)	276-007	.79
MC1458	(Dual)	276-038	.99
LM324	(Quad)	276-1711	1.29
TL082	(Dual)	276-1715	1.89
TL084	(Quad)	276-1714	2.99
LM3900	(Quad)	276-1713	1.39
LM339	(Quad)	276-1712	1.49

Audio Power Amplifiers

Туре	Cat. No.	Each
LM383/TDA2002	276-703	3.19
LM386	276-1731	1.09
TA7205AP	276-705	2.99
LM380	276-706	1.59

Tantalum Capacitors

- 20% Tolerance
- Standard IC Pin Spacing

μF	WVDC	Cat. No.	Each
0.1	35	272-1432	.49
0.47	35	272-1433	.49
1.0	35	272-1434	.49
2.2	35	272-1435	.59
10	16	272-1436	.69
22	16	272-1437	.79

Electrolytic Capacitors

Axial Leads

μF	WVDC	Cat. No.	Each
4.7	35	272-1012	.49
10	35	272-1013	.59
22	35	272-1014	.69
47	35	272-1015	.69
100	35	272-1016	.79
220	35	272-1017	.89
470	35	272-1018	.99
1000	35	272-1019	1.59
2200	35	272-1020	2.49
3300	35	272-1021	2.99
4700	35	272-1022	3.59
470	50	272-1046	1.59
1000	50	272-1047	1.99
2200	50	272-1048	3.49

PC-Mount Leads

μF	WVDC	Cat. No.	Each
220	16	272-956	.79
470	16	272-957	.89
1000	16	272-958	.99
4.7	35	272-1024	.49
10	35	272-1025	.59
22	35	272-1026	.69
47	35	272-1027	.69
100	35	272-1028	.79
220	35	272-1029	.89
470	35	272-1030	.99
1000	35	272-1032	1.59
100	50	272-1044	.89

Mini SPDT Relays







/32 × 3/8 × 1/4"		3/8 × 9/16 × 3/8"	9/16 X 25/32 X 5/8		
Fig.	Coil	Contacts	Cat. No.	Each	
Α	5 VDC	1A, 125 VAC	275-240	1.99	
В	5 VDC	2A, 125 VAC	275-243	2.49	
C	5 VDC	3A, 125 VAC	275-246	2.99	
C	12 VDC	3A. 125 VAC	275-247	2.99	

Computer Connectors

Repair or "roll your own" extension cords and

Туре	Positions	Cat. No.	Each
Solder Sub-D Male	9	276-1537	1.99
Solder Sub-D Female	9	276-1538	2.49
Hood for Above	9	276-1539	1.99
Solder Sub-D Male	15	276-1527	2.49
Solder Sub-D Female	15	276-1528	3.49
Hood for Above	15	276-1529	1.99
Solder Sub-D Male	25	276-1547	2.99
Solder Sub-D Female	25	276-1548	3.99
Hood for Above	25	276-1549	1.99

Power Transformers

120VAC Primaries

Type	Volts	Current	Cat. No.	Each
Mini	6.3	300 mA	273-1384	2.59
Mini	12.6	300 mA	273-1385	2.79
Mini	25.2	300 mA	273-1386	2.99
Mini	12.6 CT	450 mA	273-1365	3.59
Mini	25.2 CT	450 mA	273-1366	3.99
Std.	6.3	1.2A	273-050	3.79
Std.	12.6 CT	1.2A	273-1505	3.99
Std.	25.2	1.2A	273-1480	4.39
H-D	12.6 CT	3.0A	273-1511	5.99
H-D	25.2 CT	2.0A	273-1512	6.29
H-D	18.0 CT	2.0A	273-1515	6.99

Dynamic Transistor Checker

Tests In or Out of Circuit



The quick, easy way to test small-signal and power types and match similar transistors. Lamp indicates relative gain opens and shorts. Output

21-Range Digital Multimeter

Continuity Beeper Also Indicates Over-Range
—Really Saves Time!

Zero-adjust for precise lowresistance measurements. "Diode check" for testing semiconductors. Overload

protected. Measures to 1000-volts AC, 500 volts DC, 200 mA AC and DC, resistance to

20 megohms. $6^3/8 \times 3^1/2 \times 1^3/8$ ". With spare fuse, leads. Requires two "AA" batteries. 59.95

Home Computer Programs

Reg. 7.95

Save \$5 295 For TRS-80® 16K Models I, III, 4



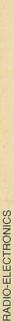
5995

Using the TRS-80 in Your Home. Listings for over 75 useful programs—financial, automotive, kitchen helpmates, scheduling, filing, math, metric and temperature conversions, games, more. 330 pages. 62-2069 Sale 2.95

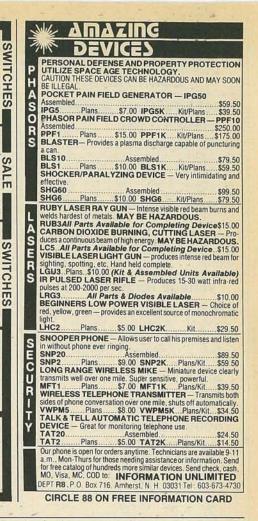
A DIVISION OF TANDY CORPORATION

OVER 8800 LOCATIONS WORLDWIDE

Prices apply at participating Radio Shack stores and dealers







TEST EQUIPMENT DISCOUNT PRICES



TOTAL ELECTRONICS CENTER . OVER 70,000 ITEMS IN STOCK

WM. B. ALLEN SUPPLY CO. INC. ALLEN SQUARE

300 BLOCK NORTH RAMPART STREET, NEW ORLEANS, LOUISIANA 70112

CALL TOLL FREE 535-9 LOUISIANA TOLL FREE 800 462-9529





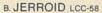
LCC-58 (Formerly Model DRX-105)

TV Remote Controller

D

A. JERROID LCC-91

- Remote Control Lets You Change TV Channels From the Comfort of Your Chair
- . Turn Your TV Set On and Off Without Touching the Dial
- 66 Channel Capacity
- Lighted Digital Display On the Converter Indicates the Channel
- Simple Do It Yourself Installation In Minutes
- · Works With All TV Models and Compatible With All Cable Systems
- Guaranteed One Year By More Than 300 General Instrument Warranty Stations



- Remote Control Lets You Change TV Channels From the Comfort of Your Chair
- Turn Your TV Set On and Off Without Touching the Dial
- 58 Channel Capacity
- Lighted Digital Display On the Converter Indicates the Channel
- Simple Do It Yourself Installation In Minutes
- Works With All TV Models and Compatible With All Cable Systems
- Guaranteed One Year By More Than 300 General Instrument Warranty Stations

c. JERROLD #JRX-3

- 37 Channel Capability
- Cord Type Remote Control
- Remote Channel Selection
- · Remote-Fine Tuning

D. JERROLD #JSX-3

- 37 Channel Converter
- Set-Top Model

	MANUFACTURE	MODEL #	RETAIL
Α	JERROLD	LCC-91	129.00
В	JERROLD	LCC-58	119.00
200	Zantani in a	TANK MANAGES	7/20/20/20

JERROLD 300 JRX-3 79.00 D **JERROLD** 300 JXS-3 69.00

LARGE QUANTITY DEALERS INVITED. SPECIAL PRICING ARRANGED.

Model JSX

Set-top

Model JRX

G M HIGH TECH

"Your Cable Warehouse"

P.O. Box 604412 Miami, Horida 33269 305-651-2634

RADIO-ELECTRONICS

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

Free I	nformation Number Pag	e –	Electronic Book Club	98	- OK Industries Cover 3
		- 44	- Electronic Industries	- 22	Pace Products International Inc 105
46	Acorn	14 6	Electronic Specialists	52	Paia
77	Active Electronics	2 9	Electronic Warehouse 109	47	Philips ECG
80	Advanced Computer Products 11	15 39	Etronix	29	Philips Tech Electronics 130
_	Advance Electronics 9-		Firestik	37	Pomona
12	All Electronics	23 —	Fluke Manufacturing	21	Professional Video
67	AMC Sales	32 —	Fordham Radio	43	PTS
84	Appliance Service	15 76	Formula117	89	Quietroll Co
87	AP Products	23 96	Global Specialties	61	Radio Shack
17	AW Sperry	22 —	Goldsmith Scientific	79	Ramsey
72	BBC	33 26	GM High Tech	31	Random Access
100	Beckman Instruments Cover	2 —	Grantham College of Engineering 25	86	RCA Dis. and Special Prod 14
16	B&K	24 75	Haltronix	3	R&D Electronics
-	C&D	32 15	Heath52-55	27	RF Electronics
18	CEI	01 85	Hickok	5	RSP Handy131
34	Chaney	16 38	HMR CO	88	Scientific Systems
70	Chemtronics	28 28	Instrument Mart	60	SEI
-	CIE	37 64	Iwatsu Cover 4	_	SM Robotics
-	C.O.M.B	99 41	Jameco	58	Solder Craft
23	Command Productions	22 42	Javanco	36	Spartan Electronics
35	Communications Electronics	2 49	JDR118-121	19	Spectrum
50	Contact East	45 7	Jensen	_	Tektronix
68	CPU1	06 4	J&W110	62	Test Probes Inc
55	Dandy Manufacturing	44 83	KCS130	_	Texas Instruments
10	Dalbani		McGraw Hill Book Club 70-73	45	Trio-Kenwood
24	Diamondback	34 93	McIntosh Labs 41	59	Vector Electronics 41
65	Digikey	33 66	MFJ108	91	VIZ
11	Digitron	22 90	Network Sales	8	Wahl Clipper
53	Direct Video		Newtone Electronics	13	Westech
99	Dokay	25 73	Non Linear	56	WM.B Allen
54	DTI	27 —	NRI	32	WM Goosby
92	EICO1	07 —	NTS 88-91	57	W.S. Jenks and Son
81	Electra Bearcat	29			



SPARTAN

Electronics Inc.

REFURBISHED

9", 12", Commercial

Remote CATV

AUTO ALARM SYSTEMS

w/on/off Fine Tuning \$94.95

58 Channel Wireless \$109.95

40 Channel VHF to UHF

Deluxe Version - Features fine tuning knob,

Block Converter

Jerrold 36 Channel

MONITORS

Grade as low as

Converter

6094 Jericho Tpke. Commack, N.Y. 11725

MAIL CALL (516) 499-9500



\$139.95

Philips Remote Cable Converter

• Micro computer technology • Quartz controlle Id's lock in picture & prevent drift • 60 channel selections • Programmable time on & off • 24 hour LED digital lock • Pavorde channel memory & recall plus scan • Wireless hand held infra-red. Transmiter system • Automatic fine fund • Adaptable to any brand television • One year warranty service

COMPUTER CARE KIT

The Preventative maintenance kit for the office and home computer



SGL WABER

Protect your computer and electronic equipment from voltage spikes

\$35.95

DG115P DG115S (6 Outlet) \$45.95



BECKMAN **CIRCUITMATE 20**

8 functions and 30 ranges -Diode/transistor test function auto-polarity, auto-zero, and auto-decimal - 10 Amps AC and DC Current Capability - Transistor Gain Test (hFE) - Conductance



WINEGARD FM CAR ANTENNA BOOSTER



-automatic turn-off and 2000 Auto Watchman

Keyless Automatic

-arms when ignition is

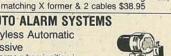
Passive

turned off

reset timer

-prevents use of master keys or the removal of ignition lock to start vehicle





\$64.95

28.95 Ea.

24.95 4 & up

\$39.95



\$34.95

EProms

1024 x-8

\$1.95 While Quantities Last

BEFORE YOU PAY \$\$ FOR A TELEPHONE SERVICE CALL, TEST IT YOURSELF!!!

BKPRECISION

Telephone Line Analyze Model 1042

Ene functions that affect

Verifies line and ring voltage levels. Checks condition of telephone line from central office to user's telephone jack. Verifies telephone line polarity that can affect polarity sensitive telephones.



PROFESSIONAL TELEPHONE PRODUCT TESTER

BK PRECISION

MODEL 1045

Features:

Provides low and normal level ring test sequence. Verifies that voice and DTMF (Dual Tone Multiple Frequency) levels are above menimum required level. As the sequency of the continue without the level of sequence of the continue without the level of sequence of the continue without the continue without the level of the level of

\$335.95

Volume Discounts

\$26.95

Min. Order \$25.00 International shipping Add I. Prices Subject to change without notice

COD 2 00 Extra Add I shipping for monitors

Dealers Welcome
Visa, MC BAC Amex, All above
prices include 4° cash discount
C 0 D impney order check Add for

251 00 to 500 00 501 00 to 750 00

\$2.50 \$4.50 \$6 00 \$8 50 499-9500

Over 1000 00 (516)

Mon Th

9-8

Tu W F 9-6

Sa 9:30-5





Multi-function 4-channel 8-trace Oscilloscopes, each with a superb fundamental performance

Coarse focusing, traces that shift up and down when the deflection factor is changed, waveforms that become distorted when signals approaching the frequency limit of the oscilloscope are input . . . everybody has experienced these problems. In many cases, the problem lies in the oscilloscope's fundamental characteristics. To eliminate these problems, the excellent performance of every IWATSU oscilloscope is achieved by going back to the basic concept of an oscilloscope as a measuring instrument; it should be reliable, easy to operate and have a wide range of useful features.

SS-5711 DC ∿100 MHz

- Frequency response margin (typically an additional 20 MHz)
- Guaranteed time difference between channels
- 1 mV/div deflection factor (at x 5 gain)
- 2 ns/div sweep rate (at x 10 mag)
- Independent A and B triggers

SS-5710 DC~60 MHz

- Guaranteed time difference between channels
- 1 mV/div deflection factor (at x 5 gain)
- 5 ns/div sweep rate (at x 10 mag)
- TV trigger
- Optional DMM and counter





IWATSU INSTRUMENTS INC. 120 COMMERCE ROAD, CARLSTADT, NJ 07072 PHONE: (201) 935-5220, TWX: 710-989-0255

■ In Canada: ATELCO, 3400 Pharmacy Avenue, Unit 1, Scarborough, Ontario, M1W 3J8, Phone (416) 497-2208,TWX 610-492-0122