Radio-Electronics®

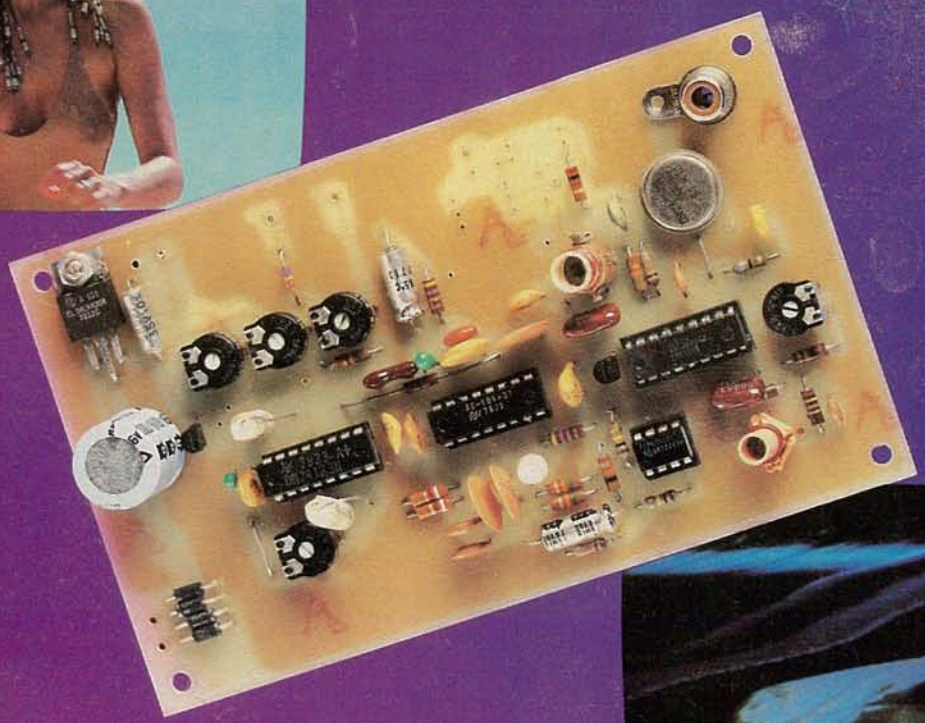
YOUR NEXT CAR—
COMPUTERS UNDER THE HOOD

$1.25 JAN. 1981

onvert your TV into a video monitor
i-fi noise reduction techniques
ells and whistles for your robot

How to use universal counter/timers
Designing with majority logic IC's
An easy way to make PC boards

BUILD YOUR OWN PAY-TV DECODER



0 71896 48783 01

THE NEW DIGITAL

performers.

MODEL 3400
Now only $125

MODEL 3410
Only $140

MODEL 4000
Only $235

MODEL 4200
Only $270

GO DIGITAL WITH MORE FEATURES FOR THE SAME COST!

When you're shopping for digitals, be sure to check out these Triplett Digital Multimeters. They're loaded with extras that extend multimeter life and make your job a lot easier and safer.

MODEL 3400 . . . Hand size, 3½ digit with handy single range switch. Six functions with 24 ranges including Hi/Lo Power Ohms, auto-zero and auto-polarity. Overload protected to 600V on all ranges. Battery life is 200 hours min. Low battery indicator with 50 hours to spare. Price is now only $125.

MODEL 3410 . . . All the features of the Model 3400 plus 1000 Volt AC/DC range and overload protection up to 600V on current ranges and up to 1000V on ohms or voltage ranges without fuse blow. Typical battery life of 500 hours. Price is only $140.

MODEL 4000 . . . Bench type, overload protected with multiple fusing to 1000V on all ranges, RF shielded, auto-zero and auto-polarity. Six functions with 32 ranges, Hi/Lo Power Ohms and 3½ digit, .43" easy-read LED display. Single range selection and pushbutton function selector. Price is only $235. (Battery version Model 4100)

MODEL 4200 . . . All the features of the Model 4000 plus a true RMS converter that computes the root-mean-square level of a complex AC input signal and displays the digital equivalent. Price is only $270. (Battery version Model 4300)

MODELS 4100 & 4300 (not shown) . . . Ni-Cad rechargeable battery versions of Models 4000 & 4200. Price of Model 4100 is $290 . . . Model 4300 is $325.

Triplett's over 75 years experience is evident in the engineering firsts included in these digital testers. For a free, no-obligation demonstration, contact your Triplett Distributor, Mod-Center or Representative. Triplett Corporation, Bluffton, Ohio 45817.

THE MARK OF QUALITY OVER 75 YEARS

Triplett performance . . . a tough act to follow

TRIPLETT

Telephone (419) 358-5015 • TWX: 810-490-2400

CIRCLE 57 ON FREE INFORMATION CARD

CIRCLE 58 ON FREE INFORMATION CARD, IN-PLANT Demonstration

Bone Fone Clone

If you thought the Bone Fone was great, wait until you hear what's new. Here's the latest on the Bone Fone spin-offs.

It started with the Bone Fone. And this very unusual stereo system has created a whole new series of products.

The Bone Fone is an AM/FM stereo radio that drapes around your neck like a scarf. Two speakers, placed near your ears, not only provide excellent stereo separation, but vibrate slightly through your bones to give you the same sensation as standing in front of your home stereo system.

UNEXPECTED APPLICATIONS

Shortly after it was introduced, the Bone Fone became a very popular product for a variety of reasons. A lady in Helena, Montana who bought the unit for her son told us, "It's made a significant contribution to my sanity. No more rock n' roll blasting through the house, the sound goes where my son goes."

A jogger in Rowlett, Texas wrote us "Amazing separation, fantastic stereo response, helps my jogging tremendously. I wasn't really expecting this type of quality through a magazine ad at this price."

But one of the most unexpected letters came from a man in Belle Center, Ohio. "You don't have to be young and jog to enjoy Bone Fone. You see, I'm 73 years old. I just sit and listen."

LETTERS EVERYWHERE

Letters have come from mailmen, roller skaters, skiers, cyclists, motrocycle enthusiasts, hikers and even people who listen to the Bone Fone stereo while walking their dog. The Bone Fone appeals to practically every American.

The Bone Fone was designed by an engineer who wanted to listen to good stereo music without carrying heavy box radios or bulky headphones. Headphones block out all other sounds—even warnings which could be dangerous outdoors, and box radios are heavy and disturb those around you. So he invented the Bone Fone—"the stereo sound you wear around."

Weighing only 17 ounces and powered by 4AA cell batteries the Bone Fone stereo provides a sound that would be impossible to describe in an advertisement. The cliche, "you've got to hear it to believe it," certainly applies here. And for **$69.95** it's the lowest priced stereo entertainment product available.

But what about the sport enthusiast who can care less about stereo music? Or the person who wants just the news? Or simply the person that just listens to AM radio and doesn't want to spend $69.95?

The Bone Fone drapes around your neck like a scarf and has a sound that you find incredible when you first hear it.

Enter NUTS! NUTS is the AM version of the Bone Fone for sports nuts, news nuts, jogging nuts or anybody who wants a low cost Bone Fone without FM or stereo. NUTS sells for **$39.95** complete with two speakers and a strap that firmly attaches the unit to you for any physical activity.

Sitting at a football game, walking your dog, jogging—NUTS gives you a convenient way to listen to music, news and sports without paying a premium for stereo.

But the Bone Fone spinoffs don't end there. There's the Neck Fone—a device you place over your shoulders and plugs into your home stereo system. This lets you enjoy your home stereo without disturbing those around you and without the bulk of headphones. The Neck Fone sells for **$34.95**.

So there you have it. Three exciting products—Bone Fone, NUTS, and the Neck Fone—three unusual solutions designed to solve any gift-giving problem.

LOWEST-PRICED STEREO

Compare the Bone Fone price with any box radio, stereo system or even the new $200 Sony Walkman. The Bone Fone is the lowest-priced quality personal stereo system you can buy. It is also safer than headphones as it leaves you free to hear the sounds around you and keeps you in touch with the environment.

To order any of the above products, simply send your check or money order for the amount listed above plus $2.50 for postage and handling (Ill. residents add 6% sales tax) to the address below, or credit card buyers may call our toll-free number below. Each unit is backed by a 90-day limited warranty and a service-by-mail facility as close as your mailbox. Service should rarely be required as the units use solid-state components and are designed to take rugged treatment. JS&A is America's largest single source of space-age products—further assurance that your modest investment is well protected.

The Bone Fone started a small revolution. Be part of that revolution with the space-age way to listen to music, news and sports. Order a Bone Fone product at no obligation, today.

JS&A®

Dept. RA One JS&A Plaza
Northbrook, Ill. 60062 (312) 564-7000
Call TOLL-FREE 800 323-6400
In Illinois Call ..... (312) 564-70

ITEM NO.
WK-7

CMOS SAFE

IC INSERTION/EXTRACTION KIT

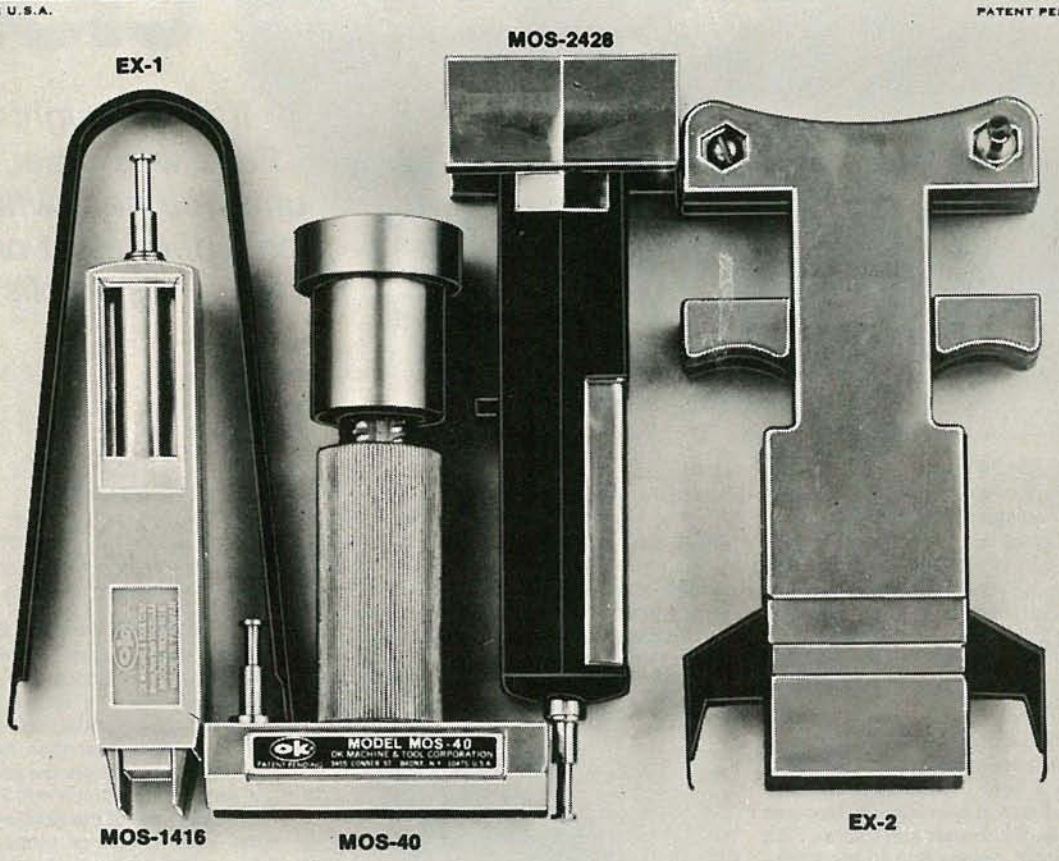
KIT INCLUDES

- MOS-1416 14-16 CMOS SAFE INSERTER
- MOS-2428 24-28 CMOS SAFE INSERTER
- MOS-40 36-40 CMOS SAFE INSERTER
- EX-1 14-16 EXTRACTOR
- EX-2 24-40 CMOS SAFE EXTRACTOR

OK MACHINE & TOOL CORPORATION
3455 CONNER ST., BRONX, N.Y. 10475 U.S.A.
PHONE (212) 994-6600 TELEX NO 125091

PRINTED IN U.S.A.

PATENT PENDING



WK-7	COMPLETE IC INSERTER/EXTRACTOR KIT	$29.95

INDIVIDUAL COMPONENTS

MOS-1416	14-16 PIN MOS CMOS SAFE INSERTER	$ 7.95
MOS-2428	24-28 PIN MOS CMOS SAFE INSERTER	$ 7.95
MOS-40	36-40 PIN MOS CMOS SAFE INSERTER	$ 7.95
EX-1	14-16 PIN EXTRACTOR TOOL	$ 1.49
EX-2	24-40 PIN CMOS SAFE EXTRACTOR TOOL	$ 7.95

MINIMUM BILLING $25.00. ADD SHIPPING CHARGE $2.00. NEW YORK RESIDENTS ADD APPLICABLE TAX.

OK MACHINE & TOOL CORPORATION 3455 CONNER ST., BRONX, N.Y. 10475 (212) 994-6600/TELEX 125091

CIRCLE 48 ON FREE INFORMATION CARD

Radio-Electronics

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

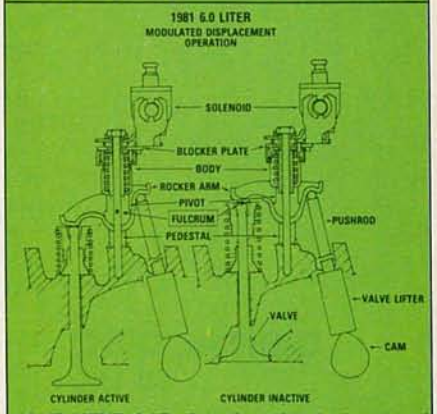
JANUARY 1981 Vol. 52 No. 1

ON THE COVER

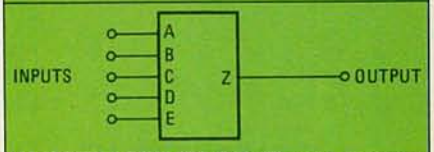
Over-the-air pay-TV stations are sprouting up across the country. Those stations broadcast encoded recently-released movies. An adapter connected internally to your TV set will enable you to decode those over-the-air broadcasts. The lower right-hand corner of the cover shows what the encoded broadcast looks like. The upper left-hand corner of the photo shows Bo Derek in a scene from the recent movie "10"*.

For a look at how the over-the-air pay-TV encoding system works, and how you can build your own decoder, turn to page 41.

*Copyright ©1979 by Orion Pictures Company



YOUR NEXT CAR. A look under the hood and how microprocessors will be controlling the engine in the next generation of U.S. cars.



MAJORITY-LOGIC IC's that will make designing digital circuits easier are available. To find out what majority logic is, and how you can use it, turn to page 64.

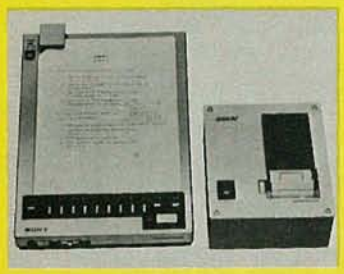
Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Phone: 212-777-6400. Controlled Circulation Postage Paid at Concord, NH. One-year subscription rate: U.S.A. and U.S. possessions, $13.00. Canada, $16.00. Other countries,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

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

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

looking ahead

INTERACTIVE VCR



Videocassette recorders can assume many of the interactive features of sophisticated videodisc systems, using Sony's new Video Responder, designed to enhance the users of Betamax and U-matic machines for education and training. It employs a microprocessor that enables the user to respond to questions presented in the program, and provides quick access to chosen segments of the videotape. It also is equipped with a printer that records answers on a paper tape, providing a record of all of the trainee's responses.

Rather than use a alphanumeric keyboard for responses to questions posed on the tape, Sony uses a text holder that resembles a sort of electronic clipboard, on which written questions coordinated with the videotape can be attached. The holder has nine keys for multiple-choice answers. Pressing the wrong answer can automatically cause the tape to speed to the segment that tells the user he's wrong and why, giving the correct answer or encouraging him to try again.

The Video Responder is designed to be used with existing tapes, and makes it possible to re-program them for interactive use.

DISC QUIETER

For some time, Dolby had the noise-reduction field virtually to itself. Then came ANRS, followed by dbx and Telefunken's system. Now comes CBS with its own system designed primarily for use with records, and claimed to eliminate surface noise totally, and to improve dynamic range. CBS says that its new system provides reproduction almost as good as the digital or analog master tape, with an 85dB signal-to-noise ratio. The system will also work with tape recorders.

One major advantage claimed for the new CBS system is complete compatibility—encoded discs or tapes can be played on standard home equipment lacking decoders without sound deterioration. One CBS source estimates that a decoder component for existing stereo systems could be made to sell for about $50. Built-in decoders would add a lower figure to the cost. CBS plans to use the system in making its own records and is negotiating with other record and equipment manufacturers for adoption of the system. Meanwhile, at Dolby, all is not quiet. The company is talking with its licensees about the imminent introduction of a new consumer noise reduction system, the C-type, which presumably eventually would replace the standard Dolby-B system.

DIGITAL DISC PLUS

JVC's revised entry into the competition for the digital audio disc system of the future turned out to be a major surprise. It carries three channels of audio and provides optional still pictures. Designed as an optional component for its VHD videodisc system, JVC's AHD (audio high density) videodisc is designed as the first consumer digital-TV device. At its original demonstration at Japan's Audio Fair, the disc provided three discrete audio channels and a color picture that changed every seven to ten seconds, although the company says the production model will be able to change pictures every four to five seconds. As displayed, the picture showed photographs of the performers on the record and words to songs. JVC has set no date for commercialization, but is submitting the specifications to Japan's Digital Audio Disc Standardization Committee.

COMPETITIVE PROJECTION

The new General Electric Widescreen 3000, which was designed to be priced in the $3,500 area, has joined in the general projection-TV price competition with indications it will be competitive with the Sony, Advent and Kloss two-piece systems at just under the $3,000 level. The GE unit is an improved three-tube version of the company's self-contained rear-projection set. When introduced in New York, one dealer put a pricetag of $2,800 on it; at the same time, GE had a $150 factory-rebate promotion on the model, bringing the cost to the customer down to about $2,650. There seems to be no doubt that projection-TV prices are on the way down—and that may be just what the giant-screen medium needs to bring public acceptance.

TV STEREO PROCEEDS

The choice of a stereophonic sound system for television may be a more harmonious process. An industry-wide EIA subcommittee has been conducting field tests on three proposed systems—backed by the Electronic Industries Association of Japan, Telesonics, and Zenith. If the subcommittee reaches a strong consensus to present the FCC, multichannel sound could be broadcast along with the TV signal as early as 1982. Under the rules of the subcommittee, any system recommended must be capable of accommodating two discrete soundtracks, so it can be used for bilingual broadcasts as well as stereo.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

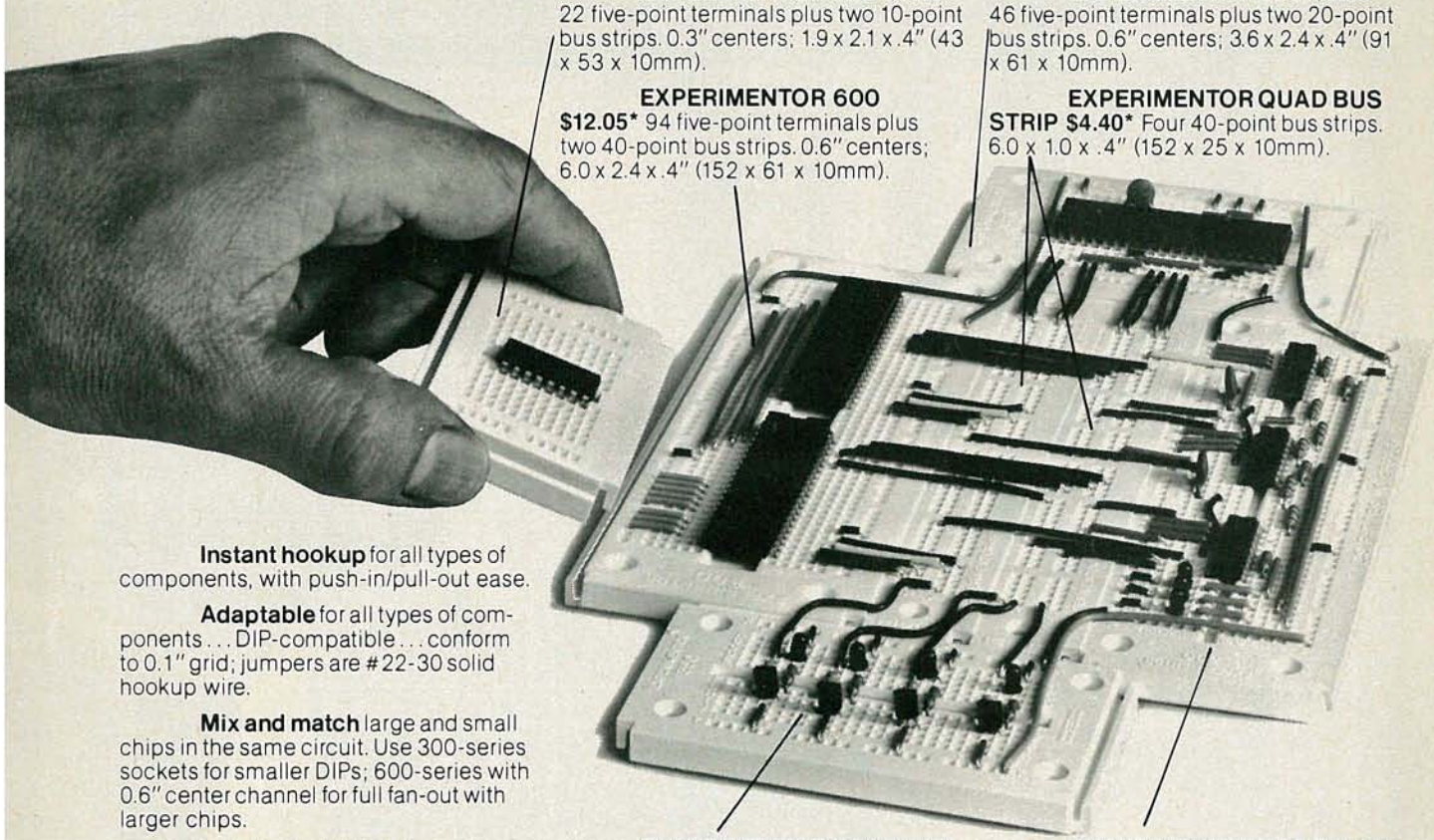
A breadboard as big as your ideas.

EXPERIMENTOR 325 $3.05*
22 five-point terminals plus two 10-point bus strips. 0.3" centers; 1.9 x 2.1 x .4" (43 x 53 x 10mm).

EXPERIMENTOR 650 $6.90*
46 five-point terminals plus two 20-point bus strips. 0.6" centers; 3.6 x 2.4 x .4" (91 x 61 x 10mm).

EXPERIMENTOR 600 $12.05* 94 five-point terminals plus two 40-point bus strips. 0.6" centers; 6.0 x 2.4 x .4" (152 x 61 x 10mm).

EXPERIMENTOR QUAD BUS STRIP $4.40* Four 40-point bus strips. 6.0 x 1.0 x .4" (152 x 25 x 10mm).



Instant hookup for all types of components, with push-in/pull-out ease.

Adaptable for all types of components . . . DIP-compatible . . . conform to 0.1" grid; jumpers are #22-30 solid hookup wire.

Mix and match large and small chips in the same circuit. Use 300-series sockets for smaller DIPs; 600-series with 0.6" center channel for full fan-out with larger chips.

Infinite flexibility lets you expand and modify circuits vertically and horizontally, simply by snapping sockets together.

Easy mounting using 4-40 screws from front or 6-32F self-tapping screws from rear. Vinyl-insulated backing lets you fasten to any surface.

EXPERIMENTOR 350 $6.05*
46 five-point terminals plus two 20-point bus strips. 0.3" centers; 3.6 x 2.1 x .4" (91 x 53 x 10mm).

Marked tie-points simplify translation from breadboards to PC boards or wiring tables.

Ruggedly built of abrasion-resistant materials that withstand 100°C.

EXPERIMENTOR 300 $10.95*
94 five-point terminals plus two 40-point bus strips. 0.3" centers; 6.0 x 2.1 x .4" (152 x 53 x 10mm).

Quick construction of microprocessors and other circuits—each EXP-4B gives you four bus lines, with 8-, 12-, and 16-line address and data buses easily created by combining Bus Strips.

It's hard to believe how much faster and easier building circuits can be . . . until you try our Experimentor™ solderless breadboarding sockets. From the largest DIP to the smallest resistor, components plug in and out instantly, without special hardware or jumper cables. So you save time and money by eliminating soldering and component damage. Start small and expand in any direction your thinking takes you, by snapping sockets together vertically or horizontally. With no limit to your ideas. Get started today, for as little as $3.05*!

Smarter tools for testing and design.

70 Fulton Terr., New Haven, CT 06509 (203) 624-3103, TWX 710-465-1227
OTHER OFFICES: San Francisco (415) 421-8872, TWX 910-372-7992
Europe: Phone Saffron-Walden 0799-21682, TLX 817477
Canada: Len Finkler Ltd., Downsview, Ontario

GLOBAL SPECIALTIES CORPORATION

Call toll-free for details
1-800-243-6077
During business hours

SEE US AT SOUTHCON BOOTH 744 and 746

*Suggested U.S. resale. Prices, specifications subject to change without notice.

CIRCLE 32 ON FREE INFORMATION CARD

"Here's the best news yet about Fluke Digital Multimeters.

Now you can carry one home."

Right now, in selected electronics supply stores across the country, Fluke is introducing a new line of low-cost DMM's: the Fluke Series D. With their distinctive dark cases and full range of accessories, these five DMM's are designed to meet the test and measurement needs of the uncompromising service technician, home hobbyist, student or working engineer.

Fluke perfected the handheld DMM and set tough standards for accuracy and reliability that have made analog meters obsolete, and other digitals seem clumsy by comparison.

You've probably heard about their superior electrical performance, mechanical ruggedness and environmental endurance. And now you can see for yourself at your favorite electronics dealer why Fluke DMM's have become the professional's choice the world over.

Series D Handheld Models.

D 800: Fluke's lowest-priced DMM, easy to operate, with six functions, 24 ranges and 0.5% dc voltage accuracy. Guaranteed a full year by Fluke. A sure-fire solution to basic measurement needs. $125.*

D 802: Basic dc accuracy of 0.1% and conductance for high resistance measurements to 10,000 MΩ make this multimeter a solid price/performance value. $179.*

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

D 804: A powerful, versatile handheld DMM with nine functions, 26 ranges, 0.1% basic dc accuracy and more. Direct temperature readings in °C with K-type thermocouples; peak hold on voltage and current functions; even an audible indicator for instant continuity and logic level detection. Available January 1981. $229.*

Series D Bench/Portables.

D 810: By means of a Fluke-built hybrid converter, this multi-purpose DMM delivers True RMS measurements of ac voltage and current with speed and precision. Also features conductance, 0.1% basic dc accuracy, an extra 10A range and diode test. $259.*

D 811: Same performance features as the D 810 with the added convenience of battery power. Rechargeable "C" size Ni-Cad batteries deliver up to 40 hours continuous operation. $299.*

Series D Accessories.

A wide range of accessories to extend the measurement capabilities of your Series D Multimeter is available, including temperature and current probes, carrying cases, deluxe test leads and thermocouples.

With Series D Multimeters so easy to find and economical to own, Fluke has made selecting the right DMM much simpler. This is your opportunity to own a Fluke.

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

*suggested U.S. list price.
For technical data circle no. 25

FLUKE®

Now NRI takes you inside the world's most popular microcomputer to train you at home as the new breed of computer specialist!

NRI teams up with Radio Shack to teach you how to use, program and service microcomputers... make you the complete technician.

It's no longer enough to be just a programmer or a technician. With microcomputers moving into the fabric of our lives (over 200,000 of the TRS-80™ alone have been sold), interdisciplinary skills are demanded. And NRI can prepare you with the first course of its kind, covering the complete world of the microcomputer.

Learn At Home in Your Spare Time

With NRI training, the programmer gains practical knowledge of hardware, enabling him to design simpler, more effective programs. And, with advanced programming skills, the technician can test and debug systems quickly and easily.

Only NRI gives you both kinds of training with the convenience of home study. No classroom pressures, no night school, no gasoline wasted. You learn at your convenience, at your own pace. Yet you're always backed by the NRI staff and your instructor, answering questions, giving you guidance, and helping you over the tough spots.

Training includes TRS-80 computer, transistorized volt-ohm meter, digital frequency counter, and the NRI Discovery Lab with hundreds of tests and experiments.

Explore the TRS-80 Inside and Out

NRI training is hands-on training, with practical experiments and demonstrations as the very foundation of your knowledge. You don't just program your computer, you go inside it...introduce and correct faults...watch how circuits interact...interface with other systems... gain a real insight into its nature.

You also build essential test instruments like a transistorized volt-ohm meter and CMOS digital frequency counter. You work with the exclusive NRI Discovery Lab, performing over 60 separate experiments in all. You learn how your trouble-shooting tools work, and gain greater understanding of the information they give you. Both microcomputer and equipment come as part of your training for you to use and keep.

Send for Free Catalog...No Salesman Will Call

Get all the details on this exciting course in NRI's free, 100-page catalog. It shows all equipment, lesson outlines, and facts on other electronics courses such as Complete Communications with CB, TV and Audio Servicing, Digital Electronics,

eleven different interest areas in all.

Send today, no salesman will ever bother you. Keep up with the latest technology as you learn on the world's most popular computer. If postcard has been used, write to NRI Schools, 3939 Wisconsin Ave., Washington, D.C. 20016.

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

(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)

editorial

Consumer Electronics 1981

This issue marks the beginning of another new year. On this happy occasion, I'll try my hand at predicting what will happen over the next 12 months and beyond. The only trouble with predicting is that you will either be right on target or miss it entirely. So with a grain of salt, here goes.....

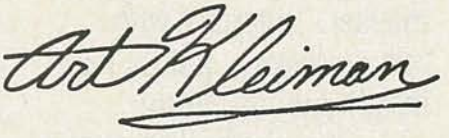
Now that inexpensive voice synthesis is a reality, we will find more and more manufacturers incorporating this new technology into their products. Talking microwave ovens, household appliances, wristwatches, calculators and even talking test instruments are right around the corner. A little farther down the road we will see automobiles with talking dashboards.

This year we will witness the introduction of inexpensive IC's for speech recognition. However, manufacturers will look much more cautiously toward incorporating this technology into their products. They will wait until they've first gained some experience with speech synthesis. Then we will see the introduction of a whole slew of new products incorporating speech recognition. Imagine being able to shout a command to your TV set, having it respond giving a verbal confirmation.

True digital records will become a reality. Before the year is out, we will witness the market introduction of the Philips Optical Compact Disc system. This is a compact laser-based player. The discs are less than 5 inches in diameter with a 60-minute per side playing time. The system provides both a S/N ratio and dynamic range in excess of 90 dB. High-fidelity will never be the same.

Unfortunately, we will not see the introduction of teletext this year. It will remain caught up in FCC red tape and politics.

No matter how we slice it, whether I'm right on target or out in left field, its going to be another great year for the electronics industry. As consumers, we will be buying higher technology items for our dollar.



ART KLEIMAN
Managing Editor

Radio-Electronics®

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

Cover photo by Robert Lewis

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

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

ADVERTISING SALES 212-777-6400
Larry Steckler
Publisher

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

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

PACIFIC COAST
Mountain States
Jay Eisenberg
J.E. Publishers Representative Co.,
8732 Sunset Blvd.,
4th Floor,
Los Angeles, CA 90069
213-659-3810
San Francisco, CA 94124
415-864-3252

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

B&K PRECISION · PHILIPS · TRIPLETT · VIZ (formerly RCA) · LEADER · HICKOK · Hitachi · Simpson · FLUKE · NLS Non-Linear Systems · KEITHLEY · DORIC · DATA PRECISION

DATA PRECISION Model 938

0.1%, 3½-Digit, LCD DIGITAL CAPACITANCE METER

Reg. $179. NOW $149.

- WIDE RANGING — from 199.9 pF full scale (0.1 pF resolution) up to 1999 µF full scale, in eight ranges...virtually every capacitance you'll ever need to measure.
- FAST AND EASY TO USE — Direct reading, pushbutton ranges. Just plug in and read.
- EXCEPTIONALLY ACCURATE — provides ±0.1% basic accuracy.
- TOUGH AND COMPACT — Built to take rough usage without loss of calibration accuracy. Fits and goes anywhere; takes very little bench space; always handy for quick capacitance checkout, matching, calibration, and tracking.
- PORTABLE — Palm-sized, light-weight, operates up to approximately 200 hours on a single 9V alkaline battery.
- EASY READING — big, clear, high-contrast 3½-digit LCD display, a full 0.5" high, readable anywhere.
- VALUE PACKED — Outstanding measurement capability and dependability. Outperforms DC time-constant meters, and even bridges costing 2 to 5 times as much.
- RELIABLE — warranteed for 2 full years.

FLUKE® DIGITAL MULTIMETERS

Model 8022A: The Troubleshooter

$139

- **Six functions**
  - dc voltage
  - ac voltage
  - dc current
  - ac current
  - resistance
  - diode test
- 3½-digit resolution
- 0.25% basic dc accuracy
- LCD display
- Overload protection

Model 8020A: The Analyst

$179

Model 8024A: The Investigator

$219

NEW

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

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

KEITHLEY MODEL 130 DIGITAL MULTIMETER

NEW $109.

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

New Portable Digital Capacitance Meter

B&K PRECISION

MODEL **820**

Call For Our Price

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

HITACHI

V-151B 15 MHz Single Trace
V-152B 15 MHz Dual Trace
V-202B 20 MHz Dual Trace, High Performance
V-302B 30 MHz Dual Trace
V-352B 35 MHz Dual Trace, High Performance
V-550B 50 MHz Dual Trace, High Performance

Call For Special Intro Price Offer

master charge · VISA

THE TEST EQUIPMENT SPECIALISTS

TOLL FREE HOT LINE

800-223-0474

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

ADVANCE ELECTRONICS

what's news

Heath SOFTSTUFF Programs

Introduced at the PC-80 Personal Computer Conference August 21-24, 1980, the new Heath software line, SOFTSTUFF, is designed for computer users who want quality documented programs to expand the capabilities of their computers for home and business use, says a Heath spokesperson. The Heath Co. has scheduled release of as many as six new programs per month during 1981.

The first releases include a full screen editor and an improved text formatter; CPS, a file transfer utility with on-line access to Micro-NET Information Services available; a sort utility and Macro-80, an assembler from Microsoft.

Available by the beginning of 1981 will be a true CP/M. Languages to be offered include CBASIC 2 and a C compiler. Applications programs for small businesses—among them, Inventory and General Ledger—will also be a part of the first offerings.

The first offerings operate under the Heath Disk Operating System (HDOS). Programs operating under CP/M will have been introduced by 1980's end.

Many of the programs have been developed by members of the Heath Users' Group, while others have been written by a team of Heath software experts. Each program has been tested and evaluated by Heath software engineers. Each product is fully documented. The line will be available through the Heathkit catalog, as well as at the 61 Heathkit Electronic Centers in the U.S. and Canada. Heath plans to offer the programs through other software retailers—in the U.S., Canada and internationally—in the future.

For details and price information, write for a free catalog to: Heath Company, Dept. 570-690, Benton Harbor, MI 49022. In Canada, write: Heath Company, 1480 Dundas Hwy. East, Mississauga, Ontario, Canada L4X 2R7.

Reader's Digest joins electronic information source

Reader's Digest announces that it has acquired a majority interest in Source Telecomputing Corp (STC), an electronic-information service located in McLean, VA.

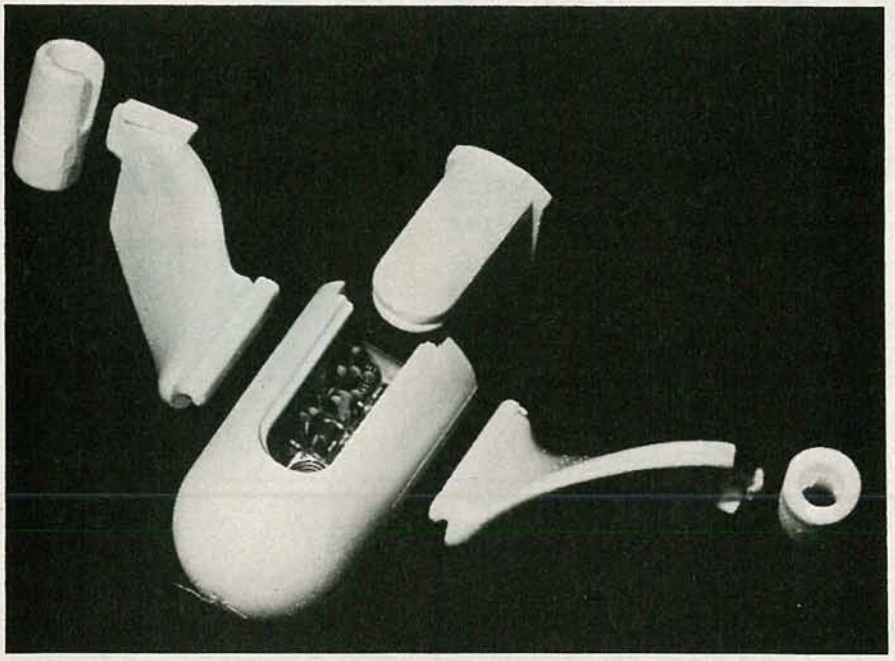
By connecting their terminals to the mainframe of Source via telephone, the 7,000 STC subscribers have access to nearly 2,000 programs and data bases. Those include UPI news, financial information, airline schedules, language lessons, a guide to wine buying, point-to-point electronic mail, and many others. The cost is approximately seven cents per minute of connect-time.

New radiosonde

A radiosonde just developed by Atmospheric Instrumentation Research of Boulder, CO, is made of molded pieces of expanded polystyrene plastic fitted together mechanically, using neither adhesives nor fasteners.

The Airsonde, as the manufacturer calls it, measures atmospheric pressure, humidity and temperature, and transmits the information through a high-frequency radio link to a ground-based computer, which prints out the information. Besides being used by such government agencies as weather stations, NASA (*N*ational *A*eronautics and *S*pace *A*dministration), NOAA (*N*ational *O*ceanographic and *A*tmospheric *A*dministration) and others, radiosondes are widely used in industry, by aircraft manufacturers, nuclear generating stations, air-pollution monitoring facilities, and laboratories.

The six parts of the new sonde are the body cavity, which holds the transmitter and other instruments; the cavity door; two wings, so shaped as to cause the craft to gyrate as it is carried upward by a balloon or dropped from an aircraft with a parachute, and two wing tubes. One of those carries a wet-bulb and the other a dry-bulb thermometer. The dry-bulb thermometer measures the air temperature. The difference between it and the temperature registered by the wet-bulb thermometer is used to calculate the relative humidity of the air.



THE AIRSONDE BODY, body door, wings and wing tubes, and the tongue-and-groove method of connecting them together.

Solar-cell break through

The Department of Energy's Solar Energy Research Institute (SERI) reports development of a thin-film photovoltaic solar cell with an energy conversion of more than 9 percent. The new cell was produced by Boeing's Parts, Materials and Processes Division, under contract to the Solar Energy Research Institute.

The Boeing cell is a Copper Indium Selenide/Cadmium Sulfide (CuInSe/CdS) type, made by evaporating the material onto a low-cost substrate. Thin-film cells are simpler to make and when fully developed, are expected to cost less than 10 percent of the cost of the present dominant silicon cell.

The goal of SERI is to produce thin-film solar cells with an efficiency of 10 percent. Boeing believes it will achieve that 10 percent efficiency in the near future.

Old-time radio get-together

More than 700 radio amateurs, engineers, historians and just enthusiasts gathered at the 1980 National Historical Radio Conference of the Antique Wireless Association last September 25 through 27, at Canandaigua, NY.

Highlights of the Conference (according to each participant's individual taste) were the old tubes and old equipment contests, the historical discussions—ranging from a review of early radio-frequency alternators to a talk on identifying C. D. Tuska radio receivers—or the continuous flea market in the parking lot.

The two auctions, in which members disposed of tubes or equipment they didn't

continued on page 16

Generate virtually any wave shape with famous B&K-PRECISION cost-effectiveness!

The new B&K-PRECISION Model 3020 sweep/function generator is the most versatile signal source ever offered by B&K-PRECISION. This one instrument can actually replace a function generator, sweep generator, pulse generator and tone-burst generator. Frequency coverage spans 0.02Hz to 2MHz in seven ranges, with each range providing linear 1000:1 frequency control.

A low-distortion, high-accuracy signal source, the 3020 has the versatility to generate almost any waveform. Examples include sine waves, square waves, TTL square waves, tone-burst, pulses and ramps. All waveform types can be inverted. Internal linear and log sweep capability is also featured. Both modulation and carrier levels can be varied so even a double sideband suppressed carrier test signal can be generated.

For those applications requiring standard function generator signals only, B&K-PRECISION also offers the Model 3010 low distortion function generator. The 3010 generates sine, square, TTL square and triangle waveforms from 0.1Hz to 1MHz in six ranges. An external VCO input is provided for sweep frequency tests. Variable DC offset is also featured for engineering applications. Modestly priced, the 3010 is a stand-out value.

Like other B&K-PRECISION products, the 3020 and 3010 are available for immediate delivery at your local distributor. A ten day free trial is available at many locations.

For additional information and the name of your local B&K-PRECISION distributor, call toll-free 800-621-4627.

B&K PRECISION DYNASCAN CORPORATION

6460 W. Cortland Street • Chicago, IL 60635 • 312/889-9087

International Sales, 6460 W. Cortland Street, Chicago, IL 60635 USA: TELEX: 25-3475 Canadian Sales, Atlas Electronics, Ontario

CIRCLE 53 ON FREE INFORMATION CARD

what's news

continued from page 14

need (often to buy as much other stuff), were the highlight to many. They were also extremely interesting to many others who bought or sold nothing, offering a clear look at much old equipment that could only be glanced at hurriedly during the preview sessions.

Several Atwater Kent breadboard models sold for over $300 each, and an ancient marine receiver brought $825. More than $18,000 worth of tubes and equipment changed hands at the two auctions. Ten percent of the auction proceeds goes to the Association, enabling it to keep up the A.W.A./Electronic Communications Museum in Holcomb, NY and publish its *Bulletin*, a little quarterly magazine of historical articles and news items of interest to members of the Association.

Next year's Conference will be held at Dearborn, MI.

Bell uses standard approach in optical installation

Southern Bell Telephone has put into operation the first leg of a lightwave telephone system that connects three central offices in the Atlanta (GA) area, where lightwave telephony got its start some five years ago.

The remarkable thing about the installation, from Bell's point of view, is that the system was ordered and installed, and is being operated and maintained by local Bell personnel, using standardized Bell System procedures. To Bell, that opens the door to general adoption of lightwave at some time in the future.

"Our successful use of standardized Bell-System procedures for ordering and installing this new technology means that the Bell System can now move ahead with larger-scale lightwave systems," states S. E. Jenette, Jr., vice president for Southern Bell in Georgia.

Moving ahead immediately with the new technology, Bell's plans include:

In March 1981, a 40.6-mile system in Pittsburgh, carrying up to 20,000 conversations.

In June, an 8.8-mile system in San Francisco, carrying 40,000 conversations, and a 27.6-mile system in White Plains, NY, carrying 20,000.

In July, a 16.7-mile, 20,000-conversation system in Philadelphia, and in December, a 26.1-mile system in Newark, NJ, also carrying 20,000 conversations.

Pioneer videodisc system now more widely available

Pioneer made its new LaserDisc videodisc system available through more than 400 retail outlets in 46 U.S. cities in October. That laser optical videodisc system consists of prerecorded discs and a player that can be connected to any standard TV set. A low-power laser reads audio and video information from the disc and transmits the picture and sound to the TV set. The audio may also be fed to a stereo-sound system.

The discs, which resemble mirrored LP records without grooves, never wear out, because no needle or stylus is used. They are recorded on both sides. Playing time is 30 or 60 minutes per side, depending on the mode of operation. Each disc contains up to 108,000 individual frames—enough for the entire Encyclopedia Britannica. Suggested retail price for the LaserDisc system is $749, and videodiscs range from $5.95 to $24.95.

Semiconductor use up 23%

The world's consumption of semiconductors will increase from $14.1 billion in 1979 to $47.2 billion in 1985, according to Mackintosh Consultants of San Jose, CA. That represents an annual growth of 23 percent. During the same period the worldwide consumption of integrated circuits will grow from $9 billion in 1979 to $38 billion in 1985, an average annual increase of 27 percent.

United States companies, Mackintosh believes, will maintain a 63 percent share in worldwide semiconductor production. However, the U.S. share of integrated circuit production will drop from 71 percent in 1979 to 67 percent in 1985.

Worldwide semiconductor manufacturing equipment expenditures will increase from $1.1 billion in 1979 to $9.6 billion in 1985, an annual growth of 31 percent.

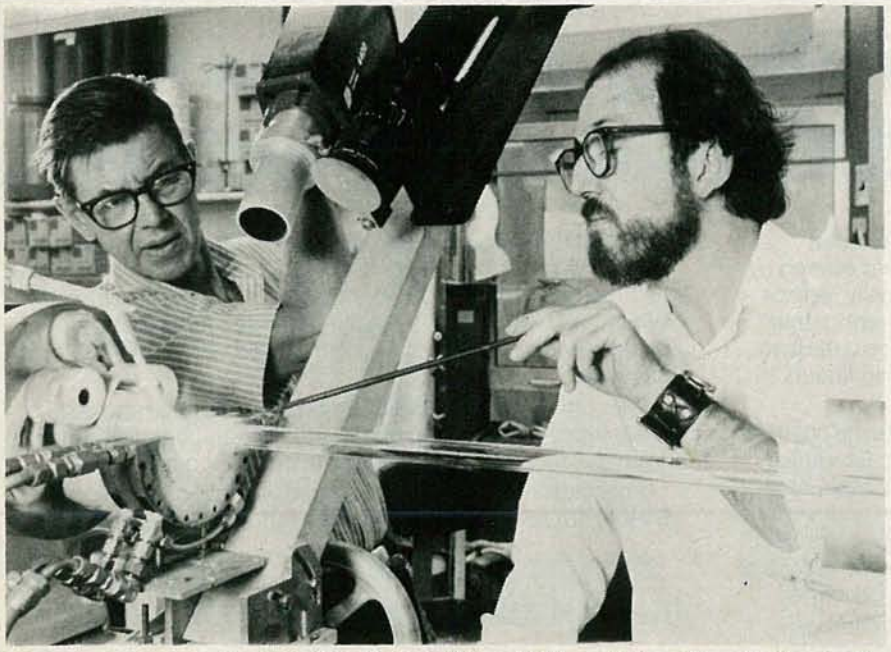
New home-computer facilities

Dow Jones & Co. put into effect a new price schedule with sharply reduced fees for personal computer users. The new schedule is designed to encourage them to use the Dow Jones News/Retrieval Service, a business and financial news and information base.

The new programming package, *Dow Jones News & Quotes Reporter*, permits users of the Apple II Personal computer to retrieve business and financial news and information quickly and easily from the data base. The software package is available on a diskette that stores the instructions for the Apple computer. Users of other computers may gain access to the Dow Jones data base by operating their computers in a "nonintelligent" mode.

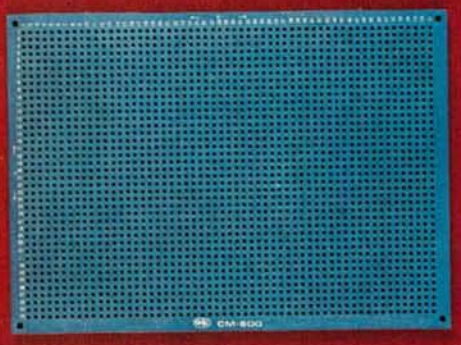
Rates for the personal computer user during non-business hours have been set at 20 cents per minute for access to the news data base and 15 cents per minute for the securities price quotations data base, with a minimum charge of 50 cents. Formerly, personal computer users had access to only the securities price quotations, at a charge of $3 for the first three minutes and 50 cents per minute thereafter.

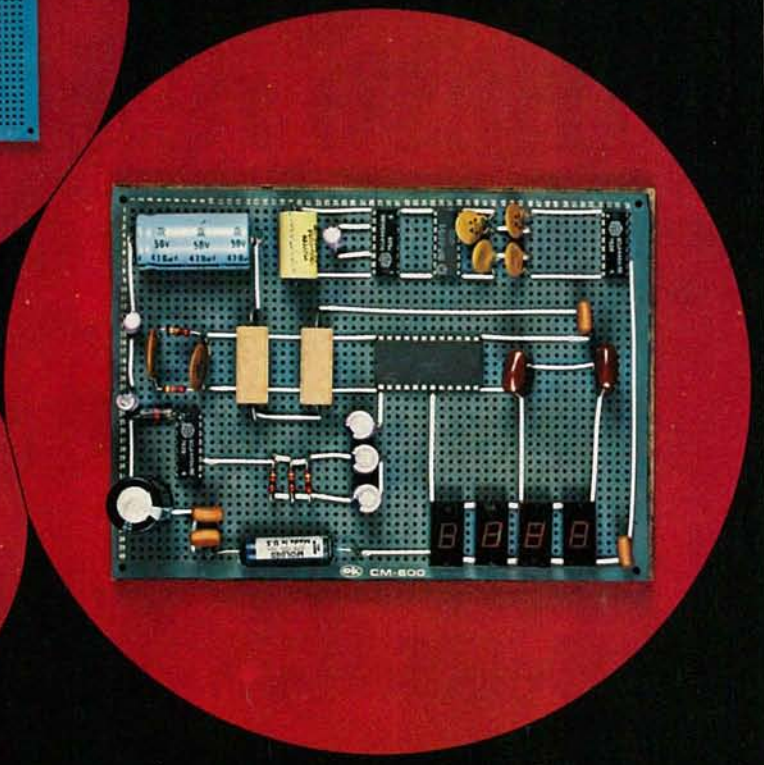
During business hours, the new personal computer rates will be $1 per minute for news and 75 cents per minute for securities prices, with a minimum charge of $2. **R-E**



THE ULTRATRANSPARENT GLASS FIBERS that will carry light signals to and from the three Southern Bell switching offices in Atlanta are fabricated by a process that begins with a silica tube being heated on a glass lathe.

CM-600 Circuit Mount





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

NEW CM-600 SOLDERLESS PROTOTYPE BOARD

CM-600 is a unique system for solderless construction of circuit prototypes, useful to both engineers and hobbyists. The CM-600 is a neoprene board 4½" (114mm) x 6" (152mm) with 2280 holes on .100" (2.54mm) centers. Standard components including DIP's are mounted by simply inserting leads into the holes in the long life neoprene material. Interconnections are easily made using 20 or 22 AWG (0,8 or 0,65mm) wire jumpers. Positive contact is assured by the elasticity of the hole, which compresses the leads together. To remove components or leads, simply pull out. This facilitates easy circuit changes making it ideal for breadboarding experimental circuits. CM-600 also features numbered rows and columns for easy reference.

Accessory Kit RW-50 contains 50 pcs of AWG 20 (0,8mm) insulated jumper wires of assorted lengths from ½" (13mm) to 4" (100mm). Both ends are stripped and bent 90° for easy insertion. In stock directly from

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

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

CIRCLE 49 ON FREE INFORMATION CARD

If you have put off learning more electronics for any of these reasons, act now!

- ☐ I don't have the time.
- ☐ High school was hard for me and electronics sounds like it may be hard to learn.
- ☐ I can't afford any more education.
- ☐ I have a family now.
- ☐ I'm here. You're there. I've never learned that way before. I'm not sure it will work for me.

Read the opposite page and see how you can get started today!

Be honest with yourself. Are the reasons really excuses? You already know enough about electronics to be interested in reading this magazine. So why not learn more? If you need encouragement, read on and see how excuses can be turned into results.

You don't have the time. Be realistic. All you have in life is a period of time. Use it. Try to know more tomorrow than you do today. That's the proven way to success. CIE studies require just about 12 hours of your time a week, two hours a day. You probably do have the time.

Electronics sounds like it may be hard to learn. You already know something about electronics or you wouldn't be reading this. Now, build on that. CIE Auto-Programmed ® Lessons help you learn. Topics are presented in simple, logical sequence. All text is clear and concise for quick, easy understanding. You learn step by step, at your own pace. No classes to attend. Nobody pressures you. You **can** learn.

You can't afford any more education. Actually, you can't afford NOT to gain the skills that can put you ahead of the others. You know what inflation is doing to you now. Education—learning a skill—is an inflation-fighter that can be yours. If you are not able to pay full tuition now, CIE will lend you funds on a monthly payment plan.

You have a family now. All the more reason why you have the responsibility to advance yourself. For the sake of your family. Do you want them to have what you had or have **more** than you had? The choice is yours. Electronics is a rewarding career choice. CIE can help you to get started on that career.

You're there. We're here. How does CIE help you learn? First, we **want** you to succeed. You may study at home, but you are not alone. When you have a question about a lesson, a postage stamp gets you your answer fast. You may find this even better than having a classroom teacher. CIE understands people need to learn at their own pace. When CIE receives your completed lesson before noon any day of the week, it will be graded and mailed back the same day with appropriate instructional help. Your satisfaction with your progress comes by return mail. That's how CIE helps you learn.

NOW, IF YOU AGREE CIE TRAINING CAN WORK FOR YOU, HOW ELSE CAN CIE HELP YOU?

Cleveland Institute of Electronics is the largest independent home study school in the world that specializes exclusively in electronics. Although "big" does not always mean "best," it is evidence that CIE is a strong, successful institution with the people and resources to help you succeed.

Step-by-step learning includes "hands-on" training.
The kind of professional you want to be needs more than theory. That's why some of our courses include the Personal Training Laboratory, which helps you put lesson theory into actual practice. Other courses train you to use tools of the trade such as a 5MHz triggered-sweep, solid-state oscilloscope you build yourself—and use to practice troubleshooting. Or a Digital Learning Laboratory to let you apply the digital theory that's essential today for anyone who wants to keep pace with electronics in the eighties.

Your FCC License can impress employers.
For some electronics jobs, you must have your FCC License. For others, employers usually consider it a mark in your favor. Either way, your License is government-certified proof of your knowledge and skills. More than half of CIE's courses prepare you to pass this exam. Surveys show that some 80% of CIE graduates who take the exam are successful.

Find out more! Today. Now.
There's a card with this ad. Fill it in and return. If some other ambitious person has already removed it, use the coupon.

You'll get a copy of CIE's free school catalog, along with a complete package of personal home study information.

For your convenience, we'll try to arrange for a CIE representative to contact you to answer any questions you may have.

If you are serious about a rewarding career, about learning electronics or building on your present skills, your best bet is to go with the electronics specialists—CIE. Mail the card or coupon today or write CIE (please mention the name and date of this magazine), 1776 East 17th Street, Cleveland, Ohio 44114.

This could be the best decision you've made all year.

Associate Degree

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

"If you're going to learn electronics, you might as well learn it right!"
John Cunningham
Senior Technical Director

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

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

Print Name_____

Address_____ Apt._____

City_____

State_____ Zip_____

Age_____ Phone (area code)_____

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

MAIL TODAY!

RE-04

satellite tv news

SATELLITE PROGRAMMING STILL GROWING

The never-ending feast of video programming transmitted via satellite continues to grow. Still another pay-TV service began aboard Westar satellites this fall: Golden West Subscription Television, a new subsidiary of Gene Autry's broadcasting company, will send 73 hours per week of movies and other shows to its stations in several cities, starting at 6 pm (Eastern Time) on weekdays and at 1 pm on weekends.

Thanks to a new series of Federal grants totalling $1.2 million, four organizations will promote the use of satellite networking by public-service groups. Much of that will take the form of specialized teleconferencing, and the next trend will probably be towards originating video at multiple points. (Heretofore, most teleconferences involved one-way video, with telephone-line callbacks; but the increasing number of satellite uplinks makes it more feasible to originate video at several locations.) Most of the programming from those groups will be educational or informational in nature, and almost all of it will be transmitted during daytime hours aboard various satellites—wherever there is room.

Meanwhile, aboard the Westar system, look for more special-interest shows now that the FCC has formally approved "shared use" of public-TV downlinks. Every PBS station in the nation is now equipped with a satellite receiver—and all PBS programs travel via the Westar network. Many of those earth stations can now be used for video transmission by other program distributors to deliver shows to closed-circuit audiences in various cities.

In addition, the FCC recently removed several major cable-TV programming restrictions, which could open the door for the creation of new satellite superstations. Unless the new FCC ruling is overturned when it is appealed to the courts, it will permit TV stations from anywhere in the country to be beamed into a cable-TV system. That means that very popular independent TV stations—or even network affiliates from major cities—could be transmitted to distant CATV systems (probably via satellite) for use.

DIRECT BROADCAST SATELLITES

Direct-to-home broadcast satellites operating in the 12/14-GHz range may still be years away from regular use in the U.S. Nonetheless, plenty of business executives and Washington bureaucrats are spending time this fall making plans for how to operate such a system—or how to fight such services. For example, network-TV executives at ABC began lobbying on Capitol Hill recently in an effort to head off the Federal Communications Commission from making any policy that could hurt current network-TV operations. ABC argues that Congress itself should deal with setting up policy on such an important issue as DBS.

Meanwhile, the FCC itself is in the midst of a study to develop a formal American policy to present at the 1983 WARC (World Administrative Radio Conference), which will determine DBS guidelines for the western hemisphere. The FCC says its preliminary approach is "to foster, not stifle" the potential uses of direct broadcasting satellite.

Another government agency is urging the FCC to adopt a national satellite-planning policy—part of which would include DBS proposals. The National Telecommunications and Information Administration is pushing for a three-phase approach that would eventually lead to long-term planning for satellite orbit/spectrum allocation. And while all those ideas are drifting about Washington, other corporate and government officials are pleading for a DBS policy, which would permit the U.S. "to keep ahead in the area of DBS." One Comsat Executive warned that other nations are rapidly adopting DBS projects—and could soon outpace U.S. activity.

AROUND THE SATELLITE CIRCUIT

TV Ontario, a Canadian educational TV operation, is beaming a direct-to-home signal via Anik B. The programming travels in the 12/14-GHz band, and is intended especially for remote homes in northern Ontario province.

Although Satcom III replacement launch and operation is still about a year away, RCA Americom has already decided who gets the extra spaces aboard that bird, which will become the major cable-TV programming network carrier. In a recent lottery, RCA drew the names of United Video and Warner-Amex Satellite Entertainment Network; those two companies will join the 20 other programmers who will move over from Satcom I when the third RCA bird goes into service.

International satellite communications are expected to double within the next four years, according to a forecast of circuit capacity just prepared by Intelsat, the international satellite organization. The Atlantic Region will continue to be the busiest area, although Pacific-region transmissions will also jump twofold by 1984.

British Broadcasting Corp., is experimenting with satellite networking, to be used mostly for transmitting shows into BBC headquarters.

GARY H. ARLEN
CONTRIBUTING EDITOR

A superb frequency counter is frequently not counted-just because it doesn't have a high price-tag.

The truth is, our 8000B 1 Gigahertz is an excellent counter. In fact, it's preferred by many engineers, technicians, and electronic enthusiasts. Not a single competitor on the market today can surpass our price/performance ratio.

And we've deliberately kept our prices down. First, we've refused to join everybody else in their high mark ups. Instead of "charge what the market will bear," for us it's "charge a fair price." Second, we sell what we manufacture, directly to you. So extra costs of extra steps are automatically eliminated. Third, we have to build a lot of frequency counters to meet the demand. Because we do sell so many, we don't have to charge a high price to make a profit.

And about quality . . . Sabtronics frequency counters always have the most innovative features available. For example, our 8000B 1 Gigahertz Frequency Counter has a 10 Megahertz precision crystal timebase. But most important, the 8000B, using the most advanced LSI circuitry, has a guaranteed sensitivity of 30 millivolts up to 1 Gigahertz, with 20 millivolts typical. The three-stage differential amplifier IC makes this possible. Altogether, the 8000B uses only 6 IC's, making the chance of failure virtually nonexistent.

Three selectable gate times provide the measurement speed you need — and greater resolution. The resolution is further enhanced by our counter's 9-digit display.

Like the 8000B, Sabtronics' 8610B is a high-quality precision frequency counter. It features only 4 IC's, and offers a frequency range up to 600 Megahertz.

The cases of both counters are high strength impact-resistant ABS plastic. Elegant but very rugged. Sabtronics doesn't believe in skimping on the high quality construction that brings excellent performance. But we're not about to charge a high price just because we could get it!

Send in the coupon and order your new frequency counter now. Credit card holders may call.

BRIEF SPECIFICATIONS:

Frequency Range: 10 Hz to 1 GHz (Model 8000B), 10 Hz to 600 MHz (Model 8610B); **Timebase:** Frequency: 10 MHz, Stability: ± 1 ppm (20 to 40C°.), Aging Rate: < 1 ppm/year; **Sensitivity** (adjustable): Input A < 15 mV to 100 MHz, Input B < 30 mV, 100 MHz to 1 GHz (Model 8000B), < 30 mV, 100 MHz to 600 MHz (Model 8610B); **Gate Times:** .1 sec., 1 sec., 10 sec.; **Resolution:** 0.1 Hz to 10MHz, 1 Hz to 100 MHz, 10 Hz to 1 GHz; **Display:** 9-digit LED 0.4″; **Power Requirements:** 4.5 to 6.5 VDC (4 C-cells) or optional AC adapter; **Dimensions:** 8″ wide X 6.5″ deep X 3″ high (203 X 165 X 76 mm), 1.3 pounds (590 g) excluding battery.

Making Performance Affordable

sabtronics INTERNATIONAL INC.

Sabtronics International, Inc., 5709 N. 50th Street, Tampa, FL 33610, (813) 623-2631.

Please send me the following:

_____Model 8000B 1 GHz Frequency Counter(s), Assembled @ $199.00 each ..... $_____

_____Model 8000B 1 GHz Frequency Counter(s), Kit @ $184.00 each ..... $_____

_____Model 8610B 600 MHz Frequency Counter(s), Assembled @ $129.00 each ..... $_____

_____Model 8610B 600 MHz Frequency Counter(s), Kit @ $114.00 each ..... $_____

Shipping and handling, $6.00 per unit* ..... $_____

10% deposit for C.O.D. orders ..... $_____

Florida residents add 4% Sales Tax ..... $_____

I enclose ☐ check ☐ money order. (Allow two to three weeks for personal checks to clear.)

Charge: ☐ Visa ☐ Master Charge

Account No. _____ Exp. Date _____

Name _____

Address _____

City _____ State _____ ZIP _____

*U.S. only. Canada $7.50; overseas air mail $25.00. RE

letters

THE COLOR-BAR GENERATOR

I feel that I must comment on the errors, omissions, and inconsistencies in the article, "Affordable NTSC Color-bar Generator" in your April 1980 issue.

Very few TV stations use special color-bar generators since the feature is included as a self-test signal in all professional camera encoders. That explains why they are often called camera-bars.

Figure 1 showed 75% bars but the text discussed 100% video. Chroma is not considered when measuring video levels, since a low-pass filter is used.

White is 12.5% carrier level, not zero modulation, which is the blanking level. Maximum modulation (−87.5%) occurs at white, not sync, which is +40%.

The staircase effect of the Y component of the bars is an artifact of the action of the NTSC color equation and is unrelated to the staircase test signal.

IWQ? You must mean IYQ, as used in the industry. The Y signal at the bottom of the split-bar display is always 100% regardless of whether the bars' part is 75% or, less commonly, 100%.

White is, by definition, *not* saturated. The term "saturation" is applicable only to chroma—not luminance.

Several important properties of the bars' signal were omitted completely. They have to do with the way in which the bars are made. Bars are the result of switching red, green, and blue into the encoder in such a way that the first four bars receive full-scale green, the first two, the 5th and 6th receive full red, and the first, 3rd, 5th, and 7th receive full blue. A look at the receiver screen with the beams turned off in pairs shows that clearly.

One of the properties of the process is that the first and 8th bars have zero saturation and all others have 100% saturation, regardless of level changes. Another is that when the primaries are viewed singly, the bar segments will have equal brightness if—and *only* if—the system is free of distortion, the demodulation axis is 90°, and the receiver color controls are set for correct color reproduction. That gives a visual check for hue and saturation settings.

TED DAVIS,
Riverton, IL

I think the differences referred to in Mr. Davis' letter lie in the interpretation. Some of the comments, I do not understand: For example, white is *zero modulation; the tips of the horizontal sync pulses are 100% modulation. That is done deliberately to give better sync on a weak signal. With no signal, the screen is white.*

The term "IWQ" was taken directly from the instrument manual. (As far as I know, this is the first time I have seen "IYQ" used, though it is quite applicable.) The manual uses "IWQ" to mean "minus in-phase chroma/white/quadrature chroma," and, to me, that is the more comprehensible term. (The "Y" confuses me: I keep wanting to call it "yellow.")

I don't know whether the statement that very few TV stations have color-bar generators is valid; but, in my opinion all TV stations should *have them. I know of several that do: the color-bar generators are used at the start of the broadcast day for setting up the color cameras so that each has identical response. The most frequent offenders in the "purple people" department is*

continued on page 26

Innovations

The sharpest picture ever achieved in big-screen projection TV

The new Heathkit Screen Star sets a new standard in picture quality for big-screen projection TV. The finest F1.0 lenses you can buy produce one of the clearest, brightest pictures ever.

Imagine watching all your favorite TV movies and sports events on a big 6-foot diagonal screen. Heathkit's three-tube projection gives you brighter, more vivid color. And it's a lot easier to build than conventional TV's.

A complete computer system in one compact unit

The Heathkit All-In-One Computer takes the guesswork out of selecting a balanced computer system. It includes built-in floppy storage, smart terminal, heavy-duty keyboard, 12-key numeric pad, Z80 CPU, and 16K RAM expandable to 48K—all in one compact unit.

Two Z80 microprocessors mean terminal and computer never share power. So both can operate faster on more complex programs. And there's no better way to learn about computers than to build one yourself.

The only computerized home weather station for instant, up-to-the-minute weather reports

Just push a button for reliable weather information anytime you need it with the unique Heathkit Weather Station. It gives you digital readouts of F or C temperatures, wind speed in miles or kilometers per hour or in knots, wind direction, barometric pressure, date and time of day, even the wind chill factor.

This microprocessor-based weather computer has memory to store data and precision infra-red sensing devices built into the outdoor transmitter. And it's very easy to build.

The finest stereo receiver ever introduced by one of the leaders in audio technology

It's loaded with luxury features that let you adjust your music to your preference.

Special features include a Precision Tuning System (PTS) that automatically corrects mistuning. 5-section FM tuning capacitor gives you maximum rejection of unwanted signals for lower noise, cleaner sound. Digital frequency readout, center tune meter, and flywheel loaded tuning are just a few of the luxury touches. Complete specifications are in the latest Heathkit Catalog.

FREE CATALOG

See all the newest innovations in build-it-yourself kits in the latest free Heathkit Catalog. It contains nearly 400 exciting kits for your home, work or pleasure. Send today.

Send to: Heath Company, Dept. 020-732
Benton Harbor, MI 49022

Yes, please send me a Heathkit Catalog.
I am not currently receiving your catalogs.

Name_____

Address_____

City_____ State_____

CL-725A Zip_____

Heathkit®

If coupon is missing, write Heath Co., Dept. 020-732 Benton Harbor, MI 49022

Heathkit Products are also sold and serviced at Heathkit Electronic Centers (units of Veritechnology Electronics Corporation) in major cities throughout the U.S. See your white pages.

CIRCLE 28 ON FREE INFORMATION CARD

the film-camera chain. One of my "local stations" is a common offender in that area; they either don't have a color-bar generator, or they aren't using it!

The comment that Fig. 1 shows "75% bars" is mildly incorrect: the drawing says of the last bar "Gray: 75% white." The tip of that bar is at 100 IEEE units, or zero modulation. Full modulation is at the −40 IEEE-unit level, and the black or reference (setup level) is at a +7.5-unit level. The bars in Fig. 3 show the two different chroma levels, at 20 IEEE-unit modulation and 40 IEEE-unit modulation. The text explains why that was done.

All in all, I think the main differences here lie in the interpretation of certain things, and are perfectly natural. Mr. Davis would agree, I am sure, that the color-bar generator is a very accurate and useful instrument, and should be of great help in TV stations and in the better TV repair shops. —Jack Darr

THE CONTRACTION EQUATION

For the many readers whose curiosities were stimulated by my exposé on the unreality of Einstein's famous "train-and-simultaneity" thought experiment (Letters, April 1980), I propose another thought-provoker involving simply capacitor plates and measuring rod:

Matter, regardless of what it is—electrons, clocks, measuring rods, starships, you name it—is purported by Einstein's theory to suffer length contraction in exponential proportion to velocity. The relativistic equation for the "revised" length is

$$L' = L\sqrt{1 - v^2 / c^2}$$

where c is the velocity of light and L is the length at rest, which is also *unchanged* to an observer moving with the matter. If you suspect that it is unreal—that an object cannot be both contracted and not contracted—you are at the heart of the paradoxical nature of Einstein's theory. We are obliged to investigate further.

Consider, then, oppositely-charged capacitor plates attached to each end of a moving measuring rod. Einstein would say: (a) to an observer moving with the rod its length is "normal" and the plates remain separated by a substantial distance; (b) to the "rest" observer, and for v close enough to c, the rod is contracted into a thin disc, so the plates and charges are very close.

As should be obvious to anybody who learned "Electronics I," if (b) is true, and Einstein's equation is consistent with the laws of electronics, the field intensity between the plates is such that the charges must arc across the small gap separating the plates and neutralize them. But, that is rejected by (a)! The situation is self-contradictory.

It is self-contradictory because it is unreal, as mentioned, the culprit being Einstein's contraction hypothesis (b) which is itself unreal, nonexistent. Only (a) represents reality since the plates maintain their charges (presuming that conditions remain stable) and that must realistically be independent of any external observers not partaking in the motion.

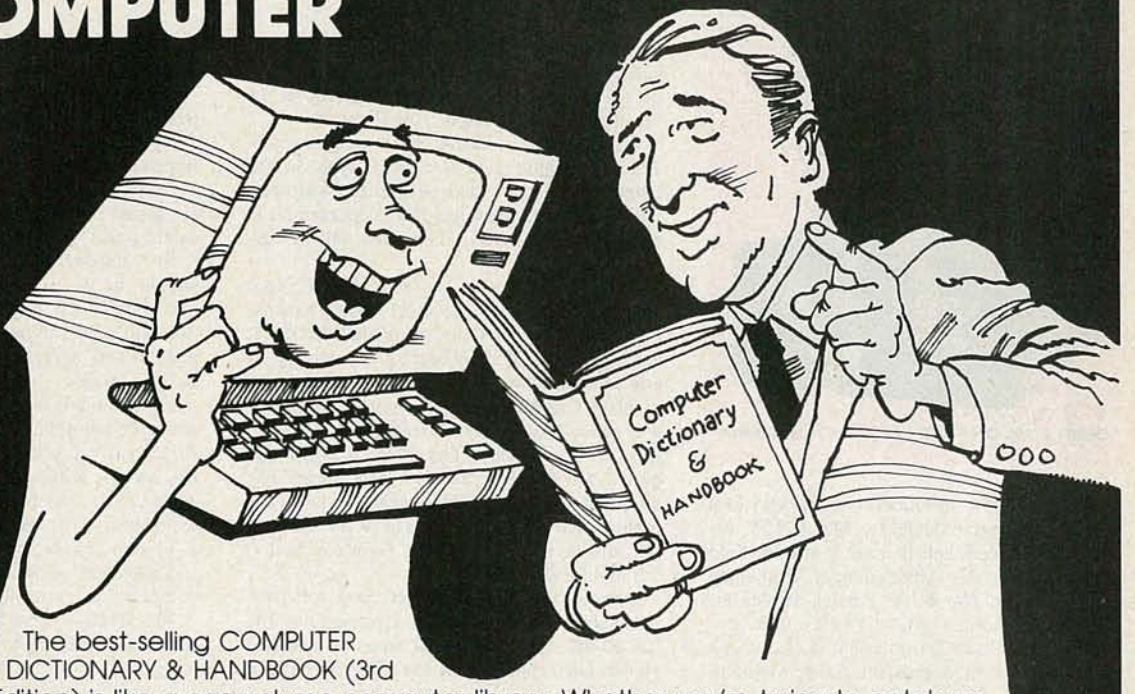
Simply because experimental evidence appears to endorse Special Relativity does not guarantee that the theory is physically possible and logically consistent. "Thought experiments" are excellent for identifying its fallacies. But is there any performed experiment contradicting Einstein? Yes. In 1971, the Hafele-Keating Experiment found that, compared with a clock at "rest", a high-velocity cesium-beam clock recorded a time loss, but another flown in the opposite direction recorded a time gain, grew *older.* The latter was an anomaly contradicting Special Relativity's time dilation predicted for relative motion. Yet, physicists never adequately and honestly admitted that, and texts exclude references to the clock that "aged" faster.

One experimental fact like that proves that the universe does not, in reality, obey rules postulated by Einstein. That happens because those rules were never real originally.

ANTHONY HANS KLOTZ,
Babylon, NY

The equation presented above is the first of the three Lorentz-Fitzgerald Contraction equations, and deals with length. The second deals with time, and the third with mass. The implications of the first equation are that at the speed of light, the length of the object so traveling would be zero in that direction. The third equation, dealing with mass, implies that at the speed of light, the mass of the object would be infinite. It was through his work on the Lorentz-Fitzgerald Contraction equations that Einstein arrived at his famous $e = mc^2$. *But there was no specific Einstein contraction theory or equation.* —Editor. **R-E**

CARRY ON AN INTELLIGENT CONVERSATION WITH A COMPUTER



The best-selling COMPUTER DICTIONARY & HANDBOOK (3rd Edition) is like a one-volume computer library. Whether you're trying to catch up with computers – or trying to stay ahead – this is the most valuable reference book you can own. This hardbound dictionary and handbook translates computer jargon into language that every teacher, student, scientist, computer operator, engineer, or businessman can understand.

COMPREHENSIVE

The most comprehensive reference available for all phases of computers and computer applications. Includes 14 appendices covering computer-related subjects such as operational control, storage devices, main memory devices, time-sharing principles and procedures, data communications, computer languages, and much, much more.

COMPLETE

Contains over 22,000 definitions, acronyms, and abbreviations dealing with the field of computers and data processing.

By Charles J. Sippl and Roger J. Sippl. 928 pages. No. 21632. $29.95

AVAILABLE IN A PERSONAL SIZE

The COMPUTER DICTIONARY is a personal-size volume that contains much of the information contained in the larger COMPUTER DICTIONARY & HANDBOOK. The COMPUTER DICTIONARY includes over 12,000 entries – including definitions, acronyms, and abbreviations. Catchwords are used for the first and last entries on each page and shown at the top of each page. Extensive cross-referencing is used. 624 pages. No. 21652. $12.95.

Mail to: **Howard W. Sams & Co., Inc.**
4300 West 62nd Street
P.O. Box 7092
Indianapolis, IN 46206
(317) 298-5400

ADO56

QUANTITY

COMPUTER DICTIONARY & HANDBOOK. No. 21632. $29.95 ____
COMPUTER DICTIONARY. No. 21652. $12.95 ____
Amount of order $____
*For charge cards, add $2.00 postage and handling costs $____
Add local sales tax where applicable $____
Total Amount of Order $____

___PAYMENT ENCLOSED **(save postage and handling costs)**
___CHECK ___MONEY ORDER
___VISA* ___MASTER CHARGE* Interbank No. _____

Account No. _____
Expiration Date _____
Name (print) _____
Signature _____
Address _____
City _____ State _____ Zip _____

Prices subject to change without notice. All books available from Sams Distributors, Bookstores, and Computer Stores. Offer good in U.S.A. only. In Canada, contact Lenbrook Industries Ltd., Scarborough, M1H, 1H5, Ontario, Canada. Offer expires 4/30/81.

Sams BOOKS®

equipment reports

Digital Meter Research Model DMR-100 Digital dB Meter

CIRCLE 101 ON FREE INFORMATION CARD

DIGITAL METER RESEARCH COMPANY, PO Box 28, Arlington Heights, MA 02175, recently introduced their first entry into the field of specialized audio test equipment. That entry is their *model DMR-100* Digital dB Meter. It's a very accurate digital dB meter, with provisions for connecting into an audio circuit at a given point (input, output, etc.), for probing to read stage gains, or for similar tests. Rated accuracy is 0.1 dB over the full range of 80 dB: −60 dB to +20 dB. At the −60 dB input level 0.1 dB means a resolution of 10 microvolts.

It's easy to use. There isn't a range switch. The main input jack is a BNC-type on the front panel, above two pushbutton switches. One of those switches lets you select readout in either dB or volts DC. The other will be covered later.

On the rear panel, along with the AC input and on-off switch, are two sets of dual banana-plug jacks. One of them is labelled dB INPUT, and can be used for offsetting the display by any amount needed when complex measurements are to be made. An input of +1.0 mV will cause the display to read −0.1 dB from the non-offset value. The offset is adjustable over a ±8 dB range and is highly linear. The dB OUTPUT is a DC voltage proportional to the input-signal level. The voltage is the same as that displayed on the meter. Gain constant is 1.0 mV for 0.1 dB.

Also on the back is a BNC jack for COMPRESSED OUTPUT. As the input varies over the full 80-dB range, this signal varies by less than 10 dB. Distortion is very low. This output can be used with a scope, or phones or an audio monitor.

The other pushbutton switch on the front panel is used to select between BUFFERED and UNBUFFERED inputs. The buffered input has an impedance of 10 megohms and is useable up to 12 volts, peak input. The unbuffered input has an impedance of only 100K ohms and can be used up to 150 volts, peak.

For production-line testing, this meter should be very useful, especially for final checkout. With a standard input, the *DMR-100* will read the output with high accuracy, and let the operator determine whether the units is in-spec.

For audio test work, two *DMR-100*'s may be used; for example, one to meter input and one for output. Or, one unit can read AC signals in dB, and the other the DC level or offset of the signal. The two-meter arrangement can be valuable in such applications as gain-readings in systems where input signal slowly varies or is a function of some other parameter; e.g., compression, expansion, etc.

The *DMR-100* has a 3½-digit LED readout, with 0.56-inch high digits. It's housed in a

continued on page 30

ELECTRONICS BOOK CLUB

Are you into CW, DX, HAM, SWL

Communications, QSLs, or OSCAR?

Take 6 great books for $2.95

(values to $112.70)

Start saving now with discounts up to 75% on hundreds of fact-filled volumes . . .PLUS special Members' Bonus Benefits!

8224 List $19.95 · 1054 List $9.95 · 955 List $10.95 · 1146 List $17.95 · 1216 List $12.95 · 1189 List $9.95 · 1120 List $8.95 · 802 $8.95 (paper)

1255 List$14.95 · 1184 $15.95 (paper) · 1132 List $10.95 · 1005 List $9.95 · 1212 List $15.95 · 1136 List $15.95 · 1066 List $19.95 · 1155 List $22.95

1070 List $12.95 · 1194 List $14.95 · 1222 List $12.95 · 1152 List $12.95 · 805 List $12.95 · 1225 List $14.95 · 1162/1177 2 vol. count as one! $15.90 (paper)

Join now, and get a *1981 Electronics Projects Calendar* . . . FREE!! (List $4.95)

7 very good reasons to try Electronics Book Club . . .

- **Reduced Member Prices.** Save up to 75% on books sure to increase your know-how
- **Satisfaction Guaranteed.** 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 dozens of up-to-the-minute titles you can pick from
- **"Automatic Order".** Do *nothing*, and the Main selection will be shipped to you 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
- **Continuing Benefits.** Get a Dividend Certificate with every book purchased after fulfilling Membership obligation, and qualify for discounts on many other volumes
- **Bonus Specials.** Take advantage of sales, events, and added-value promotions
- **Exceptional Quality.** All books are first-rate publisher's editions, filled with useful, up-to-the-minute info

ELECTRONICS BOOK CLUB
Blue Ridge Summit, PA 17214

Please accept my Membership in Electronics Book Club and send the 6 volumes circled below, plus a free copy of *1981 Electronics Projects Calendar*. I understand the cost of the books selected is $2.95 (plus shipping/handling). If not satisfied, I may return the books within ten days without obligation and have my Membership cancelled. I agree to purchase 4 or more books at reduced Club prices during the next 12 months, and may resign any time thereafter.

802 805 955 1005 1054 1066 1070 1120
1132 1136 1146 1152 1155 1162/1177 1184
1189 1194 1212 1216 1222 1225 1255 8224

Name_____ Phone_____

Address _____

City _____

State _____ Zip_____

(Valid for new members only. Foreign and Canada add 15%.) RE-181

CIRCLE 27 ON FREE INFORMATION CARD

continued from page 28

light blue extruded-aluminum case, with black end-panels and bezels. That means durability, and also shields the meter from external interference that could affect readings. The *DMR-100* is powered by an 18 VAC input, from a wall-mounted plug-in power transformer. That reduces any chance of 60- or 120-Hz interference. The *DMR-100*'s $250.00 price is quite reasonable for an instrument of its high accuracy and simplicity. **R-E**

B&K-Precision Model 1650 Tri-Output DC Power Supply

CIRCLE 102 ON FREE INFORMATION CARD

IF YOU THINK THAT A DC POWER SUPPLY is nothing but "a transformer + a rectifier + a filter capacitor," well, that *is* the definition of a DC power supply. However, if you have one like the *model 1650* Tri-Output Laboratory DC power supply (from B&K-Precision, Dynascan Corporation, 6460 West Cortland Street, Chicago, IL 60635) that's something else . . . like the difference between a moped and an MGB. One of them can do a lot of things the other cannot, and do them a lot more safely.

This is an instrument that can be used in design labs, experimental work, and the like; it's also a handy piece of test equipment to have in an electronics service shop. It's a fully-regulated, current-limited DC power supply with three separate and completely isolated outputs. It has an accurate meter that will read the voltage or current of each output; and that is what makes it a test instrument! Input voltage and current readings are awfully handy in diagnosis.

The *model 1650* has a five-volt output at five amperes for powering any kind of TTL logic circuitry. Five amps will drive a good many TTL gates! The other two outputs are identical twins, with a 0-25 VDC variable output, good up to 500 mA. The outputs can be used separately, with complete isolation, or they can be hooked in series or parallel for higher current-ratings. For a split-rail power supply, like those used for many op-amp circuits, they can be connected back-to-back.

All three outputs use "foldback" current-limiting. If the load current goes above the maximum rating, that automatically reduces the output current to at least 20% below maximum. The current meter will tell you if it happens. That feature not only protects the power supply, but also limits the damage to the equipment under test. All outputs are voltage-regulated, using IC regulators. That holds the voltage to a very tight tolerance anywhere below the maximum load.

An extremely useful feature of the *1650* is the ability of the variable "B" supply to track the variable "A" supply. This means that, as the "A" voltage is varied, the "B" voltage will change proportionately. The "B" voltage can be set so that it will be any percentage of the "A" voltage.

Somebody put a lot of thought into the design of this power supply. Our normal tendency is to turn a knob clockwise when we wish to increase the output (in this case, the voltage) of the circuit it controls, and that is indeed the case when the "A" and "B" supplies are used independently.

In the TRACKING mode, though, 100%-tracking (where B = A) is at the *counter-clockwise* end of rotation of the "B" control. This means that, should you inadvertently switch from TRACKING to INDEPENDENT mode, the "B" voltage will never be greater than it was when in the TRACKING mode. Thus, you cannot accidentally overload a circuit being fed from the "B" supply . . . a nice touch.

The tracking function has many uses. In checking subassemblies and other things that have separate or different power supplies, by using 100% tracking you can simulate the effect of low or high supply-voltages on the unit's performance. You can also imitate power supply transients and so on; both voltages will vary at the same time.

The *model 1650* is a well-built and rugged piece of test gear. All controls are plainly marked, and conveniently sized. The panel is well laid-out. Operation is about as simple as it can be made.

The DC outputs all use 5-way binding posts, which can be hooked up to any kind of test-lead. There is also a green jack—for an earth ground—on the front panel. Despite all that,

continued on page 32

NOW AVAILABLE!

WATT WIZARD™

*POWER FACTOR CONTROLLER CUTS THE COST OF RUNNING ELECTRIC APPLIANCES BY AS MUCH AS 50% -- AND YOU CAN EVEN **SEE** THE SAVINGS!*

National Aeronautics and Space Administration Patent No. 4,052,648

For over a year now, in magazines and newspapers the world over, there have been enthusiastic write-ups on a remarkable new device that can cut your electric bill while helping the U.S. save huge quantities of fuel.

"The NASA/Nola power saver," wrote a **Popular Science** senior editor, "was developed by Frank Nola at NASA's Flight Center in a program to reduce power consumption in spacecraft motors. Nola calls it a PFC — power-factor controller. I prefer to call it a power saver, however, because that's what it does."

NASA TESTED IT

According to NASA documents, "The device has been tested at Marshall Center on over 40 types of motors, with power savings ranging up to 60%, depending on the loading. The motors tested were both single-phase and three-phase, ranging from ½ H.P. to 5 H.P. Most motors will show up to 40 — 50% savings when running lightly loaded or unloaded, and some will show 5-to-7% savings at rated load."

NASA's Technical Support Package showed that "The Power Factor Controller applies to induction type electric motors — the most commonly used type in all major home appliances and the most commonly used by industry."

HOW IT SAVES POWER

Popular Electronics explained it this way: "AC induction motors characteristically run at a nearly constant speed that's fixed by power-line frequency and independent of load and supply voltage. When heavily loaded, the motor draws line current that is nearly in phase with the applied voltage...Under light load conditions, the motor develops less torque by allowing more lag between the voltage and the current. This reduces the power factor while leaving the current essentially the same in magnitude.

"To minimize this waste, Nola's device monitors the motor's power factor and when it detects light load conditions, it reduces the supply voltage..... The current, now more nearly in phase with the voltage, therefore does as much useful work as before, but it and the voltage are smaller, resulting in a net savings of electric power."

THE SAVINGS CAN ADD UP

The cost of electric power keeps going up. In 1980-81 and beyond you'll pay more and more for the privilege of running your electric appliances.

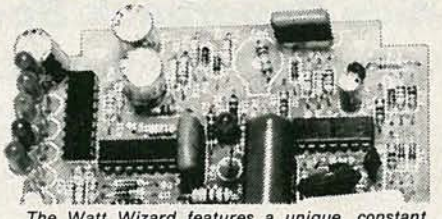
Right now, the typical consumer pays about $8 per month to operate a 16.5 cu. ft. frost-free freezer...$10 to run a 17.5 cu ft. frost-free refrigerator...and about $60 for an air conditioner used during summer months. That's what you're paying to run just **one** of these appliances per year.

Nola's power saver can soon pay for itself, then start reducing your electric bills. Until now, the device has not been **available** — except for industrial models priced at $80 or more.

INTRODUCING THE WATT WIZARD

Cynex, an American manufacturer of electrical and electronic products and a prime contractor for the U.S. Army, has been licensed by NASA to manufacture Frank Nola's power saver. Cynex calls it the Watt Wizard.

The "Watt Wizard" says Ray Beauchea, the firm's **Marketing Director**, regulates the voltage fed into an induction motor making the motors run more efficiently and quieter, while lengthening motor life.



The Watt Wizard features a unique, constant power saving readout. So you can constantly monitor you're energy savings.

SIMPLE TO USE

Cynex makes several models of the Watt Wizard (all with solid state design), including the 110 v. AC plug-in model we're offering. It's for single phase fractional H.P. motors (less than 1 H.P.) used in most freezers, refrigerators, fans, swimming pool pumps, vacuum cleaners, sewing machines, etc.

Simply plug the Watt Wizard into any electrical outlet, then plug the appliance into the Watt Wizard. There's no wiring required. Unlike some competitor's models (if and when available), the appliance does **not** have to be turned on before being plugged into the power saver. You can leave the appliance — whether on or off — plugged into the Watt Wizard all the time. Or you can move the Watt Wizard to various locations.

OTHER MODELS AVAILABLE

Air conditioners, washers and dryers require wire-in model. If you lack mechanical skill, you probably need an electrician to install it. We also offer it in 220 VAC single or three-phase.

EXCLUSIVE ADVANCE FEATURES

The Watt Wizard also includes two more unique features which no **competitor** has. It's fused so if you accidently overload the device, it won't burn out. Just change the fuse, which is available at any auto supply store.

And Watt Wizard features a unique LED readout, so you can actually tell, at any moment, exactly how much power you're saving — 10%, 20%, 30%, 40% or 50%. This feature is **available only on the Watt Wizard.**

There's a **"power-on"** light, too. And the Watt Wizard comes with the manufacturers 1 year limited warranty.

LOW COST — AND A TAX CREDIT

We're offering the Watt Wizard for only **$39.95**, with **immediate delivery.** Want two? Then its just **$37.95** each. Or splurge and get three at **$34.95** each. Wire-in models for heavy duty motors are **$6** more for each unit. Add just **$2.50** postage/handling for each **order** (not each unit).

And next year, when you fill out your tax return, you can deduct a full 15% energy tax credit - for additional savings.

30-DAY MONEY-BACK GUARANTEE

Try the Watt Wizard for up to 30 days. If not completely satisfied, return it (insured) for a full refund.

The sooner you send for the Watt Wizard, the more you can save on your electric bills. To order, send your check or money order to the address below. Or charge it to your Visa, MasterCharge, American Express, or Carte Blanche credit card. If using your charge card, you can also order via our toll-free phone number:

800-257-7850

(In New Jersey, Call: **800-322-8650**)
N.J. residents, add 5% sales tax.

Or mail your order to:

INTERNATIONAL SALES GROUP
MERCURY®
THE IMAGINATION PEOPLE®

Dept. RE-1, Lakewood Plaza
Lakewood, New Jersey 08701

CIRCLE 45 ON FREE INFORMATION CARD

EQUIPMENT REPORTS

continued from page 30

the instrument is not big and cumbersome; it takes up very little room. A supply like that can be used for a lot of useful things around a shop, and would be a fine and handy thing to have on hand. Manufacturer's suggested list price is $325. **R-E**

IET Model CM-500/ Capacitance Meter

THERE WAS A TIME WHEN NEARLY ALL capacitance measurements were made using a balanced bridge. The procedure often required interpolation of values. It was an analog process, often introducing operator error.

Times have changed. Instead of measuring capacitance indirectly by resonating a tuned circuit with the unknown capacitor, digital cir-

cuitry can measure the fundamental property of a capacitor: its rate of charge.

The new IET *CM-500* autoranging digital capacitance meter does just that. By introducing an accurate pulse-voltage to the unknown capacitor through a known resistance, the rate of charge can be measured directly.

The CM-500 autorange circuitry automatically selects the appropriate display values for the charge time. Range units include millifarads, microfarads, nanofarads, and picofarads. Since few of us have an intimate familiarity with millifarads and nanofarads, IET has located a conversion table above the display.

Why include millifarads and nanofarads when nobody uses them? The answer lies in the autoranging limits. Picofarads and microfarads, the common units, are six decimal places apart. With only 3½ digits in the display, autoranging would provide very limited accuracy for values that were too high to be measured in picofarads, yet too low to be measured in microfarads.

The display features four half-inch LED's. Measurements to a numerical value up to 1999 may be read before the meter autoranges to the next higher scale. The *CM-500* will measure any capacitance from 1 pF to 200,000 μF with 0.1% accuracy (±1 least-significant-digit). A thumbwheel offset-potentiometer corrects for stray lead-capacitance.

Front-panel provision is made for test leads or capacitor-lead insertion. A plug-in accessory (included) is used for rapid measuring of taped components.

The *CM-500* may be powered by its own internal batteries, or from an optional AC adaptor.

Accurate measurement of capacitors is only the beginning of the *CM-500*'s flexibility. An edge connector can be used to connect the tester with a useful capacitance-limits comparator (model CLC-502, optional). With this instrument, a thumbwheel selection of upper and lower limits may be used to tighten up specs on incoming capacitors. This "go/no-go" technique makes accepting and rejecting of components a snap. For quality-control purposes, the optional comparator can pay for itself quickly during bin-sorting of critical components.

Since the accessory CLC-502 is digital, it introduces no measurement error when plugged into the *CM-500*.

Our bench test

We found the *CM-500* to provide high accuracy, rapid autoranging, and clear readout-visibility. Settling time on large value capacitors was unusually short. A 2200 μF electrolytic was read in only four seconds.

The thumbwheel capacitance-offset control is a little touchy and required some getting used to. It is capable of introducing or subtracting approximately 50 pF, and some gentle persuasion is required to tease the control right to zero.

A pushbutton must be depressed each time a capacitor is measured. Not only does that prolong battery life, but a shorting position on the switch discharges the test capacitors when they are inserted to protect the instrument from overvoltage at the input.

The pulse-generating circuitry is built around a 1-MHz astable multivibrator (crystal oscillator). The squarewave output from this basic clock circuit is then divided down into useful sub-ranges for various capacitances under test. The lowest frequency (500 Hz) is used to measure the highest capacitance (20,000-200,000 μF), while the basic 2-MHz frequency is used to measure the lowest capacitance (1-2000 pF).

The *CM-500* is ruggedly built, designed for long-term reliability. It carries a list price of $299 and is manufactured by IET Labs, Inc., 761 Old Country Road, Westbury, NY 11590. **R-E**

Harada Electronic AM/FM Automotive Antenna

CIRCLE 104 ON FREE INFORMATION CARD

THE NAME "HARADA" PROBABLY DOESN'T SPUR instant recognition among most readers, but that company (1900 W. Artesia Blvd., Compton, CA 90220) claims to be the world's largest antenna manufacturer! Judging from their product-line catalog, they may be right.

Harada's specialty is producing original-equipment antennas and accessories for the automotive industry. AM, FM, AM/FM, and motor-driven antennas are available for roofs, gutters, fenders, mirrors . . . just about any spot on your vehicle where you would like to mount an antenna. And they are made for virtually every major automotive manufacturer in the western world.

As we flipped through the interesting Harada catalog, the unit which caught our fancy was the little *EA-50* "Electrona" antenna.

continued on page 34

EQUIPMENT REPORTS

continued from page 33

Studying the specifications, we discovered that the little telescoping whip contains a base-mounted preamplifier designed to increase AM and FM signal strengths. Gain is specified as 15 dB on FM, and 10 dB on AM. Fully extended, the antenna is only 16 inches long. For protection, it may be collapsed totally and laid inconspicuously into a recessed groove in its base. A 59-inch cable, terminated with a standard Motorola plug, is supplied. A single red wire also emerges from the bottom of the mounting base to attach to the vehicle's 12-volt power system.

The *EA-50* is designed to be mounted as a replacement or supplementary antenna on any of a variety of locations on a vehicle. The illustrated literature which accompanies the antenna shows a number of recommended positions, including front or back fender cowls, rear trunk lid, and roof.

The antenna is supplied with a universal mounting kit, consisting of two different rubber gaskets to align with various flat or contoured surfaces. Because the gaskets are preformed, the cutouts may be used as a drilling template for the antenna mount. Additionally, a full-size printed template appears in the accompanying literature.

Since the antenna depends upon the car-body ground return of the vehicle to complete its 12-volt circuit, a good electrical connection to the metal mounting must be provided by the screws. If the antenna is mounted on a non-conductive surface, an additional wire connection must be provided to ground the unit's base.

Inasmuch as the total current consumption of the *EA-50* is only 10 milliamps, it may be connected directly to the automotive battery without fear of running it down! Alternatively, voltage to the positive wire may be switched on and off if desired . . . but frankly, we don't really see a need for it.

After the antenna is installed, the element is extended, and the antenna is positioned by hinging it through several detent positions until the desired angle is attained. The antenna may be collapsed and recessed for protection from vandalism and carwashes.

As with any other antenna, the AM trimmer screw on the car radio should be adjusted for stronger response of a weak signal near the top of the AM band. FM peaking is unnecessary.

The accompanying literature is bilingual (German/English), and provides adequate mounting and operating hints. Suggestions are made for avoiding electrical interference due to grounds.

To check the *EA-50*'s claims, we compared it with a full-size four-foot vertical antenna element. An AM/FM radio using a common antenna input was used to simulate an installation in a vehicle. Testing the antenna using AM broadcasts, and FM as well, we found that the *EA-50* gave a good accounting of itself. Its short length was certainly deceiving in terms of ability to deliver strong signals on both bands.

In addition, the antenna worked quite well on signals outside of the bands it was designed for. For example, lower shortwave signals (up to perhaps 10 MHz or so) were quite receivable on the electronic antenna. Similarly, low-frequency signals in the 200-400 kHz range were quite readable using the *EA-50*.

Scanner buffs will be in for a disappointment, though. The *EA-50* has a rather sharp passband for FM-broadcast, and rejects signals

outside of that range quite sharply.

We would judge the best application for the *EA-50* to be where low-profile reception of AM and FM broadcast signals is desired. As with most other products, this antenna works best (if not exclusively) doing the job for which it was intended—and it does it well. Suggested retail price is $52.90. **R-E**

Tri-Star Tiger 500 Capacitive Discharge Ignition

CIRCLE 105 FREE INFORMATION CARD

THERE ARE MANY AFTER-MARKET DEVICES sold to improve automotive performances. A prime target for improvement is the ignition system. Various schemes are available, most of them electronic.

The *Tiger* CDI (*C*apacitive *D*ischarge *I*gnition) system uses an electronic-switching approach to increase engine performance. Silicon-controlled rectifiers are used to pulse the ignition coil. Tri-Star, the manufacturer, claims that the system will increase gas mileage up to 15%, reduce maintenance, and improve performance. That's an unbeatable combination if it works!

Theoretically, a capacitive discharge ignition should improve automotive engine performance several ways. It increases spark voltage, enhancing fuel combustion. At the same time, horsepower is increased. Because of the shorter spark time, spark plugs should last at least 50,000 miles. Because switching is done by the CDI system, the points hardly know they are being used. Expect considerable life from them as well. Cold starts should also be improved because of the higher spark voltage of the CDI system.

The CDI ignition is designed to work with a 12-volt ignition system, using either a generator or alternator. Triggering may be provided by breaker-type or breakerless points. Input amperage ranges from .6 to 6 amps, depending upon engine RPM. Output pulse rises to a peak in .3 to .35 μSec. There is .15 Joules of power available for each pulse. Minimum firing voltage is 5.5 volts. Output voltage (using the original ignition coil) will be 30,000 volts (engine is cranking and the battery voltage is reduced to 8 volts) to 45,000 volts (500 RPM engine speed). Peak spark current is .175 amps. The *Tiger* CDI weighs 2 pounds and measures a compact 4½ × 3 × 5 inches.

The *Tiger 500* is available both factory-wired, and as an easy-to-assemble kit. The PC board is clearly labelled, parts are high quality, and the assembly manual is excellent. It even provides periodic self-checks to insure proper assembly.

To test the ease of assembly, the kit was given to a high-school student with no previous kit-building experience. It took him 1½ hours to build. When it was finished, an examination revealed that the product looked professional. Power-switching components are adequately heat-sinked by the die-cast aluminum case.

It took less than a half hour to install the little CDI unit fully on a test vehicle. Directions were reasonably clear, although somewhat sketchy in places. By looking at the accompanying diagram, however, the owner should have no problem completing the installation correctly.

Several alternate installation diagrams are included for a variety of different ignition systems. The diagrams are clear, and the parts are of good quality.

A number of precautionary measures must be taken to insure proper operation of the *Tiger* CDI: Proper grounding, removal of interference-suppressor capacitors from the coil, use of standard plugs, and low-resistance ignition wires are a few of them.

Our tests

After the unit was assembled, checked for wiring errors, and installed, it was time to try it out. The test vehicle was a 1975 Toyota Corolla station wagon. Several nearby hills would make an ideal track for time trials.

In all, eight time-trials were run. For each trial, the accelerator was floored at a dead stop at the bottom of each hill. The ignition system was alternated between original Toyota and *Tiger 500*. The results were generally disappointing. While Tiger literature said that improvements of up to 15% might be realized,

continued on page 104

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

2-Meter FM Transceiver

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

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

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

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

Simulated TV Reception

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

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

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

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

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

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

Digital Multimeter

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

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

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

NATIONAL TECHNICAL SCHOOLS

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

NATIONAL TECHNICAL SCHOOLS
4000 South Figueroa Street, Dept. 206-011
Los Angeles, California 90037

Please rush FREE color catalog on course checked below

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

Name _____ Age _____

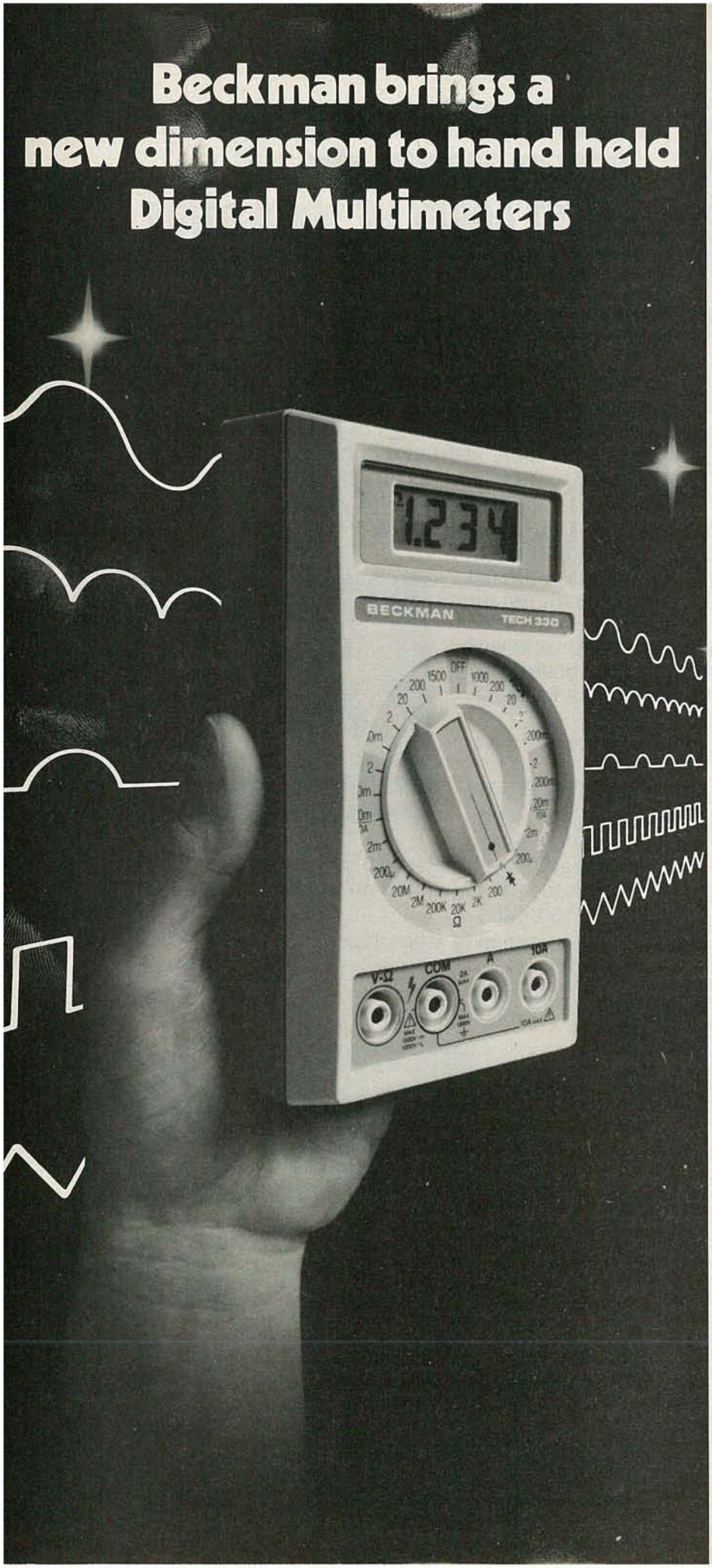
Address _____

Apt. _____ City _____

State _____ Zip _____

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

Beckman brings a new dimension to hand held Digital Multimeters



True RMS capability at an affordable price

Now you can measure the exact power content of *any signal* – regardless of waveform. Beckman delivers the new TECH™ 330 multimeter with true RMS capability and many more fine performance features for just $210.

Unlike most multimeters calibrated to read only the true power content of sine waves, the TECH 330 extends its true RMS capability to give you accurate readings of both sine and non-sine waveforms.

True RMS makes a significant difference in accuracy when measuring switching power supplies, flyback power circuits, SCR or TRIAC controlled power supplies or any other circuit generating a non-sine signal.

The TECH 330 also accurately measures the entire audio band up to 20 kHz. But that's not all you can expect from Beckman's top-of-the-line multimeter.

Measurement Comparison Chart

Waveforms (Peak = 1 Volt)	Average Responding Meter	Beckman TECH 330	Correct Reading
Sine Wave	0.707V	0.707V	0.707V
Full Wave Rectified Sine Wave	0.298V	0.707V	0.707V
Half Wave Rectified Sine Wave	0.382V	0.500V	0.500V
Square Wave	1.110V	1.000V	1.000V
Triangular Sawtooth Wave	0.545V	0.577V	0.577V

You also get 0.1% basic dc accuracy, instant continuity checks, 10 amp current ranges, a separate diode test function, 22 megohm dc input impedance, and an easy-to-use rotary switch.

With so much capability in hand, you'll be able to depend on the TECH 330 for a long time. That's why Beckman designed it tough enough to go the distance.

Enclosed in a rugged water-resistant case, the TECH 330 can take a 6-foot fall onto concrete and still perform up to spec. And to further ensure reliable, trouble-free operation, the TECH 330 gives you 1500 Vdc overload protection, RF shielding, 2000-hour battery life, gold switch contacts, and fewer electronic components to worry about.

Add another dimension to your world of electronics. Visit your Beckman distributor today for more information on the TECH 330 and Beckman's complete line of digital multimeters, starting at $120.

For your nearest distributor, or a free brochure:

CALL TOLL FREE
24 HOURS A DAY, 7 DAYS A WEEK
1-(800)-821-7700 (ext. 517)
in Missouri 1-(800)-892-7655 (ext. 517)

BECKMAN

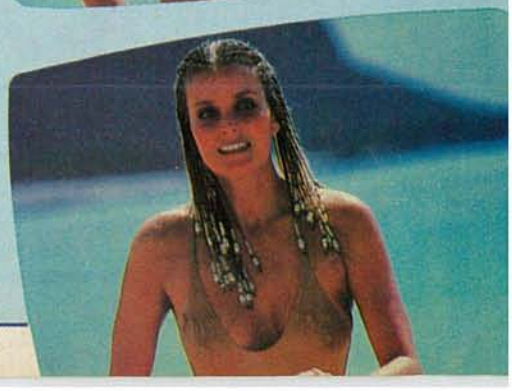
CIRCLE 65 ON FREE INFORMATION CARD

BUILD THIS

PAY-TV DECODER

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

D. LANDFEAR



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

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

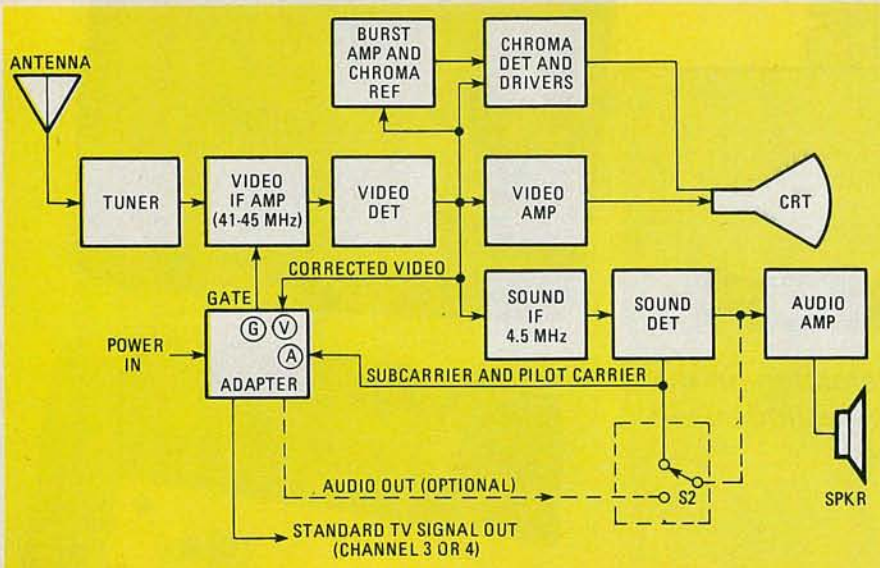
Pay TV isn't based on any new technology; indeed, the technique of scrambling TV pictures is almost as old as TV itself. In the past there have been at least a dozen different pay-TV schemes that have come and gone because of cost, complexity, or market conditions. However, current technology has played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

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

NOTE:

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

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



CONNECTION POINTS FOR PAY TV UNSCRAMBLER are indicated in block diagram. A thorough schematic will be necessary for you to locate these points in your own TV receiver.

CONNECTIONS TO TV SET(S)

Connecting the adapter to a TV receiver will require some amount of "digging" and TV knowhow on the part of the builder. There are two possible ways to use the adapter: The TV receiver with the adapter installed can serve as the monitor on which the program is watched; or the program can be watched on a second TV receiver tuned to the channel 3 or 4 output of the adapter's RF modulator.

To install the adapter it will be necessary to find the following connection points in the receiver:

- Power (12 volts or greater)
- Audio-detector output
- Emitter(s) of one or more video IF-gain stages
- Video-detector output

The diagram at the left shows a simplified block diagram of these connections, and each will be discussed next month.

All three of the encoding systems now in use throughout the country make use of one variation or another on that theme. The unscrambler described below works for only one of those three systems but the principles involved are applicable to all of them.

To determine whether the system used in your area is the same as the one discussed here, there are two things you can do. The simplest is to check for the presence of a 5.750-kHz pilot tone at the audio detector of your TV set. If it's there, you're all set. The other is to use your scope (preferably dual-trace) to observe the video waveform. If it matches that shown at the bottom of Fig. 1, once again, you're on the right track.

The significance of the pilot tone and unusual waveform will be made clear below.

How scrambling works

First, let's review the characteristics of a standard TV signal. In order to produce a picture, the entire face of the picture tube is scanned line-by-line, starting at the top left and continuing to the right and down, in what is called a raster scan. Each complete scan is called a frame, and takes 1/30th of a second to complete. During that 1/30th of a second, however, 525 lines are transmitted. Therefore, in one second, there are 525 × 30, or 15,750 lines transmitted. In order to produce a coherent image on the screen, it is necessary to transmit synchronizing (or *sync*) pulses. Those pulses are used to insure that the scan begins at precisely the correct time. Both vertical- and horizontal-sync pulses are used for this purpose.

A vertical-sync pulse defines the beginning of each frame and field (half a frame) and a horizontal-sync pulse defines the beginning of each line. In addition to sync pulses, there is an additional signal called a blanking pulse. To understand the purpose of the blanking pulses, recall how the raster scan goes line-by-line from left to right down the screen. In order for it to get from the end of one line (or one frame) to the beginning of the next, it must sweep back or retrace its path. However, during the brief period when it is doing that, it is necessary to turn off the beam, or blank it. That is the function of the blanking pulse. The sync pulses are superimposed on the blanking pulses.

What happens is that every time the beam sweeps to the end of a line, or frame, it is extinguished or blanked by the horizontal or vertical blanking pulse, respectively, before it is reset to the beginning of the next line, or frame, by the sync pulse.

Now, suppose we alter the characteristics of the sync pulses, or even remove them entirely. What happens? You guessed it—a mess on the screen instead of a picture. The waveforms of a scrambled signal have these characteristics: non-standard sync and blanking pulses. That non-standard signal is compared to a standard signal in Fig. 1, which represents about 1½ lines of video information as viewed on an oscilloscope. The upper trace represents a normal video signal and the lower trace a scrambled one.

Note that in a standard signal, the horizontal-blanking pedestal estab-

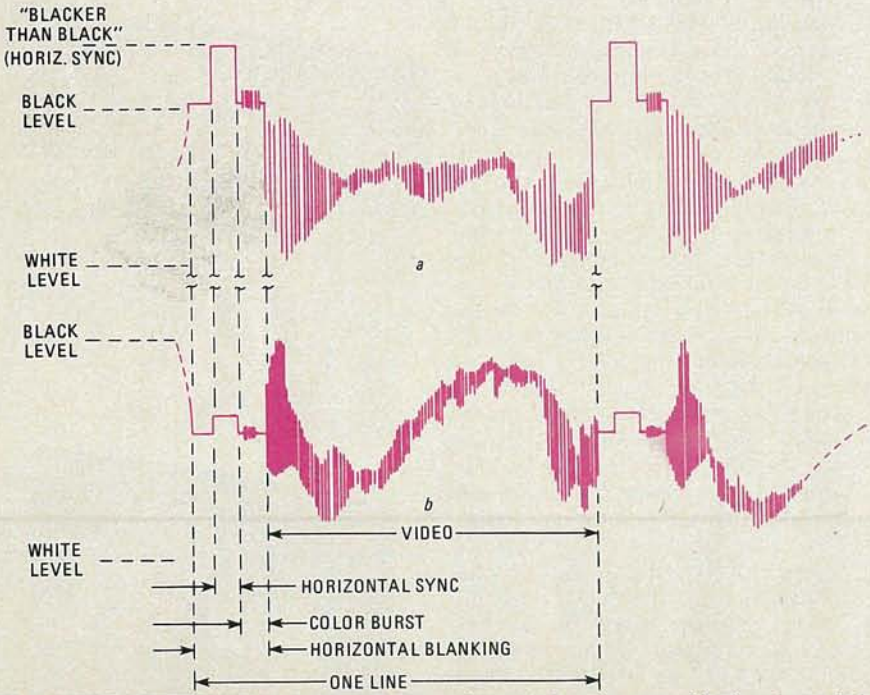


FIG. 1—NOTE DIFFERENCES in horizontal-blanking intervals between normal (top) and encoded (bottom) signals.

PARTS LIST

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

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

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

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

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

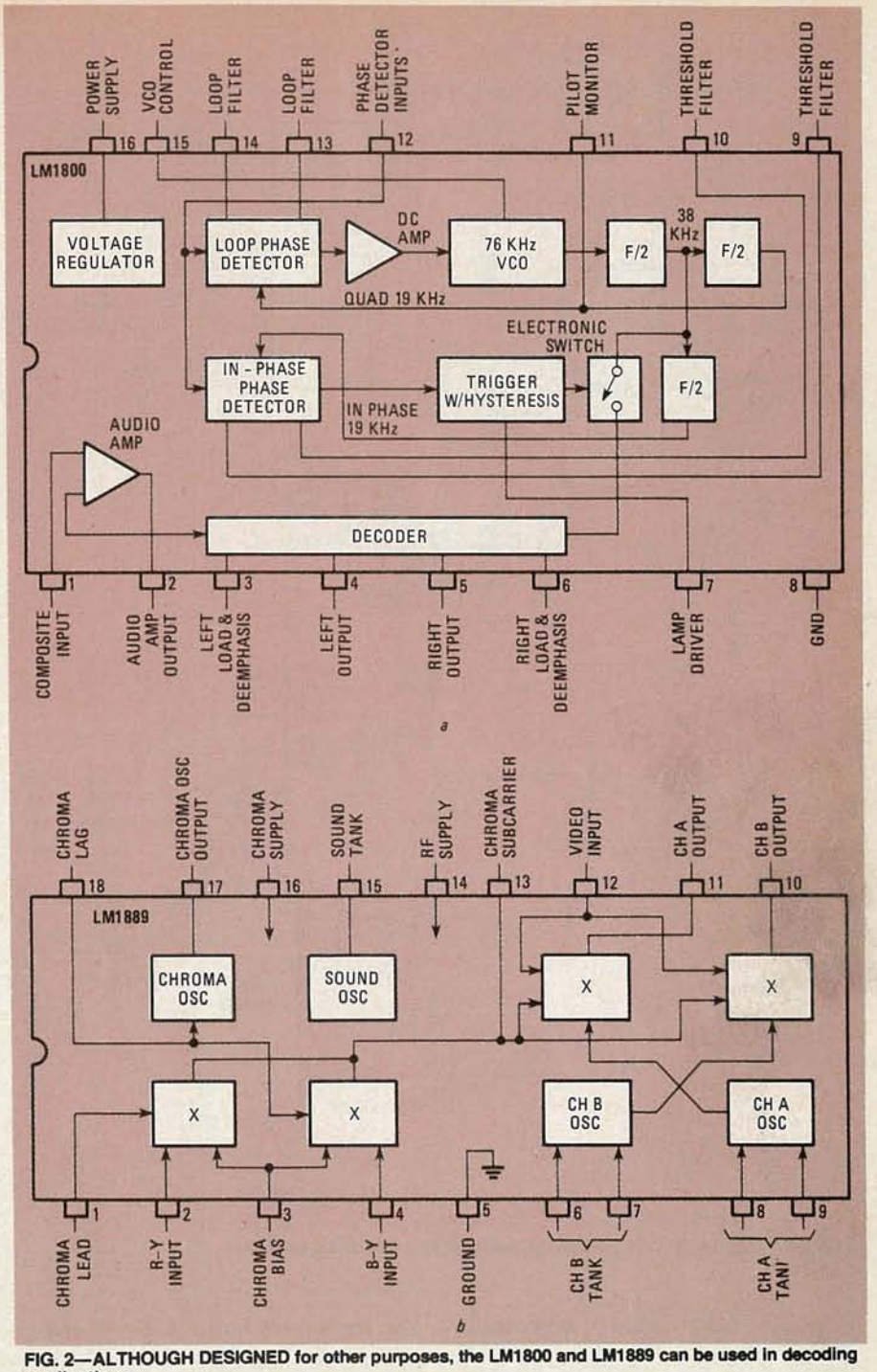


FIG. 2—ALTHOUGH DESIGNED for other purposes, the LM1800 and LM1889 can be used in decoding applications.

lishes the black level for the line. The sync tip is in the "blacker-than-black" region. In the non-standard signal, however, there is no clearly recognizable blanking pulse. Thus, there's no black reference; the video signal itself is seen in the "blacker than black" region by the set, making synchronization impossible. It should also be noted that during the horizontal-blanking interval, a color-synchronization signal is also transmitted. That signal, called the color burst, is used to synchronize the color-detection circuits in the TV set. With a normal signal, the set's circuitry expects to see the color-burst signal during a specified interval. If it doesn't recognize the blanking pulse, then it can't recognize the color-burst signal either; thus, the set's color circuitry is either unsynchronized or doesn't work at all. So just by changing one part of the signal—the blanking pulse—it is possible to destroy not only the picture sync but also the color sync.

All that has been done to the scrambled video signal has been to reduce the horizontal blanking-signal level below the video-signal level. To reconstitute the picture, all that is required is to restore everything to its original levels. That can be accomplished very simply by momentarily increasing the gain of the TV receiver during the horizontal-blanking interval. The trick

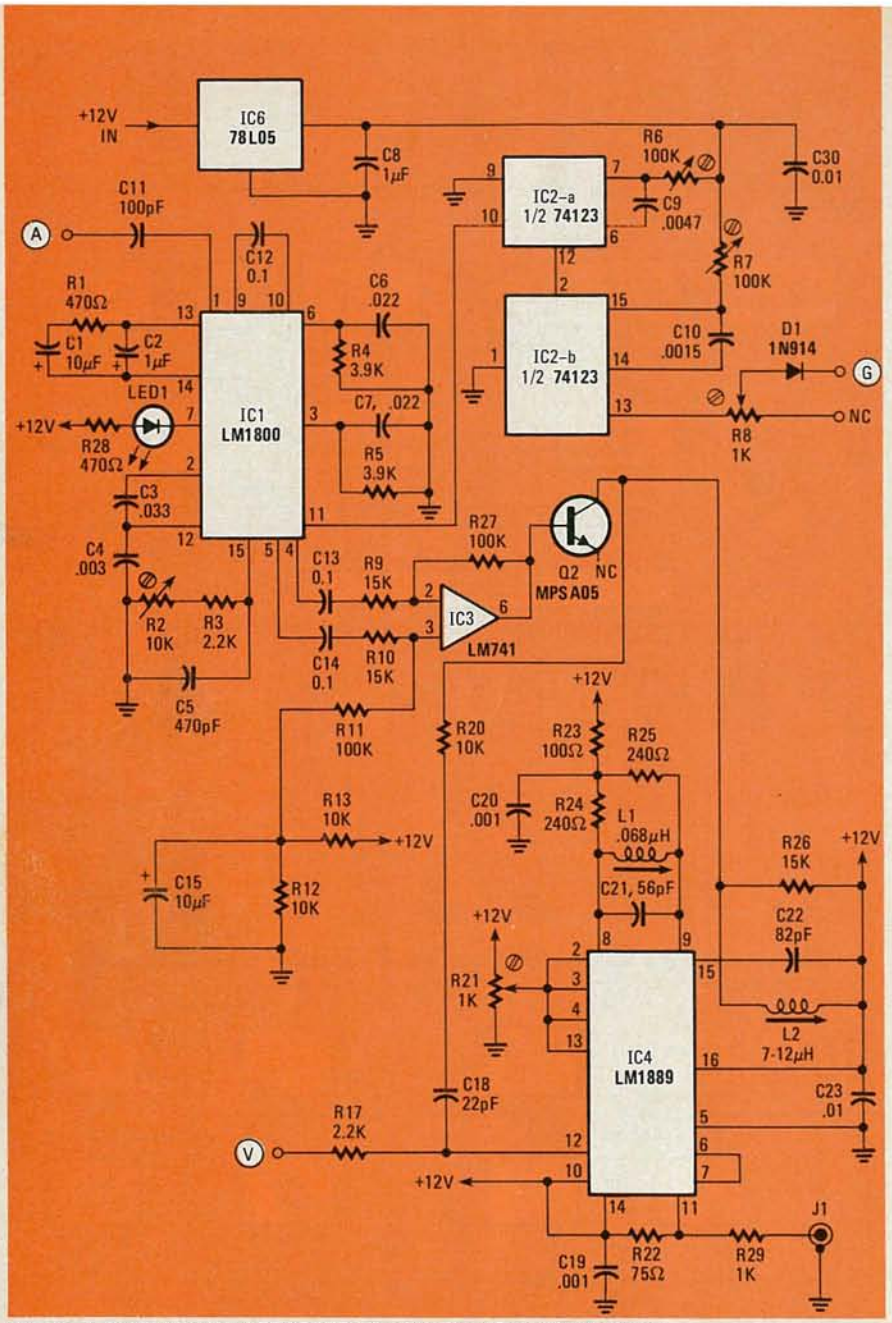


FIG. 3—A SIMPLE PAY-TV DECODER uses just four IC's and a transistor.

is to know exactly *when* to increase the gain. Since the video signal is such that the blanking pulse is almost unrecognizable, perhaps we should look elsewhere.

An unscrambler

Let's digress for a bit and talk about the sound. As you will see, there is a very important correlation between the sound and the restoration of the sync- and blanking-pulses. Program audio is transmitted via a 31.5-kHz subcarrier. The information on that subcarrier is a double-sideband, suppressed-carrier signal. In order to demodulate it, a reference signal, or pilot carrier, is required. The frequency of that pilot carrier is one-half the modulating-carrier frequency (31.5/2 = 15.75 kHz). That number—15.75—is the horizontal-line frequency we talked about earlier, and represents the number of horizontal-sync pulses generated in one second. Obviously there is some correlation here.

The pilot-carrier signal can be used as a timing reference to recreate the sync and blanking pulses. The pilot carrier generates a 15.75-kHz square-wave signal in a decoder IC such as an LM 1800. That signal in turn is used to trigger two cascaded one-shot multivibrators that produce a gate pulse of exactly the same width and phase as the horizontal-blanking pulse. That gate pulse is used to increase the IF gain of the TV receiver during the horizontal-blanking interval, restoring the sync- and blanking-signal strengths to normal.

The method is the same as the one used to transmit the difference information that produces an FM-stereo signal. And, since the same process is involved, the same hardware can be used to retrieve the signal. The only difference between the stereo system and this system (other than the choice of frequencies) is in the way the signals are retrieved on the output. In a stereo system, the main-channel signal is added to the sub-carrier signal to produce two separate channels. In the unscrambling application, the main-channel signal is subtracted, and only the subcarrier signal is used.

Block diagrams of both the LM1800 PLL stereo decoder and LM1889 TV video modulator IC's are shown in Fig. 2 to help you understand the workings of the unscrambler.

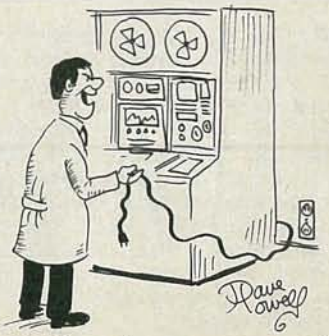
The circuit

Fig. 3 shows a schematic diagram of a decoder circuit. Assume that the circuit is connected to a TV receiver tuned to a scrambled broadcast. The outputs from the TV's audio and video detectors are connected to points "A" and "V" respectively.

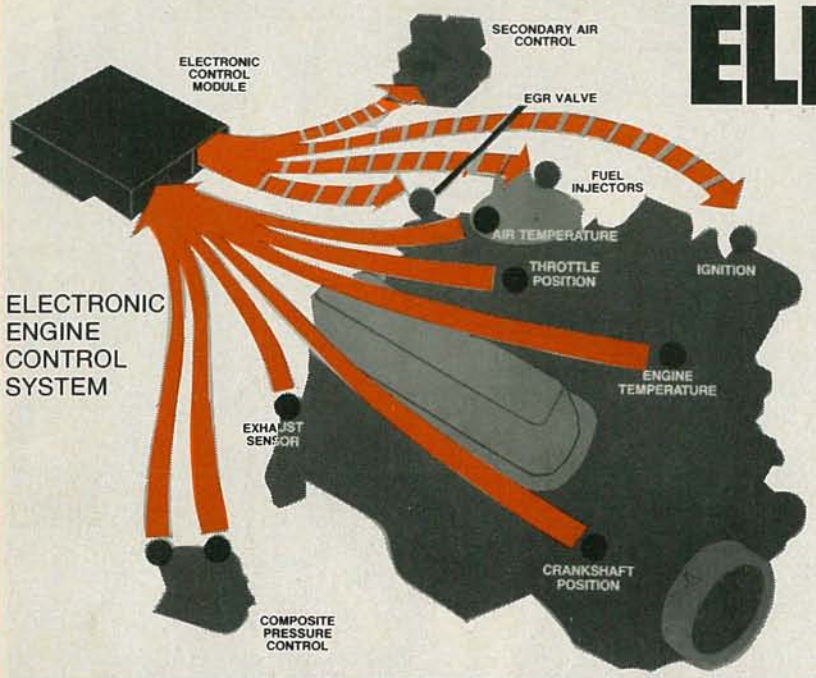
The signal from the TV audio detector is applied to pin 1 of IC1, a PLL FM-stereo demodulator, through C11, a 100-pf coupling capacitor. That capacitor removes most of the main-channel information while allowing the high-frequency subcarrier and pilot carrier to pass through. The pilot carrier is used to phase-lock a 15.75-kHz oscillator that's part of IC1. The free-running frequency of the oscillator is determined by R2, R3, and C5. Phase-lock is indicated by LED1, which lights when lock occurs.

The audio outputs appear at pins 4 and 5 of IC1; they would normally be the left- and right-channel outputs if a stereo signal were being decoded. However, since the intent is to recover only the subcarrier audio, those signals are applied differentially to a 741 op-amp, IC3. The main-channel component is in phase at both the inverting and non-inverting inputs and is cancelled out by IC3. Since the subcarrier signal is 180° out of phase with itself at those two pins, it is not cancelled and appears at the output of IC3.

Next month we will finish discussing how the decoder works and will show you how to construct such a device. We will also provide step-by-step instructions for connecting it to your own TV set. **R-E**



"Now tell me how smart you are!"



ELECTRONICS IN YOUR NEXT CAR

Microprocessor-based technology is making your car's engine a more efficient machine. It's bringing about other improvements, too.

MARTIN BRADLEY WEINSTEIN

FIG. 1—FORD'S MICROPROCESSOR CONTROL UNIT controls carbon monoxide, hydrocarbon, and nitrogen-oxide engine emissions. An oxygen sensor in the engine's exhaust manifold monitors the content of the exhaust and signals the electronic control unit to adjust the air/fuel mixture in the carburetor to maintain the precise mixture for proper operation of the catalyst.

Looking Under the Hood

LAST MONTH, IN PART ONE OF THIS FOUR-part series, we looked at electronics and how it was being applied in the passenger compartment in the new breed of automobiles from Detroit. We looked at digital dashboards and trip computers.

This month, we continue with a look at how electronics is being applied under the hood—engine controls.

Ford claims the "fastest and most versatile interactive electronic control system in the automobile industry... probably two years ahead of its closest competition in the use of electronic control systems."

The New Chrysler Corporation offers what "company engineers believe...is the world's only known continuous-flow method of electronic fuel injection."

Cadillac, the creme de la creme of GM, claims to provide 1981 model buyers "with one of the most advanced engine control, fuel-metering, and emissions-monitoring systems in the automotive industry."

Disregarding for the moment the industry's penchant for claims of superiority, we find some fascinating new approaches to electronic engine control, continued development of some recent trends, and a surprising degree of ingenuity and sophistication.

Here's a closer look at what's changing under the hood, in and around the carburetor, through the ignition system, and inside the cylinders. You don't have to know much about engines to follow this—and, even if you are an automotive expert, there is a lot to be learned from these new technologies.

The Ford EEC and MCU

Like so many other improvements in the engine compartment, Ford's Microprocessor Control Unit (MCU)—shown in Fig. 1—and Electronic Engine Con-

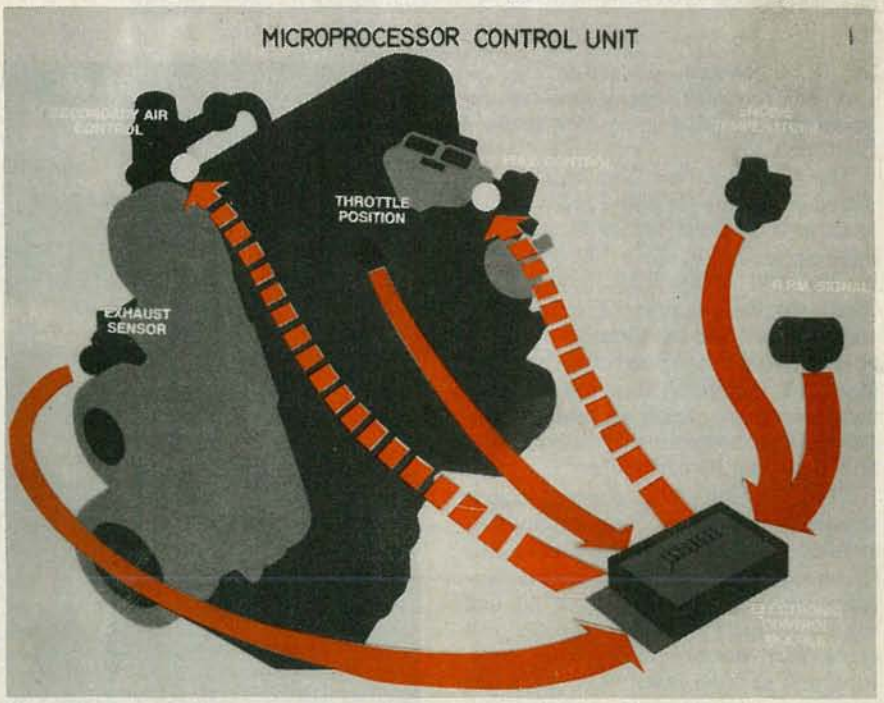
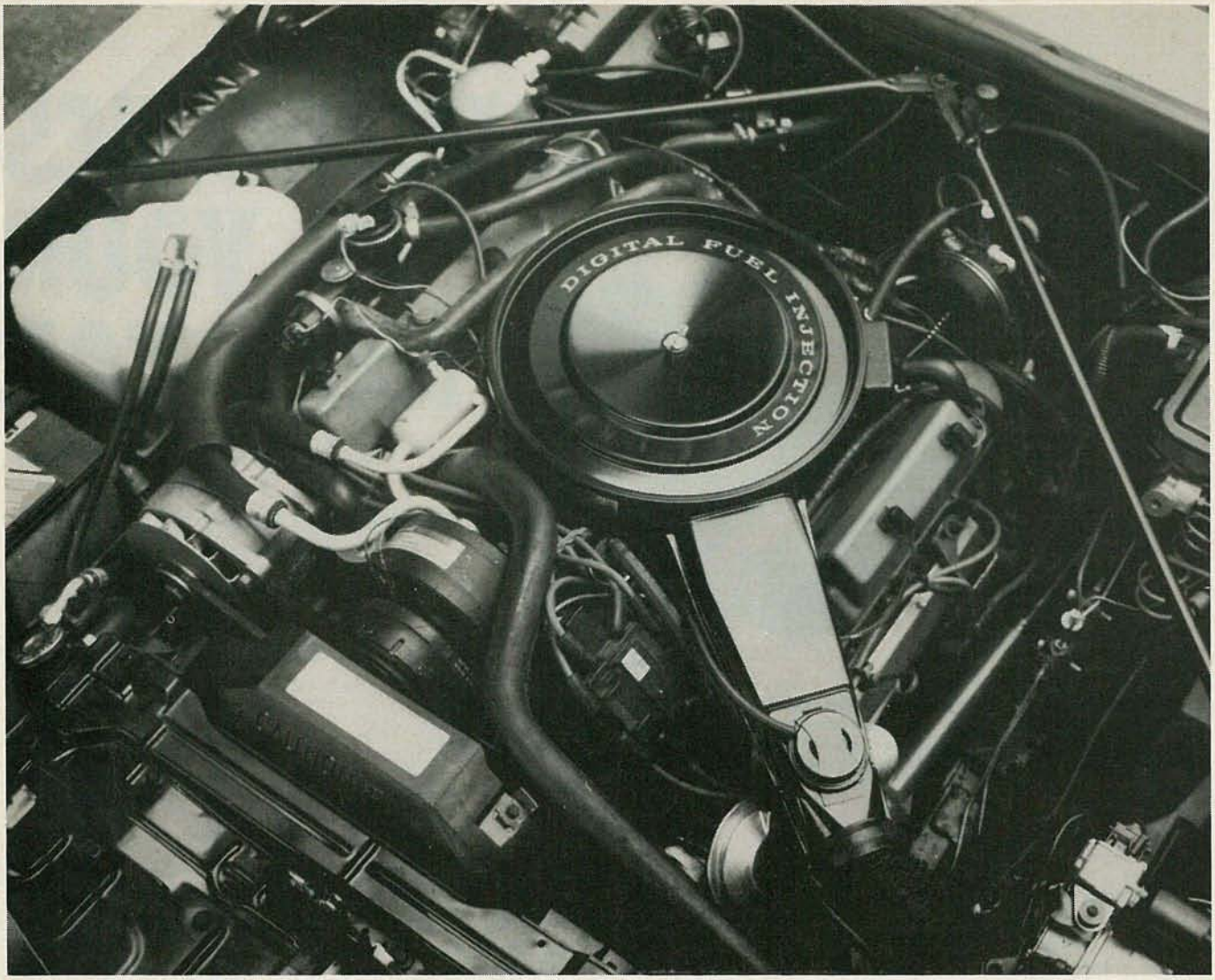


FIG. 2—FORD'S ELECTRONIC ENGINE-CONTROL system senses internal and external engine parameters of the engine, then adjusts the air/fuel mixture, spark timing, and exhaust-gas recirculation for optimum engine performance. At 55 MPH, the system can read seven engine parameters and adjust six engine functions in less than one engine revolution.



SHOULD ANYTHING EVER MALFUNCTION in this Cadillac engine, an Electronic Control Module will take over and do its best to keep the car running until service can be obtained.

trol (EEC) system—shown in Fig. 2—evolved from stiff federal emission requirements, and even stiffer ones in California.

The MCU evolved from a unit introduced on some 25,000 Ford vehicles sold in California in 1978, and will have appeared on some 597,000 Fords by the end of the 1981 model year. Inputs to the microprocessor include engine speed and temperature, throttle position, and the oxygen content of the gases in the exhaust manifold. The microprocessor analyzes those conditions and controls the fuel-air mixture (lean) in the carburetor.

EEC broadens the scope of engine sensing and control. That system, first available in its third generation as EEC-III on top-of-the-line Ford 5.8-liter engines in 1980, monitors both air and engine temperature, both throttle and crankshaft position, composite pressure, and exhaust gases. It controls fuel injectors, exhaust-gas recirculation (EGR), ignition timing, and air intake.

EEC-IV, which is the next generation system, offers even more im-

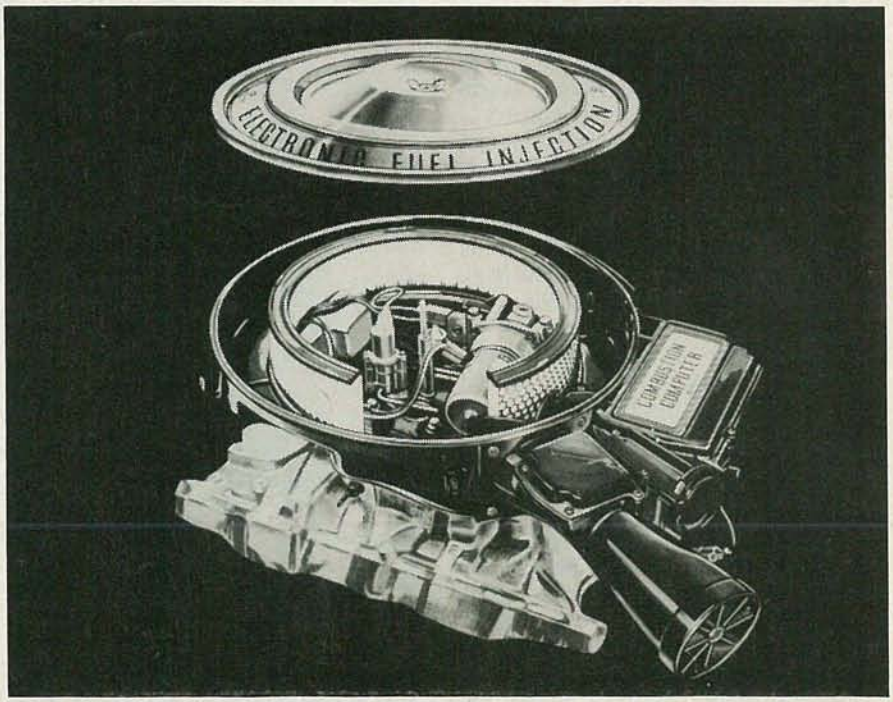


FIG. 3—CHRYSLER'S ELECTRONIC FUEL-INJECTION system replaces the carburetor with a complex pod of electronics, sensors and electromechanical devices.

provements, according to Ford VP John Betti. "It will be several times faster than our present system, have 20% more memory efficiency, and it will accomplish that with two-thirds fewer LSI chips...meeting more stringent emissions standards for oxides of nitrogen...plus Federal tamper-resistance and altitude-compensation standards."

Chrysler's EFI

Remember when Frank Sinatra drove his new 1981 Imperial off the line last summer? That was the first car with Chrysler's "continuous-flow" Electronic Fuel Injection (EFI) system, a rather remarkable accumulation of technology.

EFI controls the amount of fuel pumped from the tank, the mix, and the spark advance; that is based on air and fuel temperature and flow, engine speed, coolant temperature, throttle position, exhaust-gas oxygen content, and more. There's no choke, no separate idle-metering system, no separate wide-open-throttle metering system, no diaphragm-type fuel pump, and no special starting procedure. See Fig. 3.

There are three major parts to the EFI system. In the fuel tank, in addition to the usual plumbing, there's an electric turbine pump and several check valves.

In the air-cleaner assembly, there's an air-flow metering sensor, EGR vacuum sensing, and both metering and ignition-control electronics modules.

Third is the throttle body assembly, including the fuel-control pump and its power electronics, fuel-flow sensing, pressure-regulating valves, spraybars, and an automatic idle speed motor. See Fig. 4.

Here, Chrysler Engine Electrical Engineering Chief Engineer E. W. Meyer, Jr., explains how the system works:

> Basically, the computer senses the flow of air into the engine, the flow of fuel and oxygen content in the exhaust gas. It compares those signals to an ideal calibration. When any of the signals is different from the calibration, the computer signals the control-pump motor to deliver more or less fuel, depending on whether the air/fuel mixture is too rich or too lean.
>
> The pump in the gas tank sends fuel to the control pump. The control pump takes a small portion of it (see Fig. 5) and delivers the fuel at 21 pounds-per-square-inch at idle through the fuel-flow sensor and the fuel-delivery regulator valve, into the delivery spraybar, and then through the nozzles of the spraybar and into the engine.
>
> Since the openings are fixed, pressure has to vary to deliver more fuel at higher speeds, up to 60 psi. The spraybar is designed to produce an even flow of fuel at low

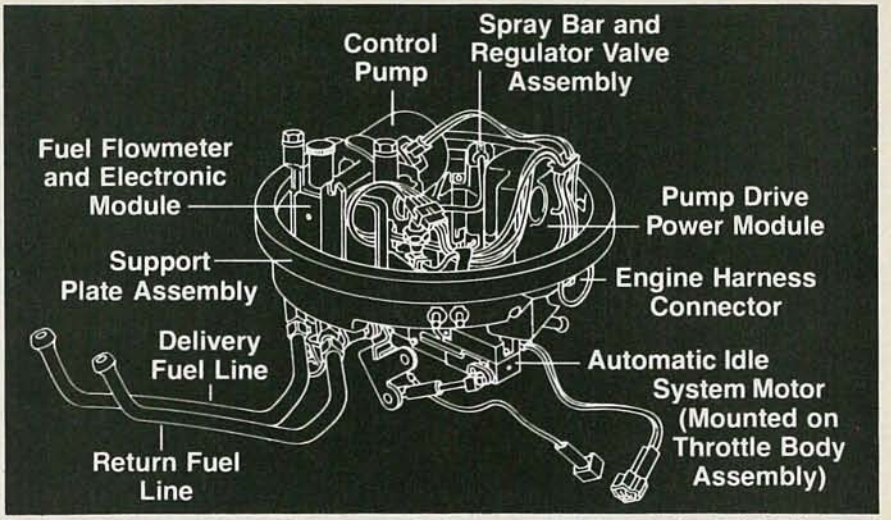


FIG. 4—THE AIR-CLEANER AND THROTTLE-BODY assembly in Chrysler's Electronic Fuel-Injection system contains the fuel-control pump and power electronics, fuel-flow sensing, pressure-regulating valves, spray bars, and automatic idle speed motor.

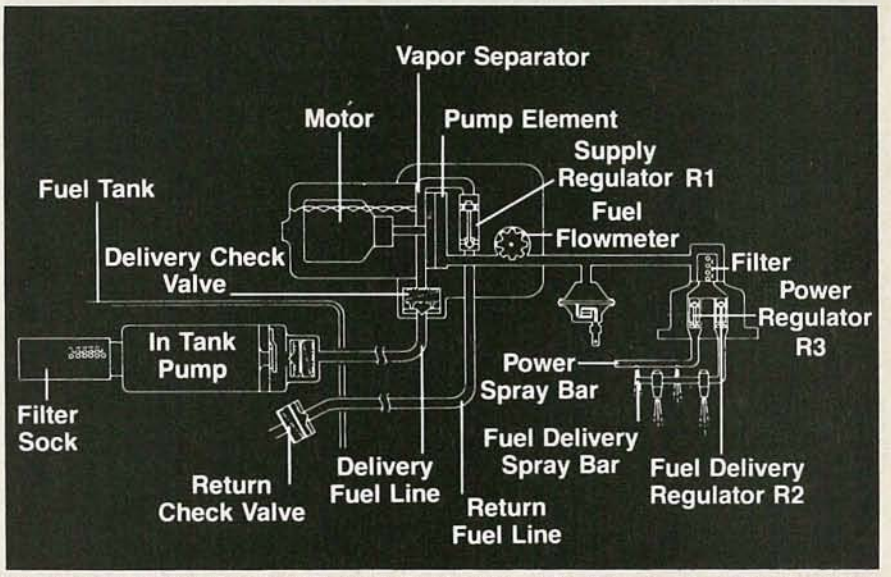


FIG. 5—FUEL FLOW in Chrysler's Electronic Fuel-Injection system is measured, monitored, metered, and manipulated by electronics.

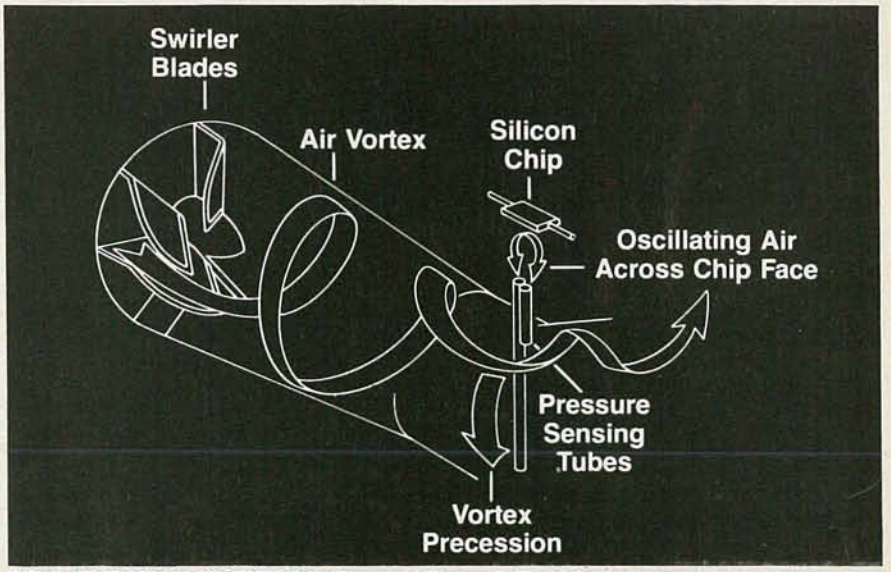


FIG. 6—THE AIR-FLOW SENSOR in Chrysler's Electronic Fuel-Injection system contains blades that swirl the air as it enters a vortex. Centrifugal effects makes the air pressure lower at the center of the vortex, higher at the outside. As the swirling air expands, the low-pressure center begins to rotate around the wall. A silicon pressure-sensor pulses faster as the air flow increases, and slower as the air flow decreases, providing air-flow data to the combustion computer.

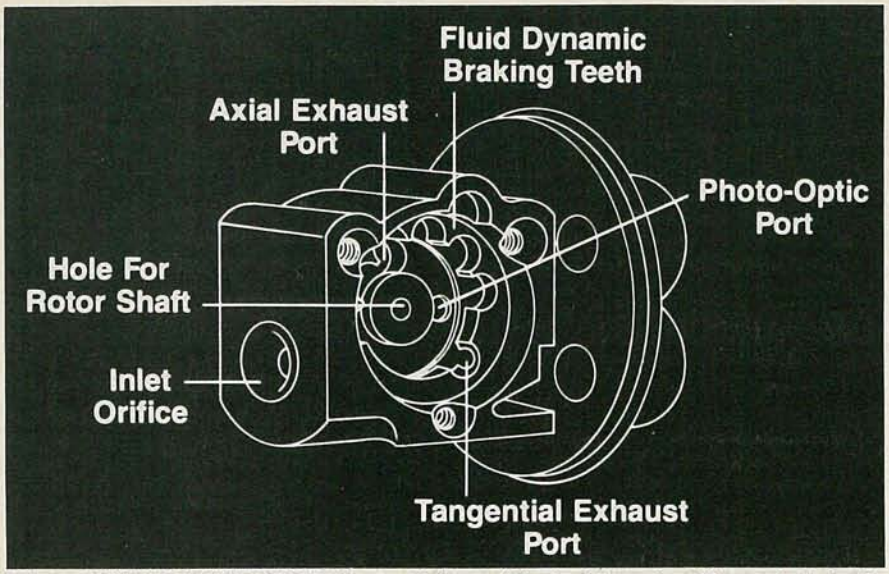


FIG. 7—CHRYSLER'S FUEL SENSOR is essentially a paddlewheel flowmeter with an optoelectronic interrupter providing a pulse rate proportional to fuel-flow rate.

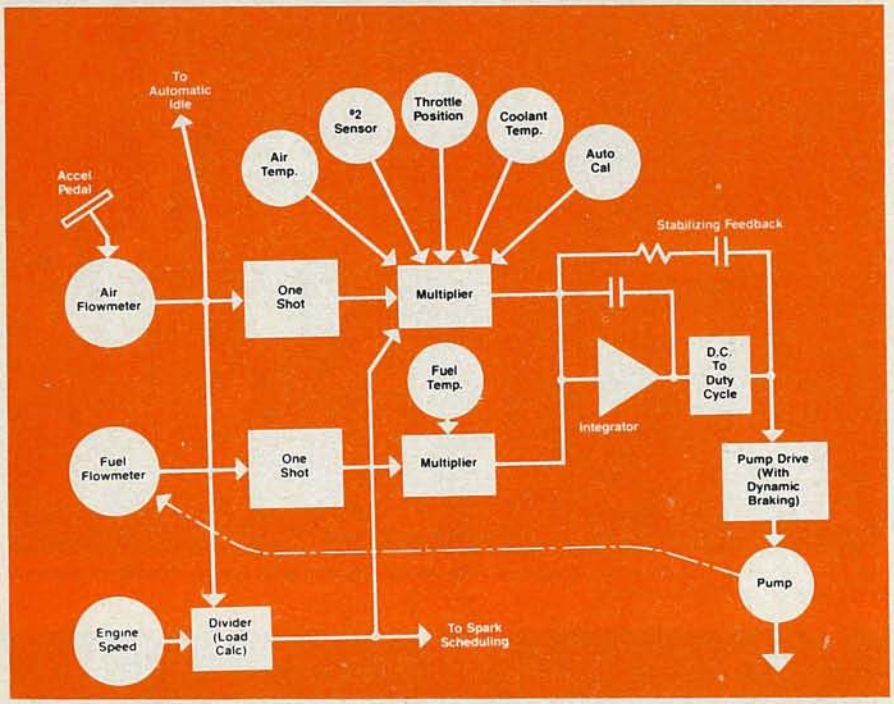


FIG. 8—SIGNAL PROCESSING in Chrysler's EFI system. Block diagram gives you some idea of the complexity of the system. The air and fuel one-shots are of opposite polarity, resulting in a continuously variable net charge on the integrator and extremely fine control of the duty cycle of the drive pulse to the pump-control transistors.

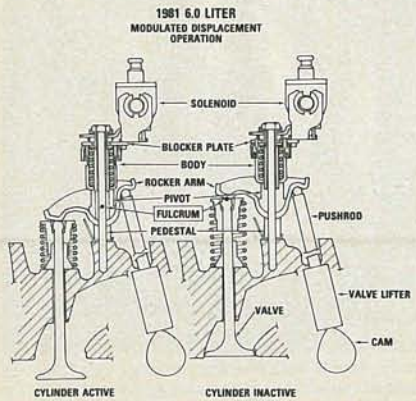


FIG. 9—CADILLAC'S MODULATED DISPLACEMENT system activates 4, 6 or 8 cylinders, as required.

speeds. At higher speeds, a second spraybar, the power spraybar, opens to deliver the full amount of fuel at the correct pressure. Fuel that is not needed for a given speed automatically returns to the tank through the return check valve and return fuel line.

The air and fuel sensors report the volume of flow. The air and fuel sensors are shown in Figs. 6 and 7. Three additional sensors change the volume readings to mass readings. Basically, the signals from the two flowmeters trigger one-shot pulses of opposite polarities. Those are fed into an integrator, which controls the pump motor. The block diagram of the signal processor is shown in Fig. 8.

EFI maintains the quality of the air/fuel mixture by arranging the throttle blades and bore in geometrical relationships that make the inducted air shear, entrain, and distribute the fuel evenly to each cylinder.

Chrysler's EFI is on the 1981 Imperial 318 CID V-8 engine. If you're fascinated, stop by a dealer for a look under the hood.

Cadillac's DFI and MD engines

Modulated Displacement (MD) and Digital Fuel Injection (DFI) are the tricks Cadillac's new 6.0-liter engine is up to. It's an eight-cylinder engine—no, six—no, four—hey, hold on there!

MD is an electromechanical system that calls up 4, 6, or all 8 cylinders, depending on driving requirements, based on commands from a controlling microprocessor to four engine-valve selector units. Those are capable of simultaneously deactivating both the intake and exhaust valves of the cylinder. (See Fig. 9.) And modulated displacement is just one factor in that remarkable engine.

Digital Fuel Injection (DFI) uses electronically pulsed fuel injectors under the control of the Electronic Control Module (ECM), central intelligence for all systems under the hood.

The ECM monitors manifold absolute pressure, ambient barometric pressure, engine-coolant temperature, intake-manifold air mixture temperature, engine speed, and throttle position. It computes ignition timing and air/fuel mixture requirements and controls them; and it also relays sensor data both to the cockpit (dashboard) systems (like MPG Sentinel and Cruise Control) and to a service-diagnostics connector.

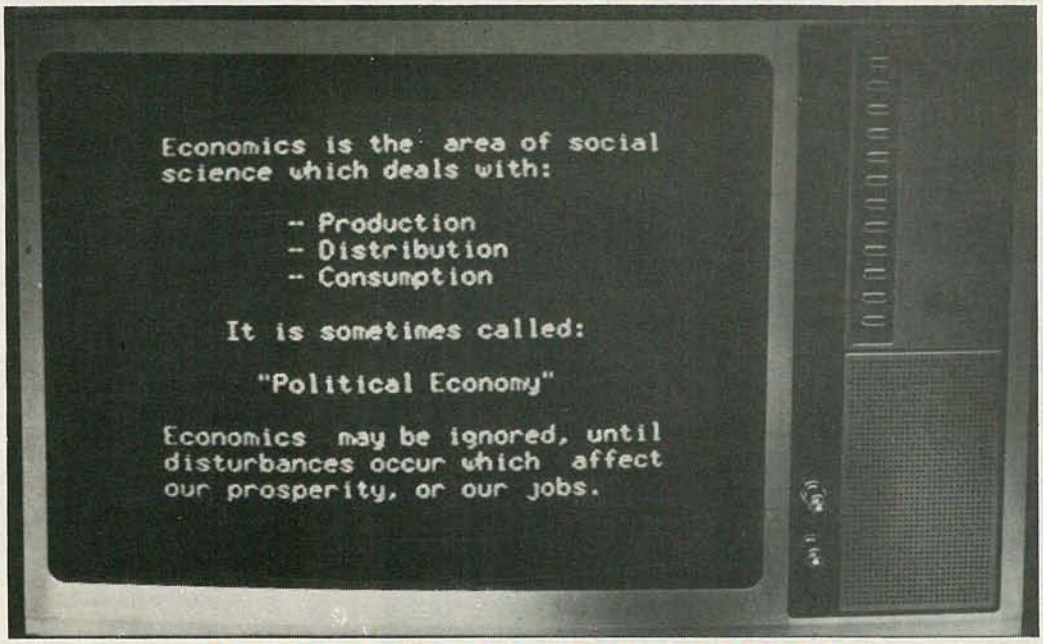
Idle speed is programmed into the ECM memory and is maintained regardless of whether or not the car is in gear, the air conditioner is on, or any other change in engine loading is introduced. That is said to reduce stalling, improve fuel economy, and eliminate idle adjustments.

The ECM also actively participates in a number of continuous diagnostic-checking routines, which result in one of the industry's most intelligent "idiot lights" ever, one marked simply CHECK ENGINE. The ECM monitors the engine control system, sensors, and actuators for proper operation. Any malfunction, no matter how temporary, is memorized. The CHECK ENGINE light is turned on. Nominal values are substituted for critical sensors until repairs can be made. And when you eventually get the car to the repairman, he can tell what's wrong by instructing the ECM to display the fault code on the digital dashboard display that is normally used as part of the climate-control system.

continued on page 81

BUILD THIS

COMPUTER/TV INTERFACE



Any black-and-white TV set can safely serve as a monitor for your computer when you build this inexpensive optically-isolated interface.

DAVID E. CARTIER

A SHORT TIME AGO I BUILT A SMALL MIcrocomputer. As it neared completion, I realized that, since it had a composite video output, I would need a video monitor to use it. Because of my low budget, I decided to convert a 12-inch black-and-white TV set for this purpose. As is well known, you cannot connect an AC/DC TV set to a transformer-based computer without running the risk of electrical shock or of blowing up one or the other...or all of those. Therefore, I decided to build a circuit that would couple the computer to the TV set using optoisolators to separate the two electrically.

The circuit I designed is simple in concept, inexpensive, and not very critical with respect to parts-replacement or wiring. It can be built using wire-wrap or point-to-point wiring techniques on perforated construction board.

The one sensitive area, however, is the speed of the components used. Because the video rate of a 64-character line, using 5 × 7 dot-matrix characters with one space between characters (the output of the video board I am using) is about 8 MHz, high-speed components must be used.

Ordinary analog optoisolators won't even begin to do the job—they're much too slow. Instead, I used a *digital* device, the HP-5082-4360, that can run at speeds up to 20 MHz. Similarly, the NE529 comparators used in the circuit are high-speed devices.

Theory of operation

To understand how the analog TV signal is turned into a digital one for the optoisolators, refer to Fig. 1. It shows an idealized video waveform of the kind generated by the computer's video-board circuitry. You can see that only three voltage-levels are really involved. The sync level is at or near ground potential—close to zero volts. Black (the background) is at about 0.5 volt and white (the color of the characters) is around one volt. By using comparators to check the level of the video signal against reference voltages for black, white, and sync, it is possible to separate those three pieces of intelligence and then pass them through the optoisolator circuitry as logic-"highs" and logic-"lows".

The complete circuit is shown in Fig. 2. The composite video signal from the computer is input at J1 and supplied to the inputs (pin 3) of two NE529 high-speed comparators.

To recover the sync signal, IC1 is referenced by resistor R4 close to—but slightly above—ground potential (about 0.1 volt). That is done because a TTL or CMOS logic "0" actually may be slightly higher than zero volt. Since the sync pulse is the low-level part of the composite video signal, IC1 produces an output pulse for each sync pulse and ignores the video—the video level never gets that low.

On the other hand, IC2 has its reference voltage set higher by R3, to accommodate the video portion of the signal. That resistor is variable so as to make it easy to define the threshold level at which black turns to white.

Two outputs are available from the NE529's, inverted and non-inverted. I used the inverted output to complement the inverted output of the optoisolators. (The two inversions restore the signal to its original polarity.)

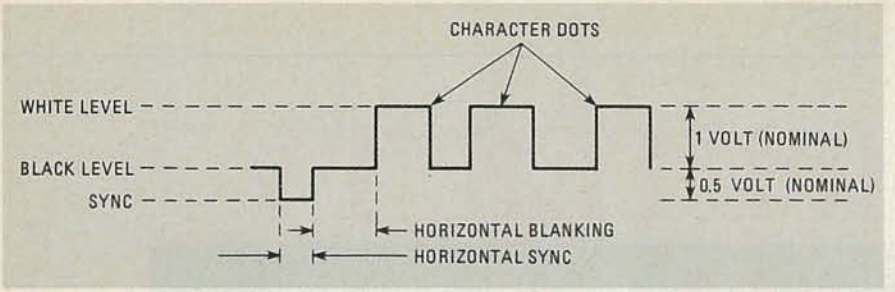
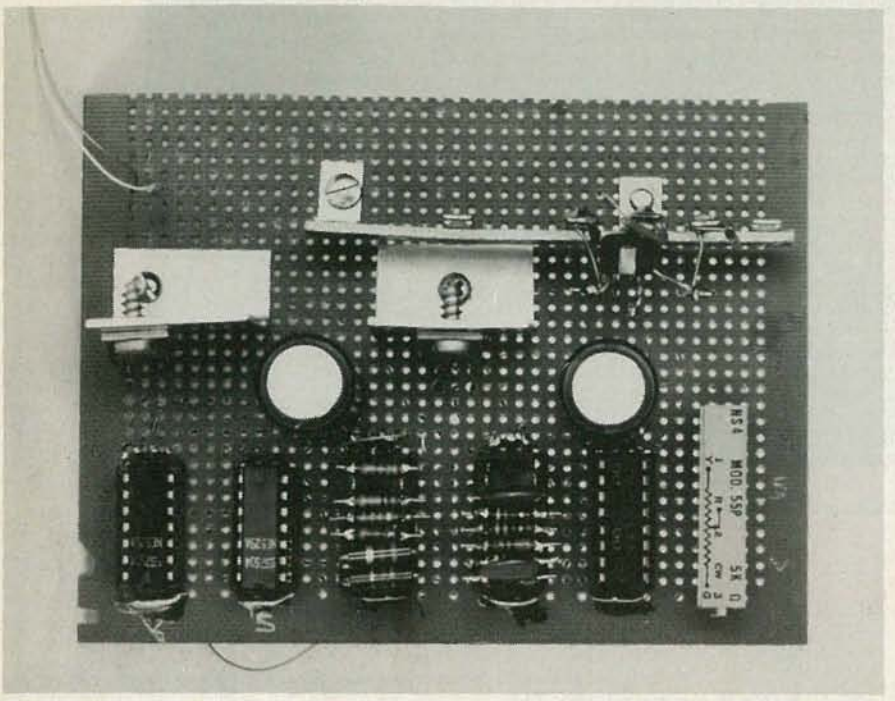


FIG. 1—COMPOSITE VIDEO SIGNAL from computer's video board has three main components: sync, black, and white.



COMPONENT LAYOUT is not critical. Tie-strip at upper-right holds bridge rectifier. Use of DIP headers simplifies mounting and connection of resistors and small capacitors.

PARTS LIST

Resistors ¼ watt, 5%
R1, R2—4700 ohms
R3—5000 ohms trimmer potentiometer
R4—100 ohms
R5, R6—560 ohms
R7—3600 ohms
R8, R10—2200 ohms
R9—10000 ohms
Capacitors
C1, C2—1000 μF, 15 volts, electrolytic
C3-C5—.1 μF ceramic disc
Semiconductors
BR1—full-wave bridge rectifier, 50 PIV, 1 amp
IC1, IC2—NE529 high-speed comparator (Signetics)
IC3, IC4—HP-5082-4360 or 6N137 opto-isolator (Hewlett-Packard)
IC5, IC6—7805 five-volt positive voltage regulator
T1—12.6-volt, 100 mA, center-tapped transformer
J1—female BNC connector
S1—SPDT switch
Miscellaneous: perforated construction board, IC sockets, 75-ohm coaxial cable, heat sinks, etc.
NOTE: If unavailable from your usual supplier, the optoisolators may be ordered from: Surplus Electronics, 9600 Baltimore Boulevard, College Park, MD 20740 for $4.95 each, postpaid. Visa and Mastercard accepted. MD residents add 5% tax.

With the sync and video components of the signal separated and translated to logic states, the individual signals are fed to the optoisolators, IC3 and IC4. Those IC's can sink 13 mA with just 5 mA of input current, and that is well within the drive capabilities of the NE529 comparators.

The video recombining network,

continued on page 80

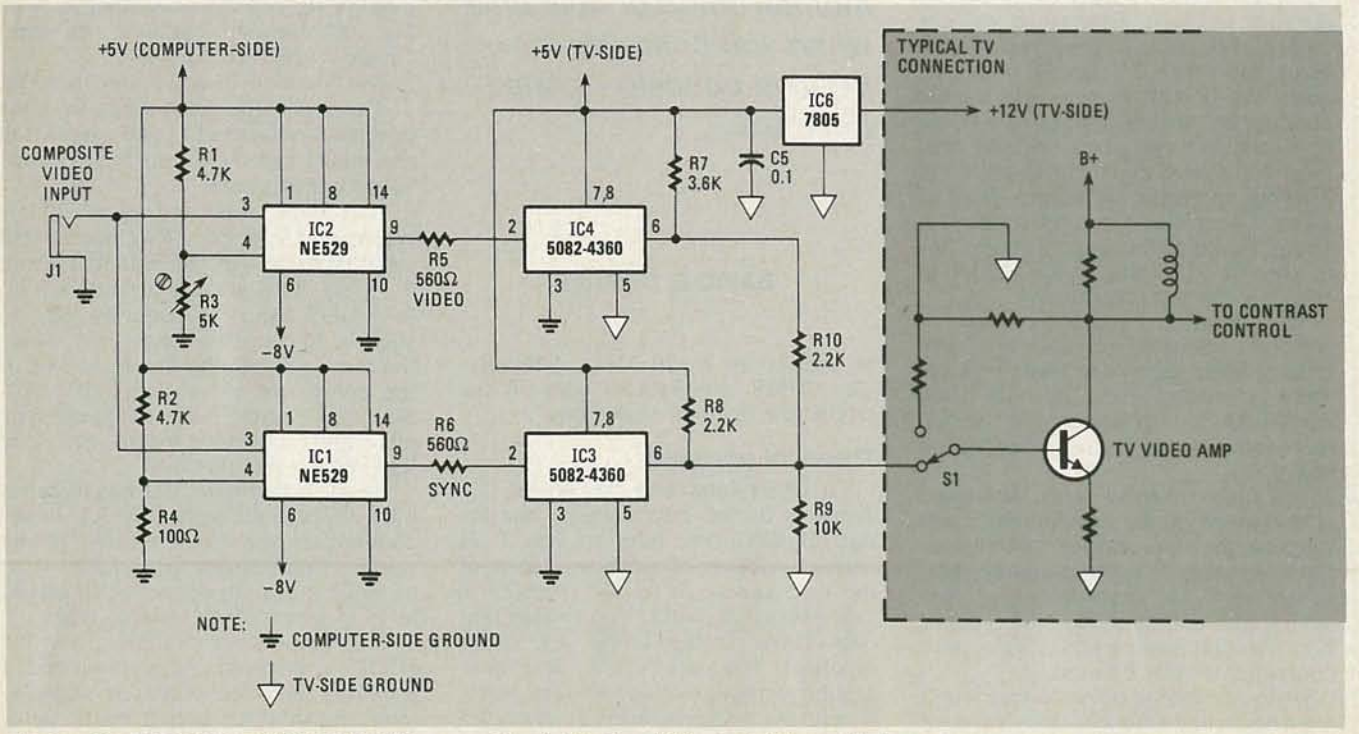


FIG. 2—TWO SEPARATE GROUND SYSTEMS are used by the interface. Make absolutely sure that each ground is made to the proper system!

UNICORN-1 ROBOT

Part 6—Add some pizzaz to your robot with two different sets of flashing lights. For the more serious-minded, there's also a twist-of-the-wrist end effector.

JAMES A. GUPTON, JR.

YOU SHOULD HAVE YOUR OWN VERSION OF Unicorn-1 in action by now, and have probably been using this time to practice controlling the robot.

In this section, we'll not only describe some simple electronic circuits that will give the robot a more impressive appearance but will provide you, as well, with one of the options promised earlier—a rotatable end-effector.

The next installments of this series will provide circuits that can be used either for radio control (R/C) and/or for computer control—the computer being either part of the robot or external to it and transmitting commands via a radio link.

Before we get involved, though, we'd like to correct an error that crept into Part 2 of this series (September 1980) and that was brought to our attention by several readers: The red and green wires between switch S1 and the barrier strip were transposed in Fig. 18. The red wire should go to ground at the bottom-right of the switch, and the green one to +12-volts at the top right.

It's good to see so many readers taking such an interest in the project!

Electronic embellishments

Flashing lights always attract attention and—you can admit it—that's what you'd like your version of Unicorn-1 to do. We'll consider two different LED-indicator circuits: one to show that the arms are in motion, and in what direction they're moving; the other (just) to attract attention by announcing that Unicorn-1 is "alive."

The first circuit, which shows that the shoulder-motors have been activated, is presented in Fig. 42. You'll remember

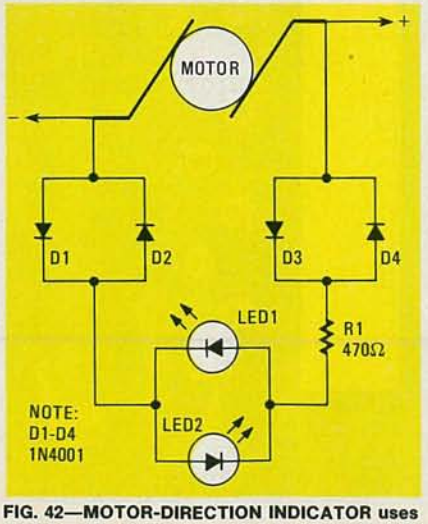
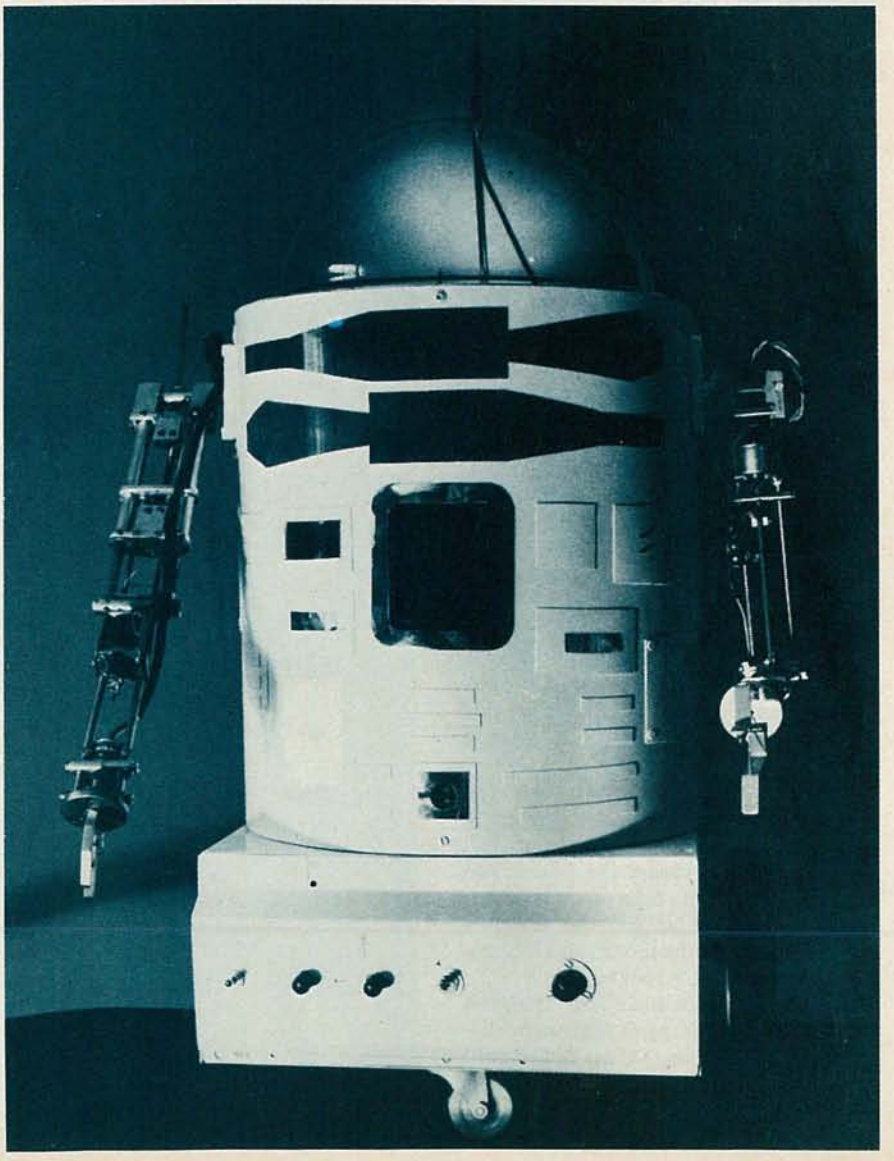


FIG. 42—MOTOR-DIRECTION INDICATOR uses twelve volts. Diodes and resistor reduce voltage and current to safe levels for LED's.



PARTS LIST—MOTOR-DIRECTION INDICATOR

R1—470 ohms, ¼ watt
D1-D4—1N4001
LED1, LED2—jumbo LED's (different colors)

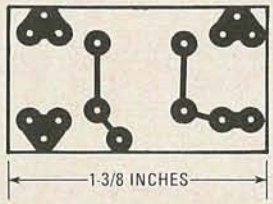


FIG 43—WHEN YOU MAKE THIS BOARD, be sure that pads *do not touch* rectangular border.

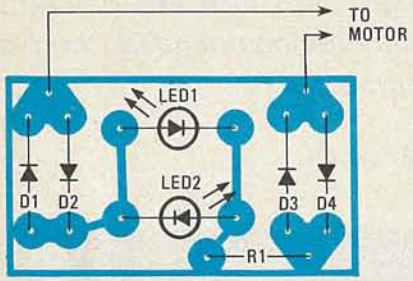


FIG. 44—PC BOARD for motor-direction indicator was designed for rectangular LED's. Circular ones will need their leads bent a bit.

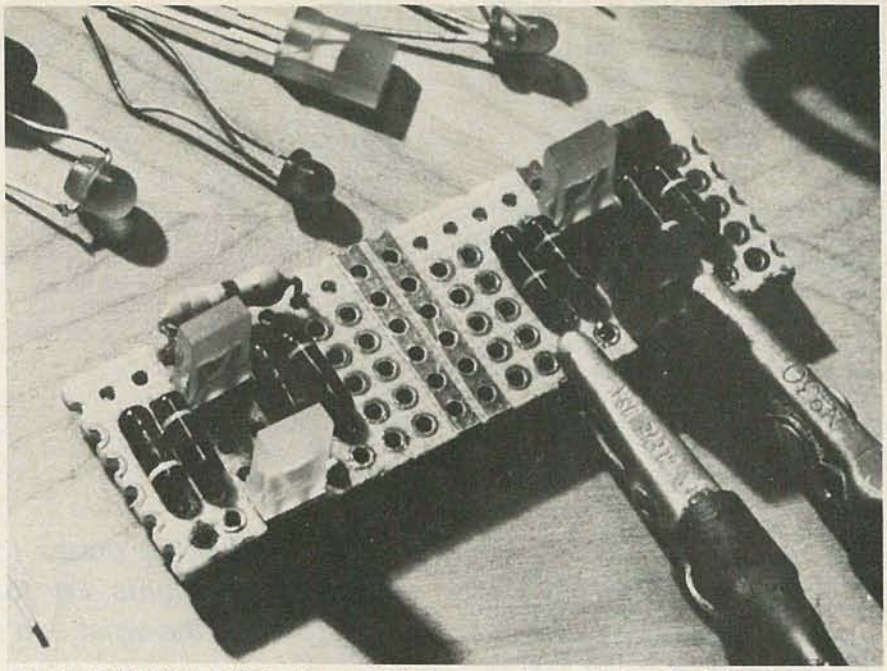


FIG. 45—ONE SMALL PIECE of board holds two complete motor-direction indicators. Current-limiting resistor is visible at top-left of board, above LED.

that the direction of motor rotation is changed by reversing the polarity of the current used to power the motor. That circuit detects which way the current is flowing and indicates it via LED's.

Looking at the schematic for the circuit, it can be seen that—if we assume the right-hand terminal to be positive and the other one negative—a stream of electrons will flow through diode D2, LED1, and through D3, causing LED1 to light. (Remember, though, that the current flow is from the positive pole to the negative.) Also bear in mind, as you consider the schematic, that, in a LED—or in any other diode, for that matter—current flows from the cathode to the anode.

Current-limiting resistor R1 is used to prevent burning out the LED's. A value of 470 ohms will be about right to provide the LED with the 20 mA it needs, based on a 12-volt system.

If a command is given to reverse the current flow—where what was previously positive becomes negative—current will then flow through diodes D4, LED2, and D1. Use different colored LED's for LED1 and LED2 so you can tell at a glance which way the motor, and its associated mechanism, is moving.

A foil pattern for the circuit is shown in Fig. 43, and the parts-placement diagram in Fig. 44. Two of those can be built on one board to take care of both arms (see Fig. 45). The LED's used on the board shown in the foil pattern were rect-

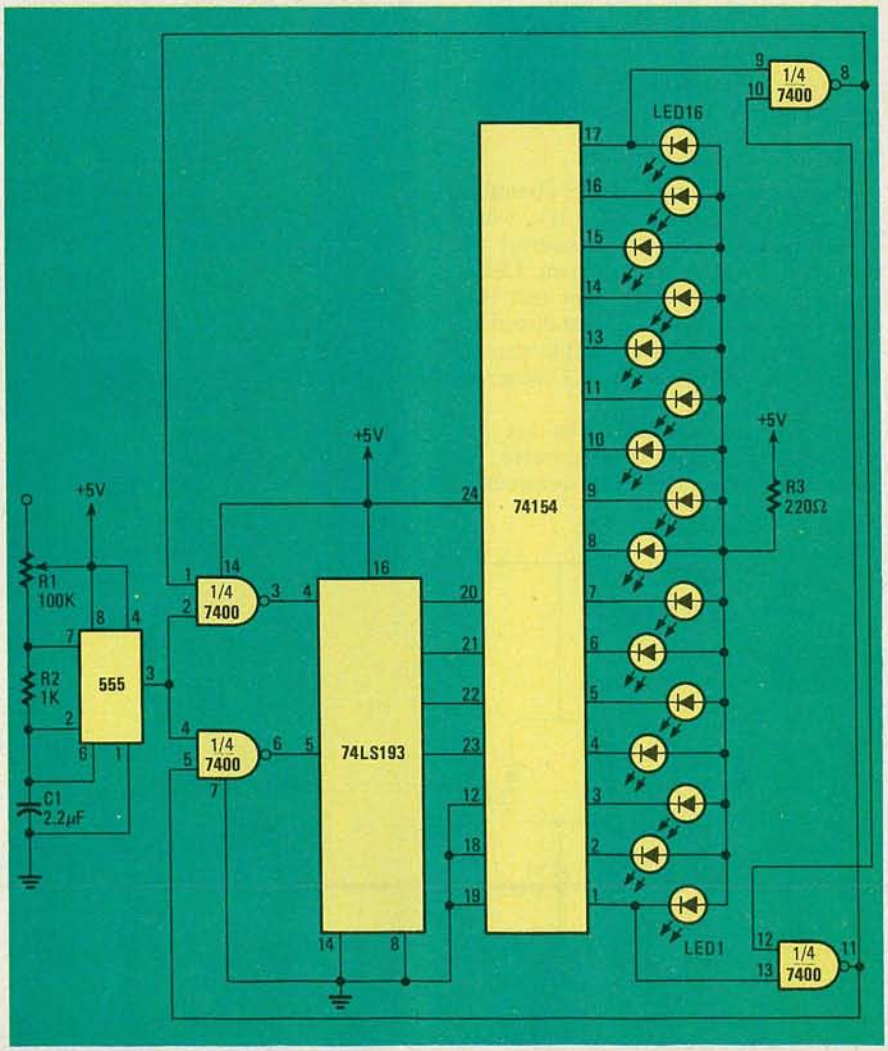


FIG. 46—SEQUENTIAL-FLASHER CIRCUIT uses 74LS193 up/down counter to drive 4-to-16-line decoder.

PARTS LIST—LED FLASHER

All resistors ¼ watt, 5%
R1—100,000 ohms, trimmer potentiometer
R2—1000 ohms
R3—220 ohms
Capacitors
C1—2.2 μF, 16 WVDC, electrolytic
Semiconductors
IC1—555 timer
IC2—7400 quad NAND gate
IC3—74LS193 up/down counter
IC4—74154 4-to-16 line decoder
LED1-LED16—jumbo red LED
Miscellaneous: 7805 voltage regulator with heat sink

angular, which explains the wide spacing of the pads. Round LED's would probably be better, since it is easier to drill round holes in the skin for displays than it is to drill rectangular ones.

One of the best attention getters is an array of flashing lights. One such LED circuit appears in Radio Shack's *ARCHER Engineer's Notebook*, and is the one described here. A display that creates a more random pattern was described in **Radio-Electronics'** Hobby Corner department in the December 1980 issue.

The sequential-flasher circuit in the original Unicorn-1 uses four IC's and five external components to operate 16 LED's. Its schematic is shown in Fig. 46. Resistors R1 and R2, working together with capacitor C1, determine the rate at which the 555 timer IC will cause the LED's to light, and R3 is the current-limiting resistor for the LED's.

The LED's are arranged in five columns of three each (see Fig. 47) with the sixteenth LED at the bottom of the middle column. In operation, they will light starting from the bottom-right, going up the column, then jump to the bottom of the next column, etc. When the last LED has lit, the process will reverse itself, working from left to right and finishing up at LED1.

Although a foil pattern and parts placement diagram (Figs. 48 and 49) are provided, the circuit, and the motor-direction indicator, are both easy enough to build on perforated construction board using wire-wrap techniques. If you have never done any wire-wrapping before, this would be a good place to start because of the simplicity of the circuits. (Articles on wire-wrapping techniques and materials appeared in the August 1979 and March 1980 issues of **Radio-Electronics.**)

You'll need nine jumper wires on the LED-sequencer board. Those can be made from wire-wrap wire, stripped at both ends and tack-soldered to the wiring- or foil-side of the board.

A few words about power supplies for those circuits: TTL IC's are very particular about their working voltage—it should be five volts, ±5% (4.75–5.25 volts). While five volts can be derived

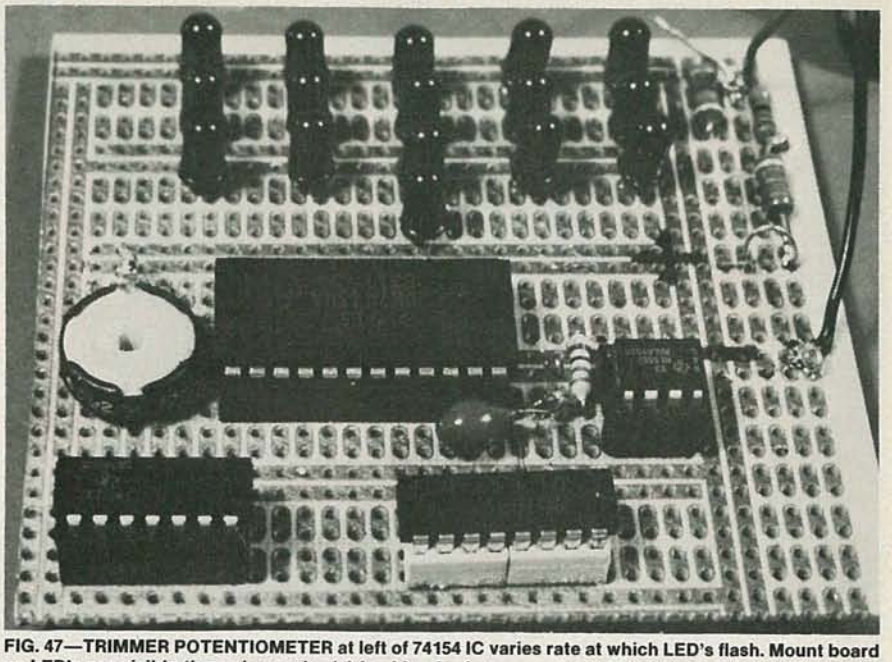


FIG. 47—TRIMMER POTENTIOMETER at left of 74154 IC varies rate at which LED's flash. Mount board so LED's are visible through opening(s) in skin of robot.

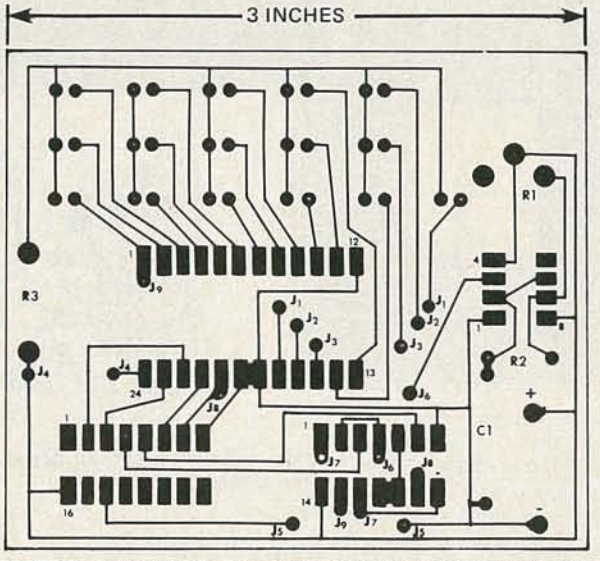


FIG. 48—PC BOARD for sequential-flasher circuit shown in prototype-version above.

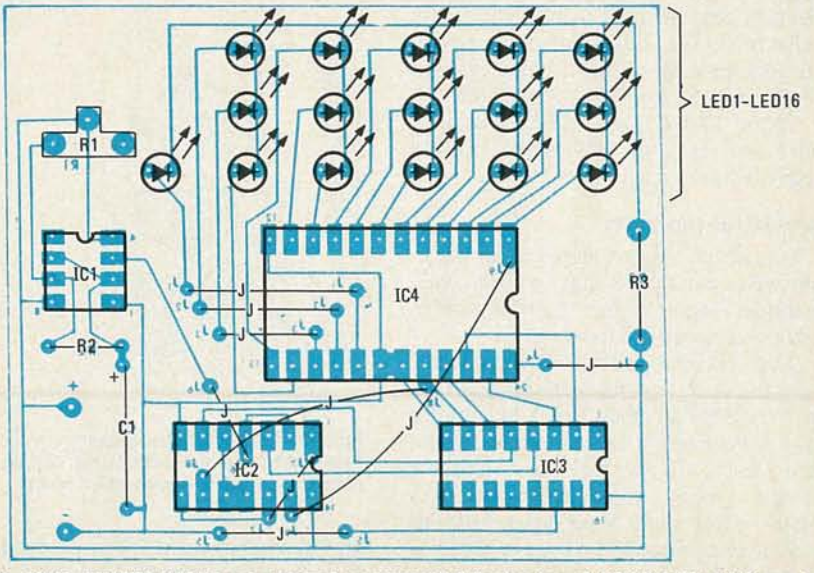


FIG. 49—NINE JUMPER WIRES are required on sequential-flasher board. "Odd" LED at left can be ommitted without upsetting anything if symmetrical layout is desired.

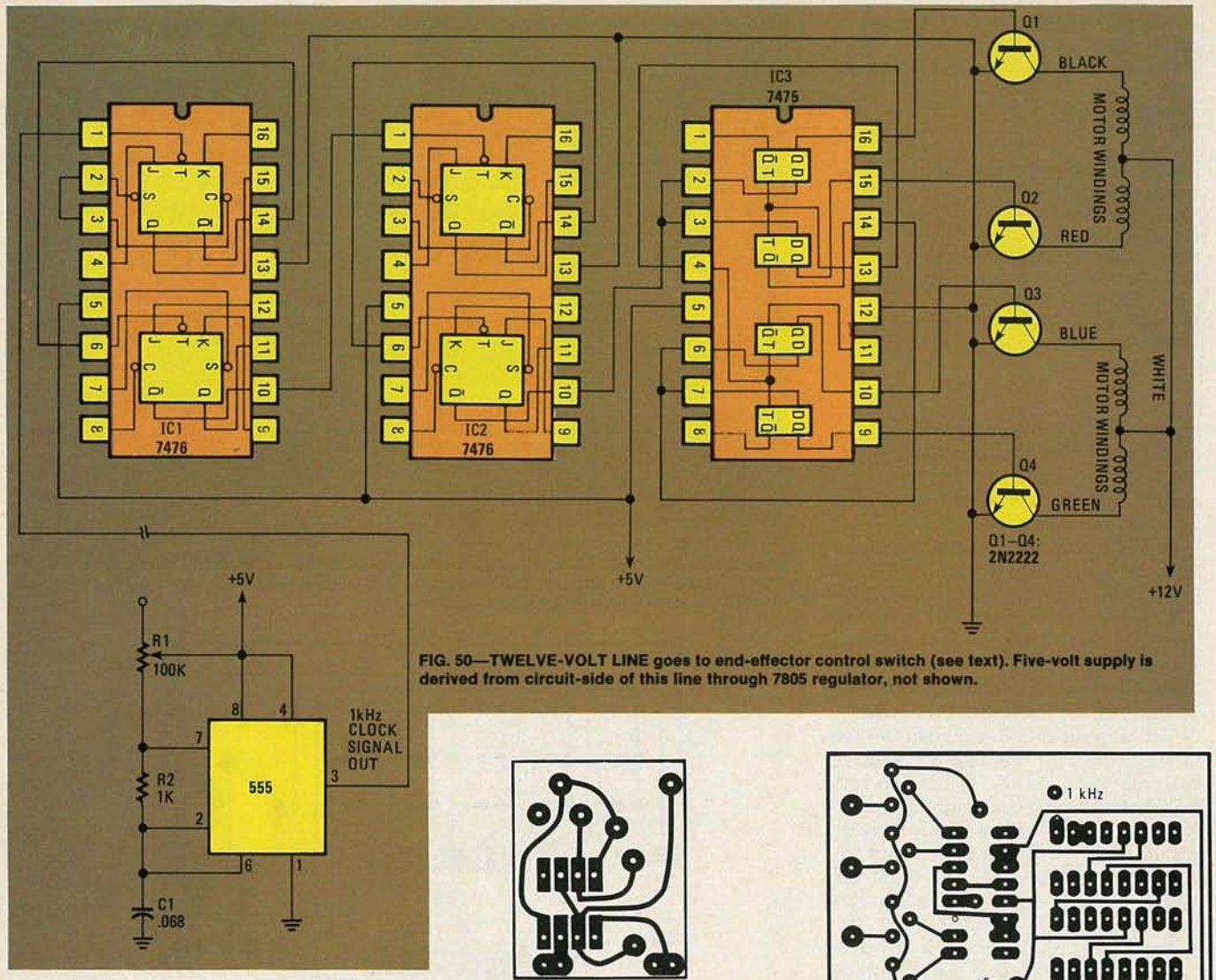


FIG. 50—TWELVE-VOLT LINE goes to end-effector control switch (see text). Five-volt supply is derived from circuit-side of this line through 7805 regulator, not shown.

FIG. 51—CLOCK-SIGNAL GENERATOR board for stepper motor controller.

FIG. 53—DIVIDER CHAIN AND LATCHES are located on separate PC board.

from the 12-volt supply by means of a dropping resistor, that method leaves itself open to fluctuations, depending on how much of a load the rest of the robot's electrical and electronic parts present to the battery at any given time. It's better to derive the five volts through a 7805 regulator, well heat-sinked to dissipate the heat generated in dropping the twelve volts to five The addition of an intermediate resistor to drop the 12 volts to eight would ease the load on the regulator.

Other TTL circuits will be described later and they, too, will benefit from a regulated five-volt power supply.

A twist-of-the-wrist

One of the options hinted at earlier in our series was an end-effector (hand) that could be rotated at the "wrist" to give an additional degree of freedom.

That "twist-of-the-wrist" end-effector uses the claw-type mechanism described in Part 2 (September 1980) but, rather than being firmly attached to the manipulator (arm), it is attached to the shaft of a stepper motor. A stepper motor is a motor whose shaft turns just a little bit each time an electrical pulse is applied to its windings.

Figure 50 shows a circuit that generates those pulses and drives the motor. The circuitry actually consists of two parts. The first, used to generate the pulses, is identical to the 555-IC section of the LED sequencer board, except for the values of R1 and C1, which are chosen to give an output of one kHz.

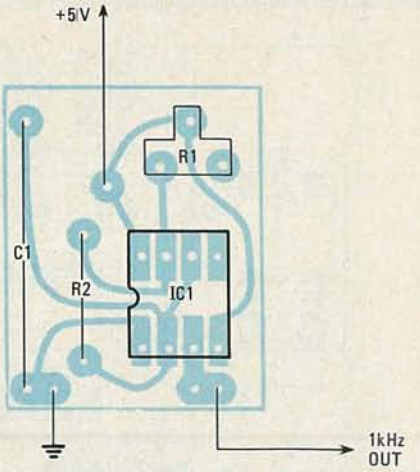


FIG. 52—INTEGRATED CIRCUIT, IC1, is a 555 timer (shown at lower-left in Fig. 50). One-kHz clock signal is fed to second PC board.

The second uses two 7476 IC's to divide that one-kHz signal by four (giving an output of 250 Hz), and that output is applied to a 7475 quad latch that feeds driver transistors Q1-Q4. Those transistors are connected so as to provide 12 volts to the four windings of the stepper motor.

Figures 51-54 show foil patterns and parts placement diagrams for the two-board circuit. The 12-volt and 5-volt (through a 7805 regulator, not shown) supplies are derived from the wiring to the solenoid of the end-effector mounted on the stepper motor's shaft.

PARTS LIST—STEPPER MOTOR CONTROLLER

All rsistors ¼ watt, 5%
R1—100,000 ohms trimmer potentiometer
R2—1000 ohms
Capacitors
C1—0.068 μF, 10 WVDC, any type
Semiconductors
IC1, IC2—7476 dual J-K flip-flop
IC3—7475 quad latch
IC4—555 timer
Q1-Q4—2N2222 or equivalent
Miscellaneous: 7805 voltage regulator with heat sink

PC boards for the above are available from PPG Electronics Co., Inc., 14663 Lanark St., Van Nuys, CA 91402. (213) 988-3525: Motor Direction Indicator and Stepper Motor Oscillator, $3.00 each, LED Flasher, $5.00, Stepper Motor Controller, $5.00. Please add $1.00 per order for shipping and handling. CA residents add 6% tax. MC and Visa accepted.

PARTS LIST—STEPPER MOTOR ASSEMBLY

Item	Size	Quantity	Supplier's part no.	Supplier
Stepper motor	12 VDC, 0.9°-step	1	Haydon 31612 or 31618, or equivalent	Ⓛ
Shaft	3/16-in. diam. × 1 inch	1		Ⓚ
Bearing	3/16-in. I.D.	2	B2-9	Ⓐ, Ⓑ
Gear	.593-in. diam., 36-T, 64 pitch, 3/16 I.D.	1	P64A19-36	Ⓐ, Ⓑ
Note: small mating gear comes with stepper motor				
Solid steel wire	20 gauge	5 inches		Ⓚ

SUPPLIERS

Ⓐ **The Robot Mart**
Room 1113
19 W. 34th St.
New York, NY 10001
($3.00 for catalog)

Ⓑ **Winfred M. Berg, Inc.**
499 Ocean Avenue
E. Rockaway, NY 11518

Ⓚ Local hardware or building supplies store

Ⓛ **Haydon Switch & Instrument, Inc.**
1500 Meriden Rd.
Waterbury, CT 06705
(Write for list of distributors)

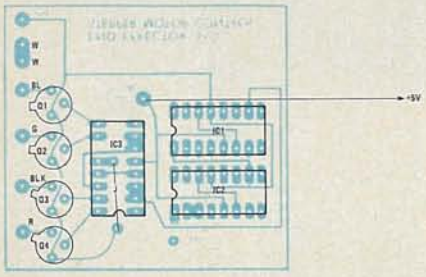


FIG. 54—COLOR CODES shown here should correspond with those on motor wires.

end-effector. The next time the circuit is activated, the end-effector closes again, but the wrist turns the other way.

The end-effector and wrist actions can be made independent of each other by the addition of another switch to the control console.

Several stepper motors that have been found to work well in this application are indicated in the parts list. The attachment of the motor to the robot's end-effector and manipulator is shown in Fig. 55. A

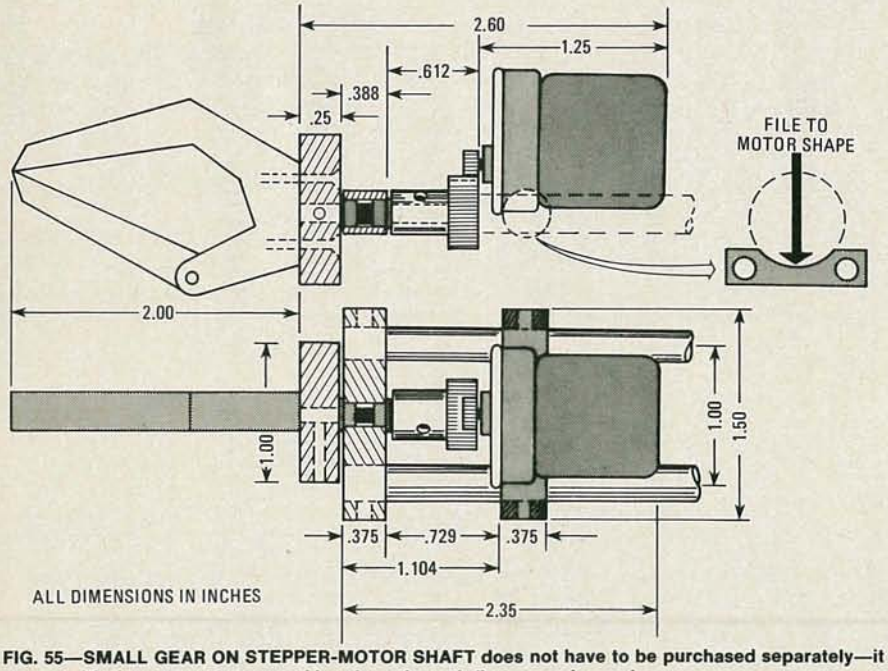


FIG. 55—SMALL GEAR ON STEPPER-MOTOR SHAFT does not have to be purchased separately—it comes with the motor. Note use of bearings through first cross-bar rod.

In practice, when the switch controlling that end-effector is thrown, the "hand" closes and the wrist begins to turn. Returning the switch to the "off" position stops the motor and opens the 9-T (nine-tooth), 64-pitch gear is mounted on the shaft of the stepper motor and drives a 36-T, 64-pitch gear attached to the end-effector mounting flange by means of a 3/16-inch diameter

FIG. 56—COMPLETED rotatable end-effector mounted on forearm shows modified connection to solenoid using solid steel wire.

shaft passed through two flange bearings in the end cross-bar rod. Not shown in the mechanical drawing is a hole bored through the axis of the shaft to pass the wire that operates the claw. Fig. 56 shows the assembled rotatable end-effector with the 20-gauge solid wire pivoted where it is attached to the solenoid to allow free rotation.

To mount the stepper motor and rotatable end-effector, the end cross-bar rod has to be drilled for the bearings and shaft, and the next cross-bar rod up should be filed to accept the shape of the motor. The motor is clamped and/or bolted to the arm assembly.

In the next installment, in preparation for radio- and computer-control, we'll describe motor-control circuits that operate from logic-level signals, and start making radio-control system. **R-E**

ALL ABOUT

UNIVERSAL

THE UNIVERSAL COUNTER/TIMER IS A new breed of test instrument, born of LSI (*L*arge *S*cale *I*ntegration) technology that makes it possible to include the essential central circuits on a single IC, in many cases. To be entirely fair, there were Universal Counter/Timers (or *UCT*'s for short) available before LSI made building them easy, but this is the first time that a number of units have been available for under $500.

The Universal Counter/Timer makes five basic kinds of measurements:

Frequency: In that mode, the UCT counts the number of selected signal transitions which are appearing at its primary input.

Period: In that mode, the UCT measures the time between successive signal transitions at its primary input. For example, the time between the rising edge of the input signal crossing a 0.5-volt threshold and the next time the input signal rose above 0.5-volt (see Fig. 1) would be displayed in the period mode. Although that might not correspond exactly to the classical explanation of period, it is proper by definition.

Event counter: In that mode, the UCT counts selected input signal transitions until manually "frozen" or reset.

Interval: In that mode, the UCT measures the time between the occurrence of a selected transition of an input signal at its primary input (which starts the measurement) and the occurrence of a selected transition of an input signal at its secondary input (which ends the measurement).

Frequency ratio: In that mode, the UCT counts the number of selected transitions that occur at the primary input between successive selected transitions that occur at the secondary input.

All that talk about selected signal edges or transitions is necessary because of the extensive input-signal conditioning that is provided for at one or both inputs. A *slope-selector* switch determines whether a positive-going transition (or *rising* edge) or a negative-going transition (or *falling* edge) will be used in any measurement. An *attenuator* is usually provided, usually offering factors of attenuation of one (unity), 10 and 100. Also since those inputs are usually DC-coupled, a *trigger level* control selects the threhold level at which the selected edge (rising or falling) is recognized by the counting circuits. The front panel of a typical UCT is shown in Fig. 2.

We will see that extensive input conditioning makes those delightful instruments all the more useful.

Let's take a look at some hints and tips and application notes to help us get all we can out of our UCT's.

Frequency counter

UCT's are not generally intended for high-frequency use, as they usually provide about a 10-MHz ceiling on their response as frequency counters. On the other hand, they are highly sensitive, offering input impedances on the order of 1 megohm.

Even with its sensitive, high-impedance inputs, a UCT can "pull" the frequency of an oscillator because of the capacitive effects of its connecting

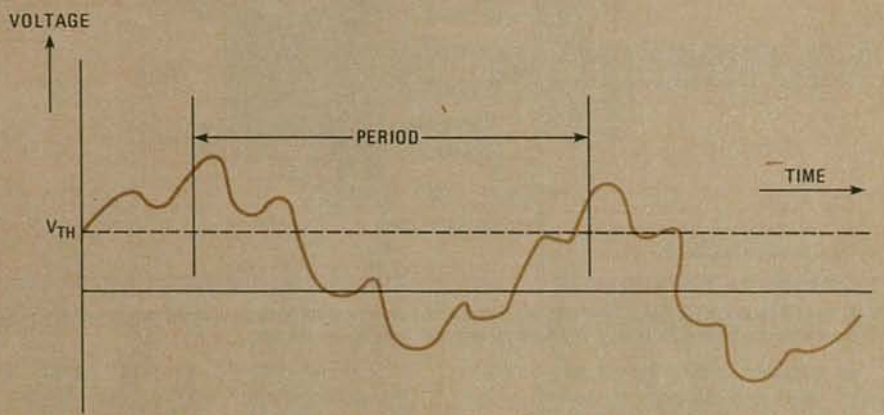


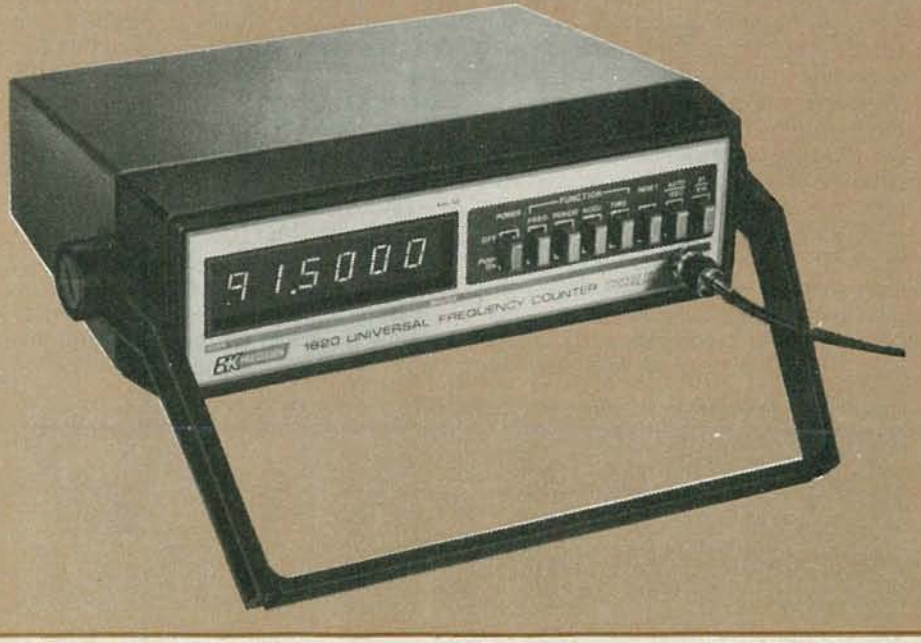
FIG. 1—PERIOD FUNCTION measures time interval between successive signal transitions. (In this example, threshold voltage V_{TH} defines the transition-point.)

COUNTER/TIMERS

DATA PRECISION MODEL 5845 (above) has a pulse-resolution of 15 nS. Low-pass filter maximizes noise-rejection when working with low frequencies.

MODEL 5001 UNIVERSAL COUNTER-TIMER (top of opposite page) from Global Specialties features two inputs, permitting one counting function to modify another.

AUTORANGING MODEL 1820 (below) from B&K Precision, Dynascan Corp. counts from 5 Hz to 80 MHz. Elapsed-time function can be remotely controlled.



When does a counter become a super counter? When it becomes a Universal Counter/Timer, capable of measuring and displaying the occurrence of events in several different ways.

MARTIN BRADLEY WEINSTEIN*

cable (if nothing else) and its input preamplifier.

A 10:1 oscilloscope probe (which, happily, readily mates with the BNC input connector usually provided) can minimize circuit loading and oscillator pulling. Better yet, measure the oscillator frequency after a stage or more of buffering instead of at the oscillator whenever possible.

If the oscillator is radiating, as in a transmitter, a short piece of wire—or a telescopic antenna—connected to the UCT may provide adequate coupling for reliable measurements. However, any *direct* connection of the UCT to the transmitter at its antenna can turn the works of both into slag before you can utter a four-letter word.

In many cases (video comes to mind), it may be important to match the UCT input impedance to that of the signal source with a 50-ohm, 75-ohm, 300-ohm or other termination. Because of the high input impedance of the UCT, a termination resistor can be applied directly to its input.

For fast, accurate measurement of very low frequencies, don't measure frequency. Instead, measure period (P), which is the reciprocal of frequency. F(MHz) = 1/P(microseconds); F(Hz) = 1/P(seconds). Keep your pocket calculator handy.

Using a microprocessor? Set your UCT up for a 2-volt threshold and your UCT can give you an exact peg on its clock frequency—which may explain why your cycle-counting software doesn't quite get its times right.

*At the time this article was written, the author was Director of Marketing for Global Specialties

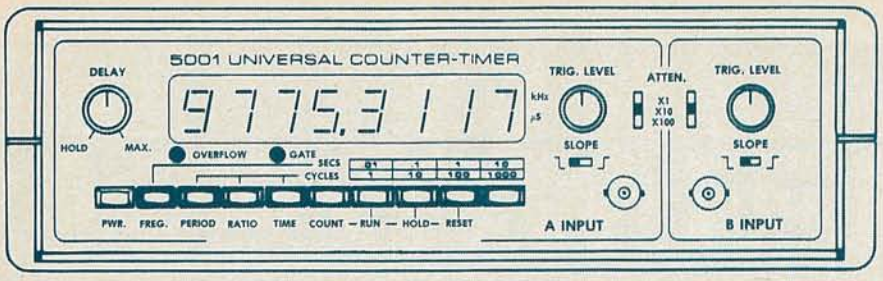


FIG. 2—TYPICAL UCT FEATURES are exemplified by front panel of Global Specialties' model 5001.

For additional accuracy, many UCT's offer multiple gate-times. The longer the gate-time, the longer the wait between display updates but the greater the resolution of the display.

Period measurement

Just as people tend to be either right-handed or left-handed, flip-flops tend to produce one very clean edge and one sloppy edge. And since flip-flops are the most common way that edges are processed in digital circuits (or gates that follow flip-flops—either way, one edge is lots cleaner), there will always be one edge at an output that gives better measurement results than does its opposite.

When the UCT measures frequency, there are lots of events being counted and generally very little noise-induced error, assuming that a non-critical trigger-level was selected. In the period mode, though, the input signal starts and stops the beat-counting of an internal clock.

To improve the odds, most UCT's provide the option of multiple-period averaging. That means they measure either 1 or 10 or 100 or 1000 periods (you decide) and position a decimal point appropriately to preserve the proper display units—seconds or milliseconds or microseconds or nanoseconds or whatever. Using a multiple-period average substantially reduces the susceptibility of measurement accuracy to noise present at the input.

We've seen that low frequencies are easy to measure by using period measurements instead of frequency measurements, and then performing a mathematical inversion. Now you can see why that is both a faster and more accurate technique.

In the frequency-counter mode, it would take 10 seconds to provide 0.1-Hz resolution in measuring a 110.4-Hz signal. But in the period-measurement mode, a 100-cycle average of 9057.971 microseconds is available in less than one second. Say the actual reading is 9057.946 microseconds: that tells us the actual frequency is 110.4003 Hz, which is three accurate digits better than we could do measuring frequency directly.

Want to know the exact speed of a movie projector? An indirect measurement using a UCT is both more convenient and more accurate than measurements of mechanical motion made directly. The units of measurement for a film projector are frames per second, which is called its frame rate. The frame rate of most projectors is usually 24. Most of the time, tweaking the speed is only done when things get really bad and Nelson Eddy starts sounding like Rocky the Flying Squirrel—but there are a number of places where precise speed is important.

Your UCT can make the measurement very accurately, as we know, using its period-measurement mode. With no film in the projector and with its motor running and lamp on, a photodetector can be tied to the UCT input to convert the flicker into a measurable signal, as shown in Fig. 3. Depending on the specifics of the detector, some degree of optical filtering, limiting, or shadowing may be desired.

A photovoltaic cell in parallel with a 10 K resistor can be connected to the UCT input directly. Or a phototransistor, photodiode, or photoresistor can be used with the conditioning circuit shown.

Time interval

The first point here is that multiple time-interval averages—available with most UCT's—accumulate errors. The period-measurement mode reduces errors when multiple periods are measured, but the multiple time-interval averaging mode accumulates them. Whenever possible, use the period mode. A device as simple as an OR gate (or flip-flop, or any convenient logic) between the signal coming in and the input to the UCT can often permit time-interval measurements using the period mode. If the time-interval mode is used (remember, a signal at the primary inputs starts the measurement, one at the secondary input completes it), expect some small variance between readings of identical intervals—that is an inherent error.

Nevertheless, tremendous accuracy and utility are available using the time-interval mode of the UCT. For example, it provides an excellent means of determining pulse parameters—especially pulse width, pulse spacing, pulse period, pulse repetition-rate, and pulse duty-cycle.

The pulses being investigated are fed to both the primary and secondary inputs of the UCT, and appropriate identical thresholds (trigger levels) selected. The selection of identical trigger levels at both inputs is important because it reduces errors due to pulse rise-and-fall-times. For a TTL-level pulse, for example, select a trigger level near 2 volts DC.

To measure pulse width, select the rising edge (using the slope-selector switch) at the primary input, the falling edge at the secondary input. To measure pulse spacing, select the falling edge at the primary input and the rising edge at the secondary input. The other pulse parameters can now be determined by simple calculations:

$$\text{Pulse period} = \text{Pulse width} + \text{Pulse spacing};$$

$$\text{Repetition rate} = \text{Pulse frequency} = \frac{1}{\text{Pulse period}}$$

$$= \frac{1}{\text{Pulse width} + \text{Pulse spacing}};$$

$$\text{Duty cycle} = \frac{\text{Pulse width}}{\text{Pulse period}}$$

$$= \frac{\text{Pulse width}}{\text{Pulse width} + \text{Pulse spacing}}$$

$$= \text{Pulse width} \times \text{Pulse frequency} \times 100.$$

Note that pulse period can be determined using the period-measurement mode of the UCT.

Time-interval measurements are also very important for any study involving rate, time, and distance, since any two of those can always be used to find the third. We'll take a look at the problem in terms of ballistics, but consider that it also applies to timing slot-cars, camera shutters, and lots of other interesting things.

Ballistics got its name because of the rifle balls and ball-shot originally studied—not to mention cannonballs. It's very important for an artilleryman to know where the next shot is going to land. The power charge, the characteristics of the gun, its azimuth and eleva-

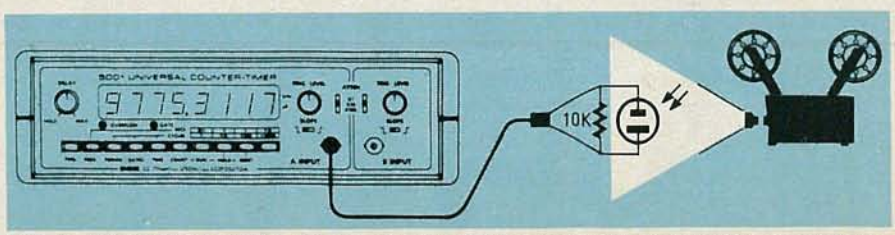


FIG. 3—PROJECTION RATE is determined using UCT to count pulses generated by photodetector.

tion, and the distance to the enemy are the only information real to him. So, to improve the odds, the science of ballistics emerged to make shooting-gallery instinct into hard mathematics.

Originally, an observer with a stopwatch and field glasses would watch as the ball hit a distant target—the distance to the target and the transition time told him what he needed to know.

The UCT helps apply the same principle over much shorter distances and a wider range of speeds, sizes...whatever. Something as simple as a pair of electrical contacts (for a conductive projectile) or a breakable (or frangible) conductor or a microswitch-type rollover (see Fig. 4) can be used where the path of the projectile is precisely known and its flight will not be disturbed by the act of opening or closing the contact.

Note that by using contact *openings* as the significant event (the rising-slope edge using the conditioning circuit shown), you can avoid the problems of contact bounce in most cases.

Even better, non-contact sensing can be used. Photoelectric beam-break arrangements are an excellent and inexpensive alternative to physical contact. Depending on materials, you may also want to look into Hall-effect magnetic sensors, photoreflective proximity detectors, etc. A typical photosensitive circuit that can be connected to the input of a UCT is shown in Fig. 5.

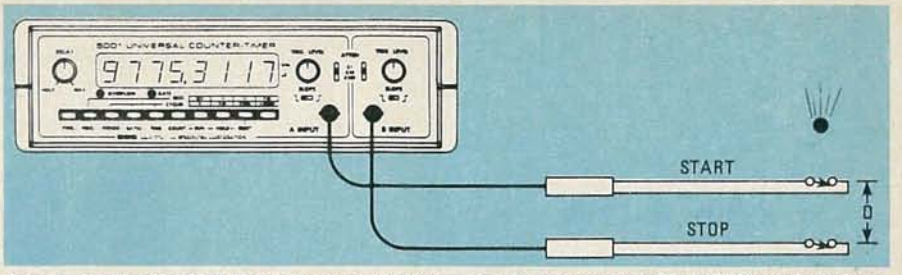


FIG. 4—TIME INTERVAL between opening of two switches can be applied in ballistics calculations.

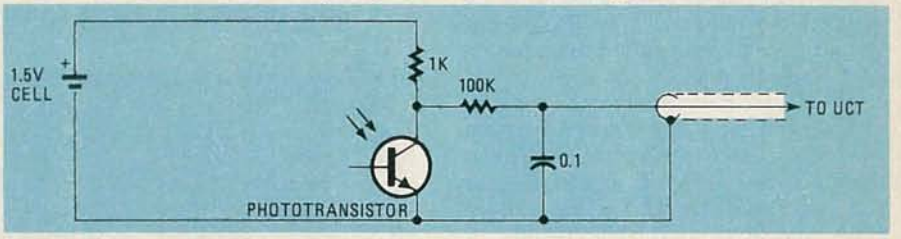


FIG. 5—SIMPLE CONDITIONING CIRCUIT provides clean pulses for input to Universal Counter/Timer.

Frequency ratio

Many times, the inputs for the UCT will come from transducers that measure real-world phenomena, like flow or rotation or weight or linear speed. The frequency-ratio mode lets you translate the input signals directly into digital displays in *standard* units—like gallons per minute, RPM, kilometers per hour, etc.

That *scaling* capability (also called *rescaling*) of the frequency-ratio mode happens because the secondary input behaves exactly like the gating circuit of a frequency counter. (Remember, frequency ratio counts the number of events at the primary input during a single cycle at the secondary input.) We *could* display frequency in Hz simply by using a one-Hz signal one-second cycle-period) at a secondary input; by substituting a different secondary-input frequency, we can make the display do all kinds of tricks.

For example, an encoding disk on a motor shaft might provide 1024 pulses per revolution. A 1024-Hz signal (1/1024-second period) at the secondary input makes the UCT display the actual motor speed in RPS (*R*evolutions *P*er *S*econd). Want RPM? Divide the secondary input frequency by 60 (1024/60 = 17.07 Hz).

Following these rules to determine the correct secondary input frequency:

1. Determine how many pulses you can expect for any event of interest, stated in the units you wish to see displayed. If you know how many pulses are delivered per pint, for example, multiply by 16 to find out how many pulses are delivered per gallon.
2. Express one second in the units of time you wish to see in your displayed reading. For example, 1/60th minute, 1/3600th hour, 1000 milliseconds, etc.
3. Multiply the pulses per event by the time units in seconds to determine the proper frequency to feed into the secondary input.

Event counter

Since the input of the UCT is voltage-responsive, a simple contact closure or

continued on page 100

UNIVERSAL COUNTER-TIMERS

B&K-Precision Dynascan Corp.
6460 West Cortland St.
Chicago, IL 60635

Model 1820
Frequency: to 80 MHz **Period:** 1 microsecond to 200 milliseconds
Interval: .01 to 9999.99 seconds **Event count:** to 999,999. **Price:** $300
CIRCLE 96 ON FREE INFORMATION CARD

Fluke Mfg. Co.
Box 43210
Mountlake Terrace, WA 98043

Model 1900A
Frequency: to 80 MHz **Period:** 1 microsecond to 200 milliseconds
Event count: to 999,999 **Price:** $345
CIRCLE 97 ON FREE INFORMATION CARD

Global Specialties
70 Fulton Terrace
New Haven, CT 06509

Model 5001
Frequency: to 10 MHz **Period:** 400 nanoseconds to 10 seconds
Interval: 200 nanoseconds to 10 seconds **Event count:** to 99,999,999
Frequency ratio: to 10 MHz at A, 2 MHz at B: **Price:** $360
CIRCLE 98 ON FREE INFORMATION CARD

Non-Linear Systems
533 Stevens Ave.
Solana Beach, CA 92075

Model RC-5
Frequency: to 10 MHz **Period:** 500 nanoseconds to 10 milliseconds
Interval: 250 nanoseconds to 10 milliseconds **Event count:** to 99,999;
Frequency ratio: to 10 MHz at A, 2.5 MHz at B **Price:** $144
CIRCLE 99 ON FREE INFORMATION CARD

NOISE

JOSEPH M. GORIN

THE GOAL OF HIGH-FIDELITY IS TO MAKE the listener feel as if the music is being created live in front of him. The state of the art is continually advancing towards that idealistic goal.

Sound is a mechanical phenomenon; the plucked string, the struck diaphragm of a drum, the resonance of human vocal cords—all send vibrations into the air. The ear picks up those vibrations, and we have true high-fidelity—a direct-to-ear non-recording. Unfortunately, that can only happen live and in only one place. To allow greater access to excellent, (and therefore rare) music, we record and broadcast it. In the process, it goes through changes in form from acoustical, to electrical, to magnetic (tape), to mechanical (discs), then back to electrical, to acoustical. By the time the music comes out of that complex system, it sounds different. The balance (frequency response) becomes changed by the system (especially the listening room). The music sounds flat because it's all coming from the speakers in front of you. The dynamic range (the ratio of the loudest to softest sounds) becomes squashed in the recording process. Unnatural noises are added. The illusion, though potentially very pleasing, could be much better and more realistic.

Although almost all of the problems induced in the chain described above are mechanically produced, there are electrical remedies available to the hi-fi or electronics enthusiast. Frequency balance can be restored with graphic equalization. The perceived relationship between the room and the listener can be changed with a rear-channel delay unit (ambience synthesizer). The dynamic range can be improved with a dynamic range expander. Surface noises on records, and hiss on tapes, can be reduced with a dynamically-variable noise filter. Of all those *signal processing* accessories, to my ears, the expander and filter provide the greatest increase in realism.

CARVER C-4000 autocorrelation preamplifier.

I will begin this four-part series of articles by explaining the principles of operation of dynamic range expanders and show how they have been implemented commercially. Next month, I will do the same with noise filters. The following two parts will contain a construction article on a combined expander/noise filter that you can build from scratch, or from a kit, for a fraction of the cost of an assembled unit.

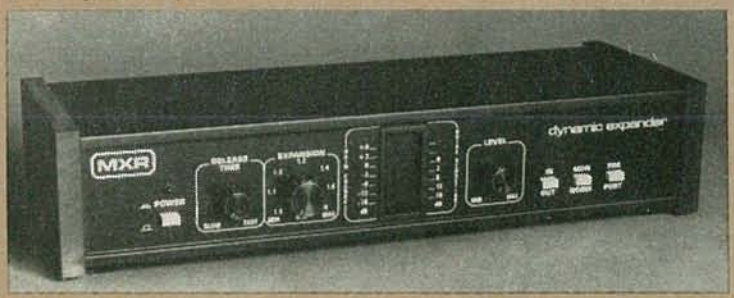
Why expand dynamic range?

Part of the excitement of live music (and part of the musician's intentions) lie in the range of loudness of the parts of the music. Expanding the dynamic range makes the loud sounds louder and the soft sounds softer. Most recordings are compressed intentionally so that the softest sounds are not obscured by the noise level of the recording medium (tape hiss and disc surface noise), and that the loudest sounds do not overload the medium. (In tape systems, an overload causes tape saturation and distortion; in discs, overload can mean a burned-out cutter-head, excessively-wide grooves, backcutting, or untrackable passages.) In radio broadcasting, compression is almost always applied to give the station a "louder, clearer" sound and to overcome road noise for the motorist-listener. Peak limiting is always available in the system to prevent illegal overmodulation. Those signal-processing activities are the reason that your favorite record almost always sounds better on your own turntable than on the strongest radio station in the area.

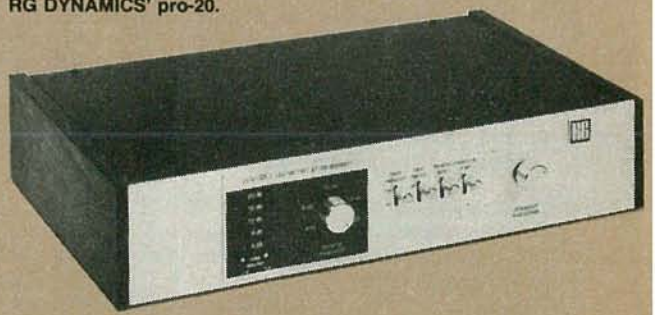
Another reason for compression and expansion is for noise reduction. If the noise is only audible for low-level signals, and the low-level signals are attenuated, then the apparent noise will also be attenuated. Thus, the compression applied to the recorded signal can be beneficial.

There are even signal sources that have not been compressed but which benefit from expansion. Live music is

MXR's dynamic expander.



RG DYNAMICS' pro-20.



REDUCTION TECHNIQUES

The music that comes out of the speakers of your sound system has usually been processed more thoroughly than cheese spread. The dynamic range expander provides one means of restoring much of the naturalness to your program material.

frequently compressed by the musician to overcome surrounding noise.

By restoring the dynamic range of music, noise filters and expanders (and especialy the combination) can create a dramatic improvement in your system—but beware; they are addictive!

How expanders operate

All expanders follow similar straightforward block diagrams with differing details of implementation. As shown in Fig. 1, the work of the expander is done by a device frequently called a VCA (*V*oltage-*C*ontrolled *A*mplifier), in which the gain is controlled by the voltage (or current) applied to the control terminal.

All the manufacturers of expanders (listed at the end of this installment) have differing implementations of the blocks shown in Fig. 1, each for its own reason. There are three main classes of expanders. First, we have the fixed expanders, as exemplified by the expansion portions of the Heath, Phase Linear, and Carver expanders. They use a conservative, fixed amount of expansion (7, 7.5, and 3.6dB, respectively) as a portion of their noise-reduction units. Then there are the variable expanders, such as those made by RG Dynamics. They have a variable amount of expansion, and often other controls for different parameters (input/output expansion-slope control, decay time, etc.). A third type is the expander portion of a compressor/expander system intended for noise reduction in tape systems, such as those manufactured by dbx, inc. That type is not optimized for single-ended use (playback of unencoded material) and is thus not applicable to the present discussion. Of course, the variable-type expanders are more flexible, more expensive—and easier to use to excess (too much expansion always sounds unnatural and too little expansion is of negligible value).

Channel coupling

Most expanders control the gain of both channels together. That reduces the cost of the control circuitry by not requiring two of everything; also, it assures that, regardless of the instantaneous amount of expansion, an instrument placed between the two speakers

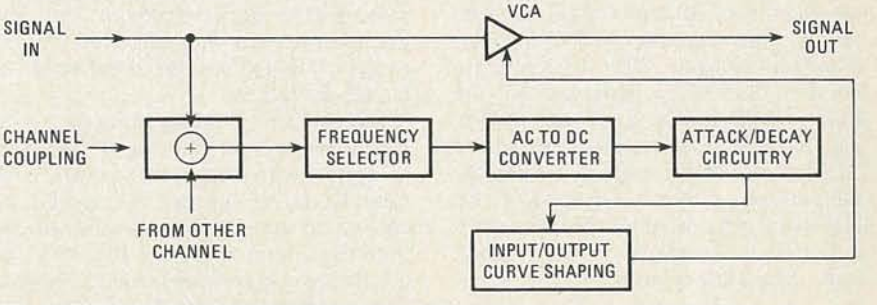


FIG. 1—DYNAMIC RANGE EXPANDERS use a VCA to "ride gain" on the incoming signal.

RG-2 dynamic processor from Pioneer.

MODEL 1BX from dbx.

will not "wander around" because the ratio of its level in each channel will remain constant. If the channels are independent, a strong signal in the left channel can raise the gain of that channel and "pull" a center-stage instrument. Also, if a single instrument is "panned" across the stage, the increased expansion on the dominant side causes an effect very much like increased separation. An advantage of independent channels, though, is that a loud signal in one channel will not change the noise level in the silent channel—an effect that will most likely be noticed only on headphone listening to multi-track recorded music.

Frequency selection

The frequency-selection filter determines which signals affect the expansion most. All the filters attenuate rapidly below 30 Hz to reduce the effect of rumble and other subsonic information. Filtering ultra-sonic signals is also desirable in order to remove FM pilot tones, tape-bias oscillator interference, and other non-musical signals. Typically, however, those are at a very low level and some manufacturers elect not to filter the high end. Besides such obvious criteria, however, there are a number of schools of thought on the shape of the frequency-selection filter. The dbx people are of the broadband school and they suggest that a long, sustained tone will be undesirably modulated by music of changing frequency (but not amplitude) if the frequency filter is not flat. Of course, that situation does not occur often, and it would be hard to detect in an expander of subtle operation (low slope of expansion). Moreover, most musical instruments vary their amplitude with each note. Robert Grodinsky, who designed the products of RG Dynamics, as well as Pioneer's RG-1 (recently updated to the RG-2), believes that the filter should be sensitive to the frequencies where most musical harmonics lie. That will allow more gain when the compressed source is supposed to be loud (lots of harmonics) than when it is soft (fewer harmonics), thus giving more accurate expansion.

AC-DC conversion

Almost all the expanders use precision full-wave detectors to convert the level of the AC signal to a DC signal suitable for expansion control. A typical circuit is shown in Fig. 2. An explanation of that circuit appears in the February 1980 issue of **Radio-Electronics.** (See "Audio Power Level Meter.") Interested readers are referred to the detailed explanation that is given there. The device is termed "precision" because it is extremely insensitive to the parameters of the diodes, since they are in the feedback loop of the operational-amplifier IC1. The detector is full-wave because it responds identically to peaks of either polarity. That is important if the expander is to respond to rapid asymmetric signals (almost all audio signals are highly asymmetric). The Carver preamp is the only expander to be of the non-precision (passive) half-wave type. At dbx, they use a combination full-wave detector and RMS (*R*oot-*M*ean-*S*quare) detector.

Attack/decay circuitry

A typical attack/decay circuit is shown in Fig. 3. Voltage V_{IN} is the output of the detector. If a large, fast transient comes along (and music is full of such signals), capacitor C1 will charge up rapidly to a voltage close to the peak value through D1–R2. (Diode D1 is often enclosed in a feedback loop for precision.) Even if the signal is removed, however, C1 must discharge through R1, which is much larger than R2 and allows only a slow discharge rate. That is desirable because the initial edge of a transient should be expanded for enhanced impact. (It is also very likely to have been compressed.) The ear, fortunately, cannot sense the presence of noise immediately following a high-level passage of music, and thus doesn't mind a slow decline in gain. The slow decline prevents the gain from varying rapidly enough to be unpleasant or cause distortion.

RG Dynamics has a special circuit for attack/decay shown in Fig. 4, and used in series with the more conventional type. In that circuit, R2, R3, and C1 are chosen so that C1 charges more slowly than the circuit shown in Fig. 3. Thus, C1 charges up on longer loud passages. Then, at the end of such a passage, the gain declines slowly (about four seconds) so that the reverberant characteristics of the concert hall in which the recording was made are not obscured. If the loud passage is not very long, neither C1 nor the reverberant field of the hall will be expanded. The diode isolates that circuit from the normal path through R1.

The dbx *model 1BX* also has a special auxiliary circuit that is shown in Fig. 5. It is designed so that a short high-level signal will charge up C1, but not C2; and when the signal dies down, the gain returns to normal (determined by the voltage on C2) rapidly. However, a long, high-level passage will charge up C2, and the gain will decrease slowly because the value of C2 is large (seven times as large as C1). That allows expansion of percussive sounds without varying the expansion of the underlying long-term signal.

Input/output curve shape

In most designs, the shape of the expansion curve (expansion vs. input level) is determined by the implementa-

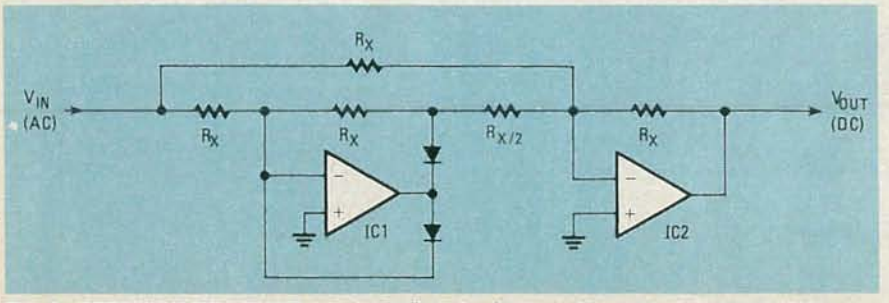


FIG. 2—PRECISION FULL-WAVE detector is first step in generating control signal for VCA.

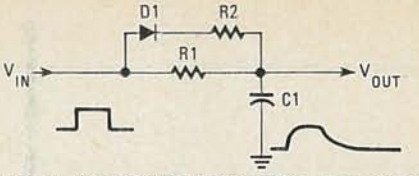


FIG. 3—ATTACK/DELAY CIRCUIT discharges "slowly" to compensate for effects of compression.

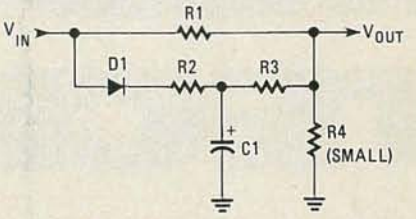


FIG. 4—CIRCUIT USED BY RG DYNAMICS offers longer decay time to long, loud passages.

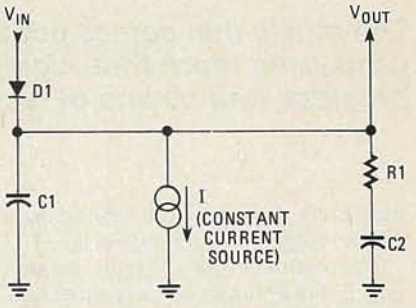


FIG. 5—TWO-STAGE attack/delay circuit is used by dbx for greater flexibility.

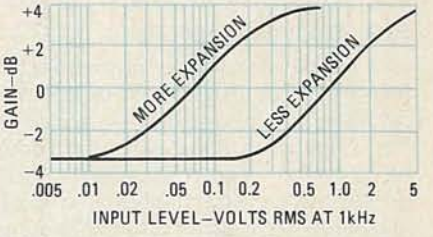


FIG. 6—SLOPE OF EXPANSION should be kept to a minimum to avoid rapid changes in volume.

tion of the other blocks of the circuit, although special shaping circuits can be constructed easily. All the expanders, except the Carver unit, have relatively straight slopes of expansion vs. level. An example is shown in Fig. 6. A slope should be as shallow as possible, because that minimizes audible gain changing. Also, a modest-size total variation in maximum to minimum gain is desirable for good noise reduction. The way to get the greatest variation with the smallest peak slope is with a straight line. The shape of that curve is probably the designer's most basic tool; the shallower it is, the less audible any possible side effects will be. (For example, "breathing", where changes in gain when signals are small cause audible variations in the noise level, and "pumping", where changes in the gain are obvious.)

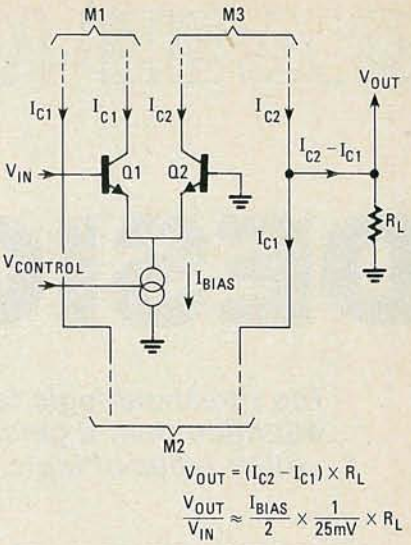


FIG. 7—CURRENT MIRROR PRINCIPLE is illustrated in CA3080 transconductance amplifier.

Voltage-controlled amplifiers

The work of an expander is done by the voltage-controlled amplifier (VCA). Most of the units described use a "transconductance" technique, as shown in Fig. 7. That is typified by RCA's CA3080 operational-transconductance amplifier. A control voltage changes the bias current to differential pair Q1–Q2. The collector current of Q1 goes through current mirrors M1 and M2 (a current mirror "reflects" the input current to its output), and the collector current of Q2 is reflected by M3. The gain of that circuit is due to the transconductance (the ratio of I_{OUT} to V_{IN}) of Q1–Q2 times the load resistance, R_L. Since the transconductance of Q1–Q2 is proportional to I_{BIAS}, the gain is easily controlled.

The drawback of that, and all other VCA's, is that the control element has to be non-linear and it therefore generates distortion. In addition, it will be noisy. (If it were perfectly quiet, the input signal level could be lowered so that the distortion could be dramatically reduced.) The Carver preamp varies the bias on diodes to vary their impedance and change gain, and the Phase Linear 1000 uses FET's as voltage-variable resistors.

Now that you know about what expanders do and how they do it, I expect that you will find my implementation of an expander you can build very interesting. Next month, we will discuss the varied world of dynamic noise-filters. **R-E**

ADDRESSES OF MANUFACTURERS

Carver
C-4000 Preamplifier—$900
P.O. Box 664
Woodinville, WA 98072
CIRCLE 88 ON FREE INFORMATION CARD

dbx, inc.
1BX—$260
71 Chapel Street
Newton, MA 02195
CIRCLE 89 ON FREE INFORMATION CARD

Heath
AD-1304*—$200 Kit
Benton Harbor, MI 49022
CIRCLE 90 ON FREE INFORMATION CARD

MXR
Dynamic Expander—$300
247 N. Goodman Street
Rochester, NY 14607
CIRCLE 91 ON FREE INFORMATION CARD

Phase Linear
1000 Series II*—$400
20121 48th Ave. West
Lynnwood, WA 98036
CIRCLE 92 ON FREE INFORMATION CARD

Pioneer
RG-2—$200
85 Oxford Drive
Moonachie, NJ 07074
CIRCLE 93 ON FREE INFORMATION CARD

RG Dynamics
PRO-16—$300
Skokie, IL 60076
CIRCLE 94 ON FREE INFORMATION CARD

SSS
ASRU**—$100 Kit
912R Knobcone Place
Loveland, CO 80537
CIRCLE 95 ON FREE INFORMATION CARD

* Includes dynamic noise filter—see next month's article.
** This unit is the final subject of this article series.

MANUFACTURERS OF EXPANDERS

Manufacturer	Channel Coupling	Frequency Selection	Attack/ Decay Circuits	Expansion Fixed Variable	VCA Technique	Features
RG Dynamics	Partial	Midrange "harmonic"	See Text	Variable	Transconductance RCA CA3080	Max. expansion, slope both variable.
MXR	Together	Wideband w/high-treble emphasis	~1.5mS/ variable decay	Variable	Transc. Signetics NE571	User variable decay time.
dbx, inc. 1BX	Together	Wideband	See Text	Variable	Transc. Custom dbx circuit.	
Pioneer RG-2	Partial	Midrange	Similar to RG Dynamics	Variable	Unknown	
Phase Linear 1000 Series II	Independent	1.5 kHz and up	Currently being changed.	Fixed—7.5 dB	JFET variable resistor	
Heath	Together	Midrange	.3 mS/300 mS for large changes	Fixed—7 dB	Transc. CA3080	
Carver	Together	70 Hz-2.8 kHz low-level; wide-band high-level.	30 sec/.25 sec low-level; .7 mS/180 mS high-level	Fixed—3.6 dB	Diode dynamic resistance	
SSS	Together	Midrange	.3 mS-150 mS for large changes	Fixed—9 dB	MOSFET variable resistors	

DESIGNING With

The threshold-logic family is a relatively unknown one that deserves more attention than it gets. Among its characteristics are the ability to emulate other types of logic gates and to make decisions based on the number of inputs at a given logic level.

JOHN E. CUNNINGHAM

HOW WOULD YOU LIKE A SINGLE INtegrated circuit that could perform all of the logic-gating functions that you have ever heard of, as well as a few that you have probably never heard of? How would you like a gate that would tell when the majority of the inputs assumed a certain state without regard as to which inputs were involved?

Not only can you get such a gate but you can get two of them in a single dual-in-line package which sells for a low price. It is the type MC14530 Majority Logic Gate, made by Motorola.

That IC has been available for several years, but for some reason it seems to have escaped the notice of most experimenters and technicians.

Majority logic is actually a branch of a more general class of logic known as *threshold* logic. Threshold logic is analogous to the response in an animal or human nervous system where the response seems to be based on whether or not a stimulus crosses over a certain threshold. As such, it has been known for many years but has never enjoyed widespread application.

What is majority logic?

Figure 1 shows a sketch of a majority-logic gate. It has five inputs and the output is high whenever any three or more of the inputs are high. It doesn't matter which of the inputs is high—any three will do.

Figure 2 shows a block diagram of the MC14530 Dual 5-input Majority Logic Gate, together with its pin connections. The device is available in a 16-pin dual-in-line plastic package. The electrical ratings are given in Table 1.

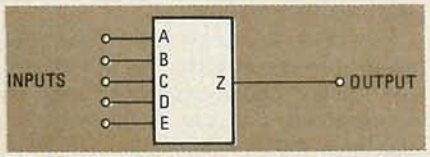


FIG. 1—WHEN the majority of the inputs (A-E) assume a given logic level, so does the output (Z).

That IC uses CMOS technology and therefore, draws very little current. It can easily be battery-powered. It has the typical CMOS high-noise immunity and can be used in environments where the electrical noise level is high. Like all other CMOS devices, the IC is susceptible to damage from static charges, but it does contain circuitry to protect its inputs.

As shown in Fig. 2, each half of the MC14530 consists of a majority gate of the type shown in Fig. 1 followed by an EXCLUSIVE NOR gate. One input of the latter is brought out to a pin.

The function of the EXCLUSIVE NOR gate is to invert the output of the majority gate by means of a signal applied to input W (pin 6). Thus, if input W is tied to a logical high level, the circuit of Fig. 2 will be a 5-input majority gate. Its output will be high whenever any three or more of the inputs are high. On the other hand, if we connect input W to a logical low level (ground), the circuit will act like what we might call a "*minority*-logic gate." The output will be *low* whenever three or more of the inputs are high. The truth table for the EXCLUSIVE NOR gate is shown at the

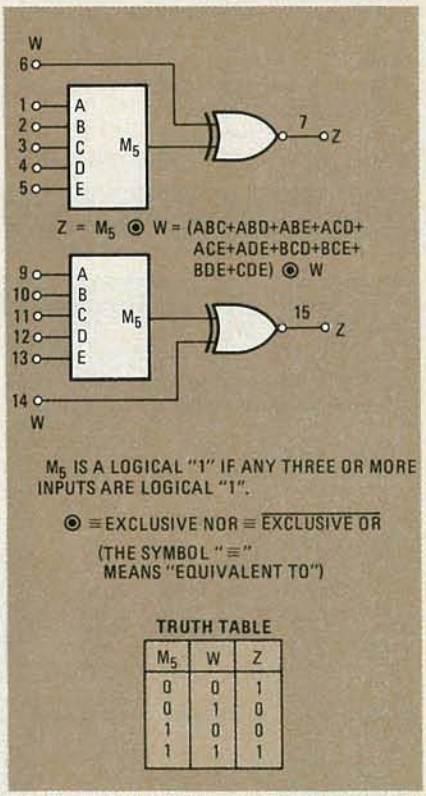


FIG. 2—THE MC14530 consists of two 5-input majority-logic gates, each followed by a NOR gate.

TABLE 1

MAXIMUM RATINGS (Voltages referenced to V_{SS}, Pin 12)

RATING		SYMBOL	VALUE	UNIT
DC Supply Voltage	MC14530AL MC14530CL/CP	V_{DD}	+18 to −0.5 +16 to −0.5	VDC
Input Voltage, All Inputs		V_{in}	V_{DD} to −0.5	VDC
DC Current Drain per Pin		I	10	mADC
Operating Temperature Range	MC14530AL MC14530CL/CP	T_A	−55 to +125 −40 to +85	°C
Storage Temperature Range		T_{stg}	−65 to +150	°C

MAJORITY-LOGIC

TRUTH TABLE

INPUTS A B C D E	W	Z
FOR ALL COMBINATIONS OF INPUTS WHERE THREE OR MORE INPUTS ARE LOGICAL "0"	0	1
	1	0
FOR ALL COMBINATIONS OF INPUTS WHERE THREE OR MORE INPUTS ARE LOGICAL "1"	0	0
	1	1

FIG. 3—OUTPUT STATE of the NOR gate is determined by the status of "W" and of the five inputs.

bottom of Fig. 2. Figure 3 shows the truth table for the circuit shown in Fig. 2.

There is no reason why a majority-logic gate must have five inputs. We can easily connect it to act as a 3-input majority gate as shown in Fig. 4. When the gate is connected as shown in Fig. 4-a with input W high, the output Z will be high whenever any two of the three inputs A through C are high. With pin W low, as shown in Fig. 4-b, the output will be low whenever any two of the three inputs are high.

FIG. 4—TYING ONE OF THE five inputs high and one low leaves a 3-input majority-logic gate.

Simulating conventional gates

The MC14530 IC can be used not only as a majority-logic gate, but it can also be made to behave as a 2- or 3-input OR, NOR, AND, or NAND gate. Figure 5 shows how connections are made to make the device behave like any conventional 3-input gate. All that is required is that two of the inputs be permanently connected to predetermined levels. For example, in Fig. 5-a, two inputs are permanently connected to a high-logic level. Now, inasmuch as any two of the five inputs are already high, if any of the remaining inputs go high the output will go high. That is exactly how a 3-input OR gate behaves, so our circuit will behave like a 3-input OR gate.

In Fig. 5-b, input W is connected to ground. That, as we saw earlier, inverts the output so the circuit will now behave like a 3-input NOR gate.

In Fig. 5-c, two of the five inputs are tied to ground. The only way the output can go high is for all of the remaining inputs to go high. That is exactly what happens in a 3-input AND gate. To turn the circuit into a 3-input NAND gate, simply tie input W to ground as shown in Fig. 5-d.

Now we have ways to make the basic circuit behave like any 3-input logic gate. We don't have to stop here. We can also make it behave like any 2-input gate. The connections are shown in Fig. 6.

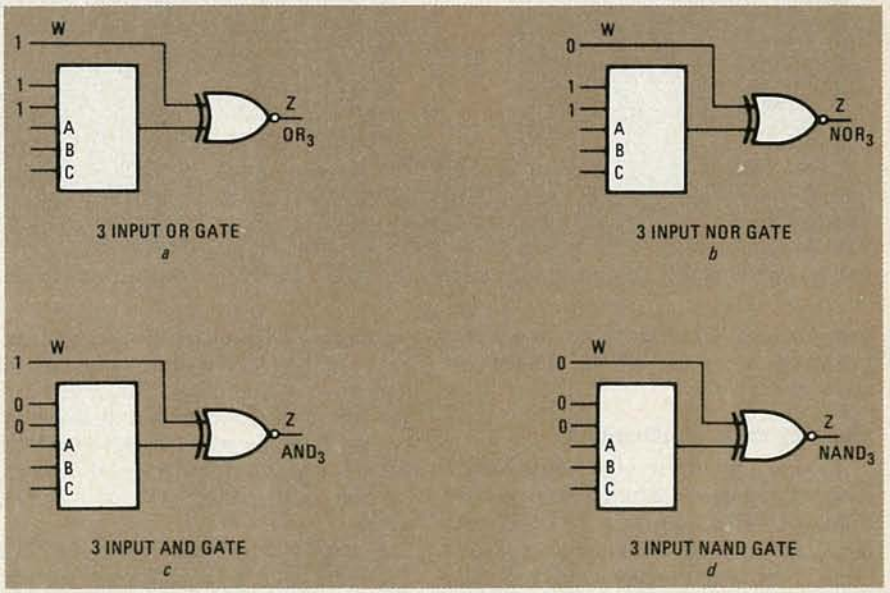


FIG. 5—VARIOUS 3-INPUT logic gates can be formed from a 5-input majority-logic gate.

In Fig. 6-a, we have simulated a 2-input OR gate by tying two inputs permanently high and grounding another input. If either of the remaining inputs should go high, the output will go high. Thus, we have a 2-input OR gate. To make it into a 2-input NOR gate all we have to do is to ground input W, as shown in Fig. 6-b.

In Fig. 6-c, we have simulated a 2-input AND gate. Here we have tied two of the inputs low and one of them high. The only way the output can go high is for the remaining two inputs to go high. That, of course, is the AND function. Again to convert the circuit into a NAND gate, all we have to do is to ground input W as shown in Fig. 6-d.

Since the logical function of the gates shown in Figs. 5 and 6 is determined by the logic levels applied to some of the pins, we can change the function of a

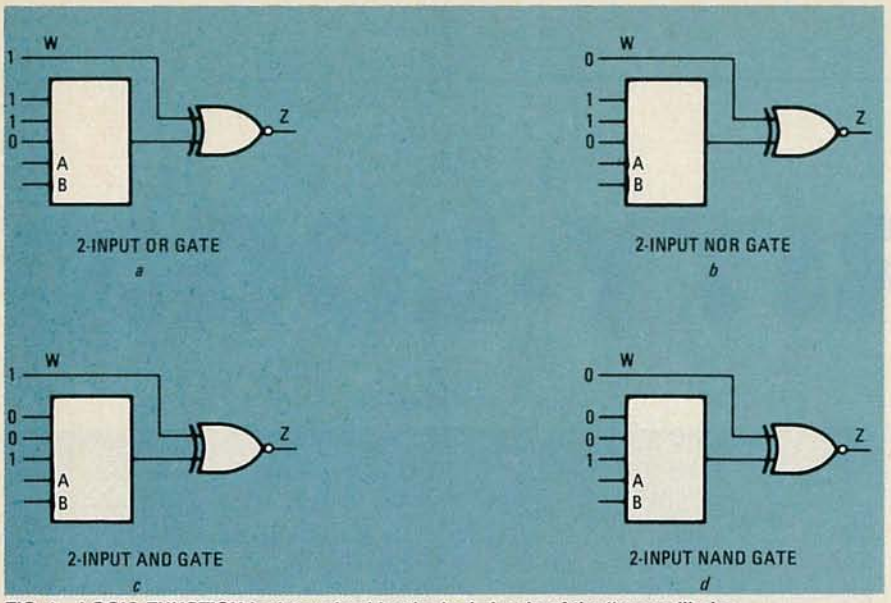


FIG. 6—LOGIC FUNCTION is determined by the logic levels of the "unused" pins.

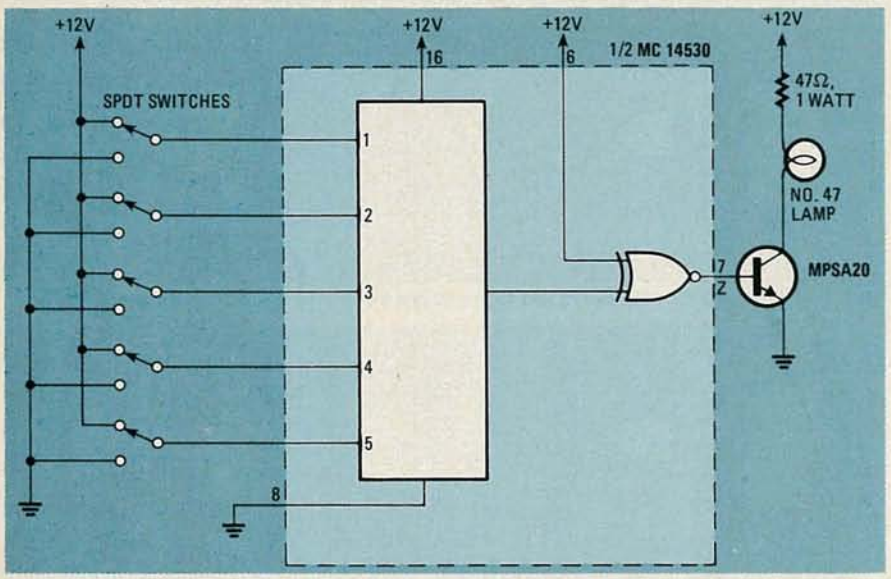


FIG. 7—THE PRINCIPLE OF majority logic is easily applied to a vote where a simple majority rules.

gate while it is in the circuit by simply changing the logic levels applied to those pins.

Majority-logic applications

To make good use of majority logic, most of us have to adopt a new way of thinking. When we think of logic systems and digital circuits, we usually think in terms of the more conventional OR, NOR, AND, or NAND gates. We don't think in terms of majority gates, simply because we haven't been exposed to them.

Many logic-circuit problems can be solved easily using majority logic. Figure 7 shows a secret voting machine for five voters. Each of the voters has a single-pole double-throw switch. When the switch is in the up position it connects one of the inputs of the logic gate to a high logic-level. When the switch is in the down position it connects the input to a low logic-level. Whenever the majority of the voters set their switches to a high position, the output of the logic gate will go high. Thus, we know that the majority have voted that way, but we have no way of knowing which three (or more) of the five did. The circuit also has possibilities as a simple game.

Figure 8 shows the application of a majority gate to a foolproof security system. One of the most annoying features of intrusion alarms is that they can be tripped by things other than an intrusion, such as failure of a component. The result is false alarms that are annoying and sometimes even dangerous.

The circuit of Fig. 8 minimizes the probability of a false alarm by requiring two out of three instrusion dectectors to be tripped before the alarm will sound. Any type of intrusion detector may be used with the system; all that is required is that the output of the alarm

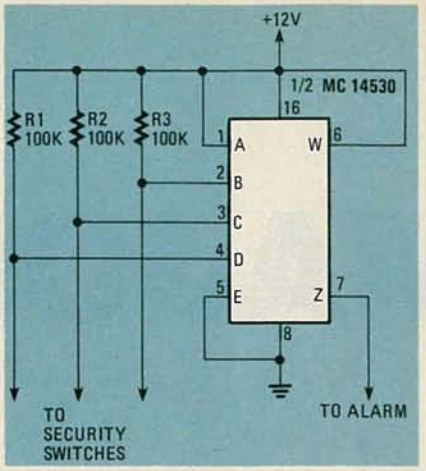


FIG. 8—"FOOLPROOF" SECURITY SYSTEM requires that more than one alarm device be tripped.

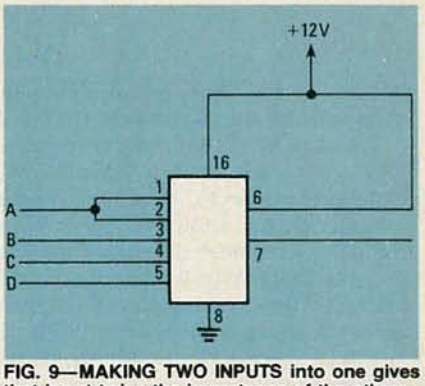


FIG. 9—MAKING TWO INPUTS into one gives that input twice the importance of the others.

be a switch or relay that keeps the output grounded until an intrusion occurs. The intrusion detectors are arranged so that normally an intruder will trip all three upon entering the protected area.

The circuit of Fig. 8 is a 3-input majority gate. The output will go to a high state whenever any two of the input circuits is opened. Thus, if one of the intrusion detectors should fail, it will not cause a false alarm. Similarly, an intruder who skillfully avoids tripping one of the alarms, will sound the alarm upon tripping the other two.

Weighting an input

Another interesting feature of the majority gate is that an input can be "weighted" or made more important than the other inputs. Figure 9 shows a circuit where input A is weighted so that it is twice as important as the other inputs. That is accomplished by simply connecting input A to two of the input pins of the gate.

The output of the circuit of Fig. 9 will go high when inputs B, C, and D go high, or when input A and any one of the other inputs go high. Thus, as far as the circuit is concerned, input A is twice as important as any of the other inputs.

A circuit of that type can be used where one part of a system, such as an intrusion alarm; is more reliable than other parts. **R-E**

ELECTRIC BILLS TOO HIGH? GET A

watt saver™

National Aeronotics and Space Administration Patent #4,052,648

Advanced-design Power Factor Controller cuts the cost of running electric appliances by as much as 40%! See for yourself—try it for 60 days!

If you think your electric bills are high **now**, brace yourself. They'll be even higher next year, and for years to come—even if your use of electricity remains constant—due to utility company rate increases.

Right now, it's probably costing you $120 to $160 a year to run a refrigerator ...about $130 for a freezer...and other outrageous sums to power your attic fan, washing machine, sump pump, electric typewriter and/or trash compactor. Even a gas clothes dryer uses expensive electricity (to rotate the drum).

So it makes a lot of sense to use a lot less electric power. And now you can do just that—**without** cutting down on your use of electric appliances!

INTRODUCING THE WATT SAVER

Our exclusive new Watt Saver is based on an invention developed and patented by the National Aeronautics and Space Administration. "The NASA/Nola power saver," wrote a **Popular Science** senior editor, "was developed by Frank Nola at NASA's Flight Center in a program to reduce power consumption in spacecraft motors. Nola calls it a PFC—power-factor controller. I prefer to call it a power saver, however, because that's what it does."

NASA TESTED IT

According to NASA documents, "The device has been tested at Marshall Center on over 40 types of motors, with power savings ranging up to 60%, depending on the loading. The motors tested were both single-phase and three-phase, ranging from ½ H.P. to 5 H.P. Most motors will show up to 40-50% savings when running lightly loaded or unloaded, and some will show 5-to-7% savings at rated load."

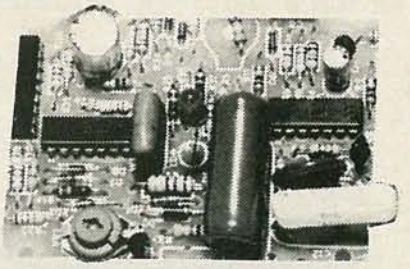
NASA's Technical Support Package showed that "The Power Factor Controller applies to induction type electric motors—the most commonly used type in all major home appliances and the most commonly used in industry." Such as those in refrigerators, freezers, washing machines, dishwashers, trash compactors table saws, drill presses, electric typewriters, gas dryers (without electric ignitors), fans, grinders, food processing machines, lathes and various types of pumps (e.g., heat, sump, swimming pool).

HOW IT SAVES POWER

Popular Electronics explained it this way: "AC induction motors characteristically run at a nearly constant speed that's fixed by power-line frequency and independent of load and supply voltage. When heavily loaded, the motor draws line current that is nearly in phase with the applied voltage....Under light load conditions, the motor develops less torque by allowing more lag between the voltage and the current. This reduces the power factor while leaving the current essentially the same in magnitude." (The wasted power is given off as heat.)

"To minimize this waste, Nola's device monitors the motor's power factor, and when it detects light load conditions, it reduces the supply voltage....The current, now more nearly in phase with the voltage, therefore does as much useful work as before, but it and the voltage are smaller, resulting in a net savings of electric power."

Besides saving power, the Watt Saver also allows motors to run cooler—which lengthens their life—and quieter.



Inside the Watt Saver: electronic components work automatically, microsecond by microsecond, to make sure an electric motor receives no more voltage than what's needed to handle the load at any given instant...to save you money!

IT'S SIMPLE TO USE

The Watt Saver—made in the U.S. under license from NASA—is housed in a sturdy metal case (just 5¼"W x 3"H x 2"D) with an electrical outlet and a 2-foot cord. Simply plug the cord of your appliance into the Watt Saver, then plug the Watt Saver's cord into any electrical outlet. You can move the Watt Saver to various locations as needed or, better yet, get two or more.

(For air conditioners, order the wired-in model and if you are electrically inclined no electrician is necessary to connect it.)

Whenever the appliance is used, the Watt Saver goes to work instantly. There are no buttons to push, no gauges to watch. The Watt Saver works automatically, to reduce the amount of electric power used and (therefore) to reduce your electric bills—**without** reducing the efficiency of your appliances!

LOW COST—AND A TAX CREDIT

Although we're the only company in the world offering the Watt Saver, the cost is modest—only **$39.95** for the 110V, 15-amp model that handles motors up to and including 1 H.P. Want two? They're just **$37.95** each. Or splurge and get three at **$34.95** each. Specify plug-in or wired-in models.

We also offer a 220V, 15-amp model for motors up to and including 2½ H.P. The price is **$49.95** for one; **$47.95** each for two or more. Specify plug-in or wired-in.

No matter which model you order or how many units you order, the postage/handling charge is just $2.50 per order.

And next year, when you fill out your tax return, you can deduct a 15% energy tax credit—for additional savings.

60-DAY MONEY-BACK GUARANTEE

Try the Watt Saver for as long as 60 days. If not completely satisfied, return it (insured) for a full refund.

Naturally, the sooner you send for the Watt Saver, the more you can save on your electric bills. So order today. Send your check or money order to the address below. Or charge it to your Visa, Master Card, Diners Club or Carte Blanche account. If using your credit card, you can order via our toll-free number:

800-526-2801

If it's busy, or no answer, call our other toll-free number:

800-257-7850

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

Or mail your order to:

NATIONAL SALES GROUP
MERCURY
THE IMAGINATION PEOPLE®

Dept. RE-1, 404 Madison Avenue
Lakewood, N.J. 08701
201-370-0446

hobby corner

A look at another easy way to make circuit boards.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

IN THE AUGUST 1980 ISSUE, WE DISCUSSED the *E-Z Circuit* adhesive meterials for making "instant" PC boards. You know that I am impressed with that system, produced and distributed by Bishop Graphics (P. O. Box 5007RE, Westlake Village, CA 91359). This month I want to be sure that you know about two more PC systems that are also covered in their EZ-102 manual/catalog.

The first is called *Cut 'N' Peel*. It is nothing more than a board with a special copper covering. To use *Cut 'N' Peel,* you must first sketch the circuit on the copper. Then, unwanted copper is cut with an *X-acto* or other very sharp knife and simply peeled up off the board.

Of course, with the unwanted copper gone, you are left with your circuit. There you have it—an instant PC board. You are ready to drill the board, and to mount and solder components.

The cutting and peeling may be quite difficult with a complex circuit but it *can* be done—steady hand, patience, and all that.

In my opinion, that system is well suited to relatively simple circuits. For others, I'll stick with adhesive copper patterns (pun intended!). In any case, there are two easy, clean, and reliable methods of making prototype one- or two-of-a-kind PC boards, and those methods can even be combined on one board.

What's that?—you need more copies of your board? Then, you may as well get out the etchant. *And* you'll need master artwork. That can be made in a variety of ways. My preference is to use preprinted opaque patterns on clear film (Fig. 1). That system is quick and easy; it not only gives professional-looking results but, perhaps best of all, is forgiving of placement mistakes.

Bishop Graphics offers a complete array of patterns for making original artwork for PC boards. All you have to do is to press them down on clear film in the required configuration and then run traces with the opaque tape. With just a little care, you can come up with a perfect original.

You know, one of the secrets of making a good PC board is to develop a good design (layout) in the first place. Depending upon the circuit, a lot of sketching and re-sketching may be necessary in order to get the number of jumpers down to a minimum.

Eventually, however, a scale drawing should be made to aid in the actual placement of patterns—either opaque on film, or adhesive copper on a board. Bishop's scale templates are almost indispensable in making those final drawings.

Altogether, the *E-Z Circuit* line is quite comprehensive. Use of those materials can save you a lot of "fussin' and cussin' " when fabricating PC boards.

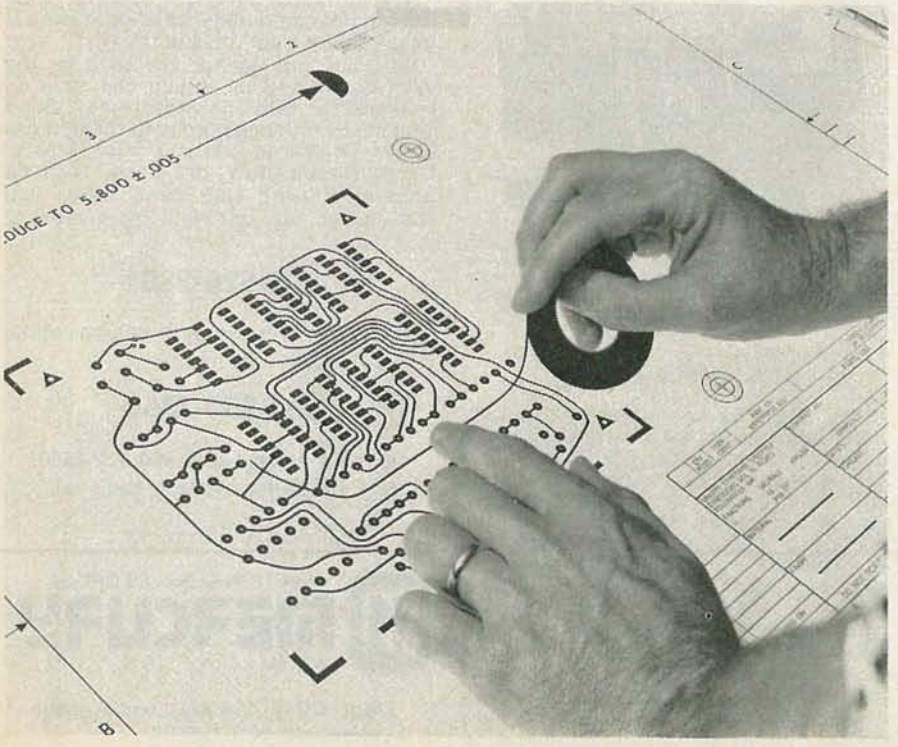


FIG. 1

Pine Wood Derby

Back in March I asked your help for Bill Wisel who was looking for a way to take the "heat" of disputes out of his Cub Scout's Pine Wood Derby heats. Your responses have been both gratifying and intriguing.

Apparently, many of you are or were Scout leaders. There have been more ideas and circuits on that topic than any other since *Hobby Corner* began. In fact, they are *still* coming in. Please accept our thanks and "well done" to each of you who has written.

Unfortunately, all that has come about too late for the 1980 Derby but there is plenty of time for '81. So, let's take a look at some of the responses.

Your answers to Bill's question ranged from the very simple to the very complex—mechanical to IC's; two-lane to six-lane; winner-only to each lane timed; arbitrary timing interval to one-thousandth-of-a-second accuracy! Since the number of circuits we can print is limited, we'll take a look first at the major differences in approach.

Most packs (and leaders!) have limited finances. In spite of using surplus and salvaged parts, an accurately timed, multi-lane finish line is going to be rather expensive. For many readers, however, that is *not* the prime consideration in deciding basic approach.

In determining the number of lanes, several respondents pointed out that those youngsters spend a lot of time building their cars. In order to have the reward of more racing, even for the losers, you have only two lanes and the "best-two-out-of-three heats" rule.

Carl Malmquist of Vestal, NY makes a very good point for *not* actually timing the cars. It is difficult to explain the logic and justice to a youngster who loses one race while having a faster time than the

continued on page 70

Start learning and computing for only ***$129.95*** *with a Netronics 8085-based computer kit. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.*

THE NEW EXPLORER/85 SYSTEM

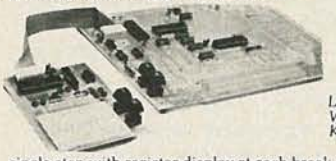
Special! *Full 8" floppy, 64k system for less than the price of a mini! Only* **$1499.95!**

(Also available wired & tested, $1799.95)

Imagine — for only $129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers on-board S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only $129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.

Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. $129.95

Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)



Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O . . . all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

PC Board: Glass epoxy, plated through holes with solder mask. • **I/O:** Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader . . . cassette tape recorder input and output . . . cassette tape control output . . . LED output indicator on SOD (serial output) line . . . printer interface (less drivers) . . . total of four 8-bit plus one 6-bit I/O ports. • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt . . . additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems . . . RAM expandable to 64K via S-100 bus or 4k on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F800, leaving 0000 free for user RAM/ROM. Features include tape load with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point, a debugging/training feature . . . go to execution address . . . move blocks of memory from one location to another . . . fill blocks of memory with a constant . . . display blocks of memory . . . automatic baud rate selection to 9600 baud . . . variable display line length control (1-255 characters/line) . . . channelized I/O monitor routine with 8-bit parallel output for high-speed printer . . . serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Keypad/Display Version): Tape load with labeling . . . tape dump with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point . . . go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

HEX KEYPAD/DISPLAY SPECIFICATIONS

Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for onboard 4k RAM expansion selectable in 4k blocks . . . address decoding for onboard 8k EPROM expansion selectable in 8k blocks . . . address and data bus drivers for onboard expansion . . . wait state generator (jumper selectable), to allow the use of slower memories . . . two separate 5 volt regulators.

LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.

Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of onboard RAM).

DISK DRIVE SPECIFICATIONS

- 8" CONTROL DATA CORP. professional drive.
- LSI controller.
- Write protect.
- Single or double density.
- Data capacity: 401,016 bytes (SD), 802,032 bytes (DD), unformatted.
- Access time: 25ms (one track).

DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible).
- 2 Serial I/O ports
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

Beginner's Pak (Save $26.00!) — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price $199.95), now at SPECIAL PRICE: **$169.95** plus post. & insur.

Experimenter's Pak II (Save $53.40!) — Buy Level "A" (Hex Keypad/Display Version) with Hex Keypad/Display, Intel 8085 User Manual, Level "A" Hex Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $279.35), all at SPECIAL PRICE: **$219.95** plus post. & insur.

Special Microsoft BASIC Pak (Save $103.00!) — Includes Level "A" (Terminal Version), Level "B", Level "D" (4k RAM), Level "E", 8k Microsoft in ROM, Intel 8085 User Manual, Level "A" Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $439.70), now yours at SPECIAL PRICE: **$329.95** plus post. & insur.

ADD A TERMINAL WITH CABINET, GET A FREE RF MODULATOR: Save over $114 at this SPECIAL PRICE: **$499.95** plus post. & insur.

Special 8" Disk Edition Explorer/85 (Save over $104!) — Includes disk-version Level "A", Level "B", two S-100 connectors and brackets, disk controller, 64k RAM, AP-1 5-amp power supply, Explorer/85 deluxe steel cabinet, cabinet fan, 8" SD/DD disk drive from famous CONTROL DATA CORP. (not a hobby brand!), drive cabinet with power supply, and drive cable set-up for two drives. This package includes everything but terminal and printers (see coupon for them). Regular price $1630.30, all yours in kit at SPECIAL PRICE: **$1499.95** plus post. & insur. Wired and tested, only **$1799.95.**

Special! Complete Business Software Pak (Save $625.00!) — Includes CP/M 2.0, Microsoft BASIC, General Ledger, Accounts Receivable, Accounts Payable, Payroll Package: (regular price $1325), yours now at SPECIAL PRICE: **$699.95.**

Please send the items checked below:

- ☐ **Explorer/85 Level "A" kit** (Terminal Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **Explorer/85 Level "A" kit** (Hex Keypad/Display Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **8k Microsoft BASIC** on cassette tape. **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM kit** (requires Levels "B", "D" and "E") . . . **$99.95** plus $2 post. & insur.
- ☐ **Level "B" (S-100) kit** . . . **$49.95** plus $2 post. & insur.
- ☐ **Level "C" (S-100 6-card expander) kit** . . . **$39.95** plus $2 post. & insur.
- ☐ **Level "D" (4k RAM) kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **Level "E" (EPROM/ROM) kit** . . . **$5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85 . . . **$49.95** plus $3 post. & insur.
  - ☐ Fan For Cabinet . . . **$15.00** plus $1.50 post. & insur.
- ☐ **ASCII Keyboard/Computer Terminal kit:** features a full 128 character set, u&l case, full cursor control, 75 ohm video output, convertible to baudot output, selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator) . . . **$149.95** plus $3.00 post. & insur.
  - ☐ **DeLuxe Steel Cabinet** for ASCII keyboard/terminal . . . **$19.95** plus $2.50 post. & insur.
- ☐ **New! Terminal/Monitor:** (See photo) Same features as above, except 12" monitor with keyboard and terminal is in deluxe single cabinet; kit . . . **$399.95** plus $7 post. & insur.
- ☐ **Hazeltine terminals:** Our prices too low to quote — **CALL US**
- ☐ **Lear-Sigler terminals/printers:** Our prices too low to quote. **CALL US**
- ☐ **Hex Keypad/Display kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **AP-1 Power Supply Kit** ±8V @ 5 amps) in deluxe steel cabinet . . . **$39.95** plus $2 post. & insur.
- ☐ **Gold Plated S-100 Bus Connectors** . . . **$4.85** each, postpaid.
- ☐ **RF Modulator kit** (allows you to use your TV set as a monitor) . . . $8.95 **postpaid.**
- ☐ **16k RAM kit** (S-100 board expands to 64k) . . . **$199.95** plus $2 post. & insur.
- ☐ **32k RAM kit** . . . **$299.95** plus $2 post. & insur.
- ☐ **48k RAM kit** . . . **$399.95** plus $2 post. & insur.
- ☐ **64k RAM kit** . . . **$499.95** plus $2 post. & insur.
- ☐ **16k RAM Expansion kit** (to expand any of the above in 16k blocks up to 64k) . . . **$99.95** plus $2 post. & insur. each.
- ☐ **Intel 8085 cpu Users' Manual** . . . **$7.50** postpaid.
- ☐ **12" Video Monitor** (10MHz bandwidth) . . . **$139.95** plus $5 post. & insur.
- ☐ **Beginner's Pak** (see above) **$169.95** plus $4 post. & insur.
- ☐ **Experimenter's Pak** (see above) . . . **$219.95** plus $6 post. & insur.
- ☐ **Special Microsoft BASIC Pak Without Terminal** (see above) . . . **$329.95** plus $7 post. & insur.
- ☐ Same as above, plus **ASCII Keyboard Terminal With Cabinet, Get Free RF Modulator** (see above) . . . **$499.95** plus $10 post. & insur.
- ☐ **Special 8" Disk Edition Explorer/85** (see above) . . . **$1499.95** plus $26 post. & insur.
  - ☐ **Wired & Tested** . . . **$1799.95** plus $26 post. & insur.
- ☐ **Extra 8" CDC Floppy Drives** . . . **$499.95** plus $12 post. & insur.
  - ☐ **Cabinet & Power Supply For Drive** . . . **$69.95** plus $3 post. & insur.
- ☐ **Drive Cable Set-up For Two Drives** . . . **$25** plus $1.50 post. & insur.
- ☐ **Disk Controller Board With I/O Ports** . . . **$199.95** plus $2 post. & insur.
- ☐ **Special: Complete Business Software Pak** (see above) . . . **$699.96** postpaid.
  - SOLD SEPARATELY:
  - ☐ **CP/M 1.4** . . . **$100** postpaid.
  - ☐ **CP/M 2.0** . . . **$150** postpaid.
  - ☐ **Microsoft BASIC** . . . **$325** postpaid.
- ☐ **Intel 8085 cpu User Manual** . . . $7.50 **postpaid.**
- ☐ **Level "A" Monitor Source Listing** . . . **$25** postpaid

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE: 800-243-7428

To Order From Connecticut Or For Technical Assistance, call (203) 354-9375

Total Enclosed (Conn res. add sales tax) $ _____

Paid By:

☐ Personal Check ☐ Cashier's Check/Money Order

☐ VISA ☐ Master Charge (Bank No. _ _ _ _)

Acct. No. _____ Exp. Date _____

Signature _____

Print Name _____

Address _____

City _____

State _____ Zip _____

NETRONICS Research & Development Ltd.
333 Litchfield Road, New Milford, CT 06776

continued from page 68

winner of another.

Two methods of triggering the circuits predominate. About half of the respondents use photocells or phototransistors to detect the car's passage over the finish line. D. R. Fair of Center Valley, PA indicates that a pencil-shaped car may not consistently activate such a trigger. Paul Bradley (Sterling Heights, MI) sent a circuit with trimmer pots on each photo device to adjust them for ambient light conditions.

Mechanical switches are used to trigger circuits by many of you. In some cases, leaf-actuated switches are imbedded in the track. Anthony Saxton of Burnsville, MN mounts his microswitches behind rubber pads at the end of the track.

As mentioned, the actual circuits varied from mechanical relays to 60-device electronic masterpieces. They can give first place only, first three places, arbitrary or accurate time.

Quite obviously, choices must be made about each of these variables. I suggest to Bill and others that cost and complexity be secondary considerations. Decide first what you *need* and what you *want* in terms of final result. Then plan and build accordingly.

I hope that the discussion above will give you plenty of ideas and food for thought. Space will permit only one reader circuit now. I'll include one or two more soon. By then, you should be ready to start construction. The circuits presented will be chosen to illustrate some of the different approaches, not *necessarily* because they are better than all the others that were sent in.

Perhaps the simplest circuit was one sent in by Saxton. He uses mechanical switches and relays to pick winner only. Anthony says it has the dual advantage of sufficient accuracy and no overkill.

Figure 2 shows two double-pole relays in a two lane system. Figure 3 shows how three 3-pole relays are connected for a three-lane system. In that same manner, you can expand the setup for any number of lanes. For example, six lanes would require six 6-pole relays. (Any surplus telephone relays out there?) Let's see how Anthony's circuit operates for two lanes (Fig. 2) and then you can figure out any larger one you want.

Suppose the car on Lane 1 flips that momentary switch first. The circuit is complete through lamp L1 and through the coil of relay RY1 via the closed RY2-b contacts. Thus, relay RY1 is energized and that does two things: It closes contacts RY1-a to keep current flowing through L1 and relay RY1 and it also *opens* contacts RY1-b. In that manner, lamp L1 comes on and stays on.

Now, the second car hits the momentary switch in Lane 2. The circuit to coil

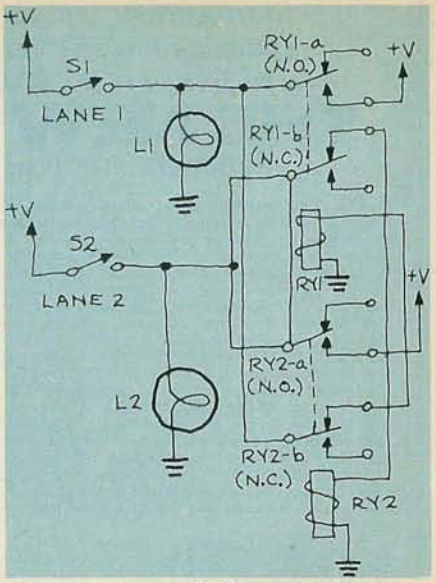


FIG. 2

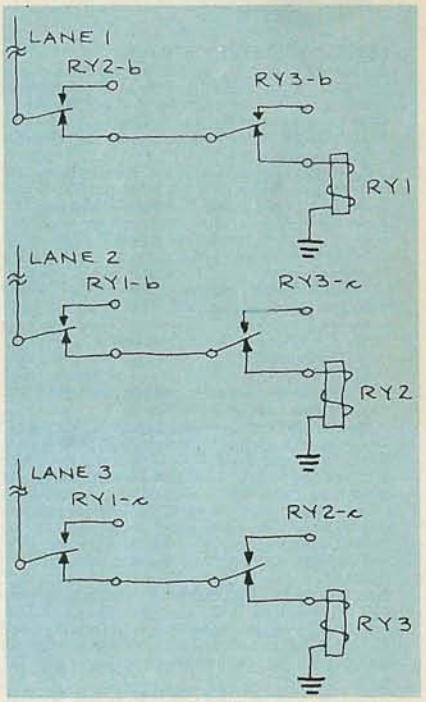


FIG. 3

of relay RY2 is *not* completed because the RY1-a contacts are now open. Thus, relay RY2 does not energize and contacts RY2-a stay open. Since contacts RY2-a are open, lamp L2 does not stay on—it only flashes briefly when the Lane-2 switch is hit.

Of course, if the Lane-2 car is faster, the sequence of events is opposite and lamp L2 lights to the exclusion of L1. A three (or more) lane setup works in the same way and indicates the winner only.

I have given no values for supply voltage, relays, or lamps. The only requirement is that they match. You can even use AC and avoid the need for a power supply.

Next month we'll look at an electronic solution to the problem and talk about some other uses for these circuits. **R-E**

NOW! A MINIATURE TELEPHONICS SYSTEM EVEN MA BELL DOESN'T MAKE AVAILABLE.

FINGER FONE™

The unique Finger Fone brings you advanced solid-state wizardry with a simple yet intelligent approach to using a telephone. It's the ideal communications instrument for home and office.

Finger Fone: modular, sophisticated, smarter than your present telephone. Comes with an ivory fascia.

Imagine you're a design engineer. You've just been assigned to come up with a smaller, simpler-to-use, more streamlined telephone with basic memory that can handle 99% of the ways people actually use a phone on a day-to-day basis.

You have a research laboratory with a support staff at your disposal. Plus access to the latest transistors, memory chips, and microprocessors. And you are given only one limitation: Keep the consumer's cost under $100.

Now, since you're something of a maverick, your mind is not trapped in the right way / wrong way syndrome. And you were too independent to take that job with the Bell System a while back. Because you didn't want all your ideas to come out "Bell-shaped."

THE ANATOMY OF DESIGN

So you set to work — but not with wires, bells and whistles. Because your approach is different: You're going to discover how people actually use a telephone today and then design the instrument from the outside in, basing your conception around real communication needs in a way quite unlike anything ever before achieved.

INTRODUCING THE FINGER FONE

When you're finished, you realize you've come up with a minor revolution in design! Your new instrument is actually a miniature telephone: the entire unit measures a scant 2¾" wide, 8¾" long, and 2¾" high (at the speaker end), scarcely any bigger than the handset on an ordinary phone. Your Finger Fone has a nearly standard alphanumeric keyboard plus a couple of special benefits we'll get to in a minute. It also has an omnidirectional microphone, volume selector key, automatically control the volume of incoming voices, with four LED indicator lamps to display each volume level, and even a bright red on-off light.

What's more, it plugs into the new miniconnector Ma Bell provides for all its phones these days — with no additional wires for any other power source (which make the Finger Fone unlike those other multi-wire "speaker-phones" that sell for more but do less).

WHY PICK A PHONE UP EVERY TIME IT RINGS?

Let's face it, your hands are often occupied when the phone rings. So to answer, you've got to stop at least half of what you're doing. With a Finger Fone, all you do is reach out and tap the "On" key with one finger. And since you needn't pick the instrument up, you can place it conveniently on a desk, counter, or table — or hang it on the wall.

MORE FINGERTIP CONVENIENCE

When Finger Fone announces an incoming call with its pleasant electronic chirp, tap the "On" key and begin speaking. If the caller is someone the whole family wants to hear, simply tap the volume control key and select one of the four sound levels and your caller's voice will be audible to everyone in the room. This benefit is great for the office as well, making it possible to replace an ordinary telephone, separate speaker-phone, and their complicated controls.

If you wish to speak with complete privacy, press the volume control key for low level volume. Yes, for strictly private calls you'll have to hold Finger Fone up to your ear. You won't mind, however, because the entire unit is a mere 11¼ ounces, just a featherweight more than ordinary telephone handsets.

YOU HEAR THEM, THEY DON'T HEAR YOU

Need to put your caller on "hold" for a moment? Easy. Tap "hold" key. All five LED indicator lamps will be blinking, indicating your caller is on hold. The other person won't be able to hear you, but you'll be able to hear him or her. We recommend you tell people about this so they don't make unguarded comments they think you can't hear. When you're ready to resume your call, simply tap "off" key, the LED lights will stop blinking, and you can continue.

BUSY SIGNAL? FORGET IT!

Because Finger Fone automatically remembers the most recently dialed "busy" number. When you want to call that number again, tap the "RE" (Recall) key once. Finger Fone dials the number for you, as often as needed until you get a clear line.

WHY WAIT FOR PUSH BUTTON DIALING?

Finger Fone is compatible in areas of the country where push-button dialing is already in use. But if you live in the 30% or so of the country where only rotary-dial phones can be used, wait no longer. Finger Fone automatically converts from musical tones to rotary-dial signals. This way, you can have the speed and advantages of push-button dialing without waiting for your local phone company to install central equipment.

NOW AVAILABLE AT INCREDIBLE LOW COST

Finger Fone costs only **$89.95** compared with prices of similar-looking telephones (but not similar in performance) costing $109, $130 or more. Want two? Then it's only **$84.95** each. Three? Save even more at **$82.95** each. Add a **$2.50** charge to your total order for insured shipping, and if you live in New Jersey, include 5% tax.

MONEY-BACK GUARANTEE

You can try one or more Finger Fones in your own home for 30 days, protected by our unconditional money-back guarantee. If you're not satisfied with Finger Fone for any reason, simply return it (insured) for a full refund, no questions asked. Finger Fone is also covered by a 1-year parts and labor guarantee.

To order Finger Fone, call toll-free now. We're open 24 hours a day. You can charge it on Master Charge, Visa, American Express, Carte Blanche or Diners.

800-526-2801

800-257-7850

In New Jersey, Call: 800-322-8650

N.J. residents please add 5% sales tax. You can also mail your order with check or money order to:

INTERNATIONAL SALES GROUP

MERCURY

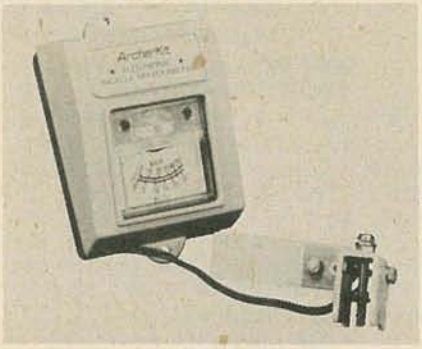
THE IMAGINATION PEOPLE®

Dept. RE-1
Mercury Bldg., 404 Madison Avenue
Lakewood, N.J. 08701

new products

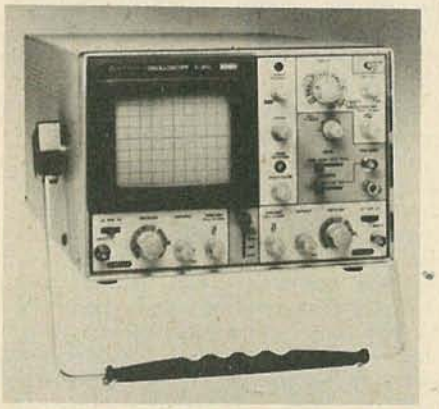
More information on new products is available. Use the Free Information Card inside the back cover.

ARCHERKIT ELECTRONIC BICYCLE SPEEDOMETER, is a kit designed to fit most bikes and has ½-inch dual-scale 0 to 60 kilometers-per-hour and 0 to 30 miles-per-hour indication. The unit operates on one 9-volt battery. The speedometer has a rugged 4 × 2½ × 2-inch molded housing and comes complete with mounting bracket, hardware, and step-by-step assembly instructions. Price is $14.95.—**Radio Shack,** 1300 One Tandy Ctr., Fort Worth, TX 76102.



CIRCLE 151 ON FREE INFORMATION CARD

OSCILLOSCOPE/COMPONENT TESTER, *model HM307,* is a compact, lightweight single-trace oscilloscope designed for both field service and laboratory applications. It has a built-in component tester that tests common semiconductors and passive components in circuit. (Transistors, diodes, resistors, capacitors, and most other components can be checked.) The *model HM307* changes from an oscilloscope to a component tester with the press of a single button while the oscilloscope settings are left undisturbed.



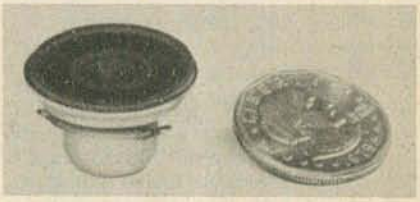
CIRCLE 152 ON FREE INFORMATION CARD

The component tester applies ±8.6 volts RMS maximum to the device with current limiting to 28 mA; the resulting V/I display instantly reveals most bad semiconductors. No drift compensation is needed, and the *model HM307* will trigger on signals as small as 3mm up to 30 MHz. Vertical sensitivity ranges from 5 mV to 20 V/cm in 12 calibrated steps. The time base is from 2 seconds to 0.2 μsec/cm with auto and external triggering that ranges from 2 Hz to 30 MHz.

All critical DC voltages are regulated. The input AC transformer can be connected to operate from 110 to 237 volts AC, 50 to 60 Hz. The built-in 1 kHz, 0.2-volt (± 1%) squarewave generator is used for checking probe compensation. The *model HM307* comes housed in an all-metal low-profile case—4.5 × 8.3 × 10.4 in.—designed for rugged field-service use. There is a handy carry handle and retractable tilt-up stand that pulls down from under the unit. Accessories include ×1 probes, ×10 probes, ×100 probes, demodulator probes, test cables, viewing hood, carrying case, and scope chart. Price $405.00 —**Hameg, Inc.,** 191 Main Street, Port Washington, NY 11050.

MINIATURE SPEAKER, *model S100RA,* measures 1 × ⅝ in. and weighs 15.2 grams. The fully-enclosed Alnico magnet weighs 0.209 oz. Nominal power is 0.2 watt and frequency response is 750-10,000 Hz. Voice-coil impedance is 8 ohms but may be varied upon special request.

The *S100RA* is designed for small-space applications such as in beepers, mobile telecommunications devices, portable medical equipment,



CIRCLE 153 ON FREE INFORMATION CARD

walkie-talkies, and headphones. Cone material is paper and the frame is cadmium-plated steel. Price $1.00.—**Intervox Speakers,** International Components Corporation, 105 Maxess Road, Melville, NY 11747.

PHASE METER, *model 200,* has a 0-360° mode for lagging test signals or a ± 180° mode for signals whose phase relationships vary around zero. The input-voltage range is 35 mV to 250 volts RMS. Input impedance is 1 megohm for all input levels. Frequency range for a 35-mV RMS signal is 20 Hz to 300 kHz, with ±2° accuracy over that range. Front-panel calibration controls can also

CIRCLE 154 ON FREE INFORMATION CARD

be used to offset any phase shift in the test setup. Display is three digits, plus sign. An analog output provides 10 mV per degree. Price $325.—**FSI,** 1894 Commercenter W. No. 105, San Bernardino, CA 92408. **R-E**

new ideas

PLANT WATER GAUGE

THIS PLANT WATER GAUGE CAN EASILY BE constructed on a small piece of perforated construction board. Its case is made from a piece of Styrofoam with a section carved out to hold the nine-volt battery, and a small recess is made into which the underside of the board is pressed. The probes are stuck right through the center of the foam and glued in.

Assemble the gauge following the schematic in Fig. 1 and the drawing in Fig. 2. Be sure to tin the probes with solder to keep them from corroding.

To calibrate the gauge, connect the battery and press the probes gently into a pot containing a plant that is just on the verge of needing water (stick it in so that only an inch of the probe is left visible at the top). Turn the potentiometer until the "OK" LED lights and then turn it back to the point where that LED goes out and the "W," or "Water," LED just comes on. The device should now be properly adjusted.

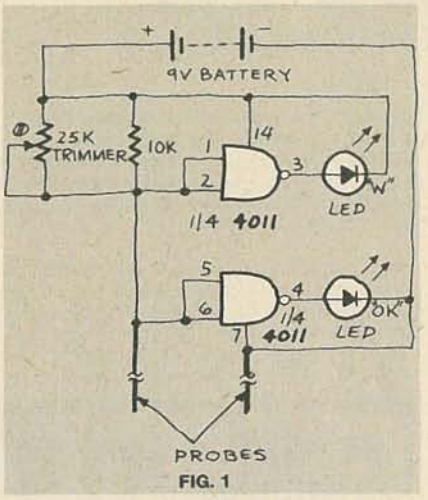


FIG. 1

Use this gauge anywhere for indoor plants and you will find it very useful in determining when to water and in preventing overwatering, since it reaches much farther down into the soil than you possibly can with your own fingers.—*Bob Mostafapour*

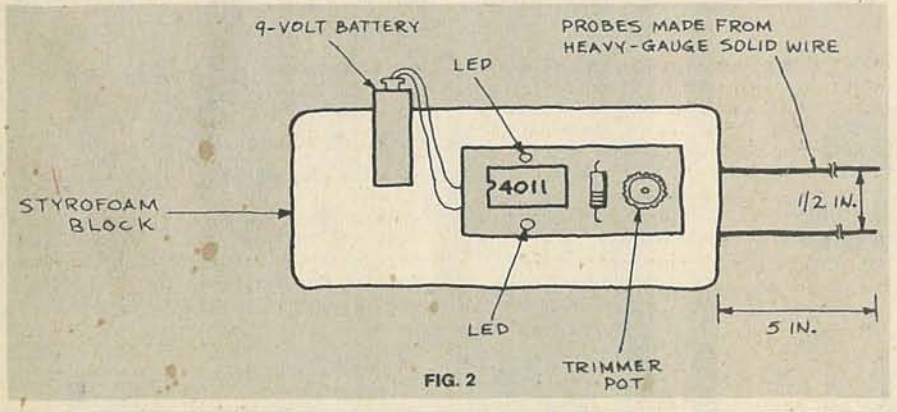


FIG. 2

"Would you like to hear my new secretary in stereo?"

NEW IDEAS

This column is devoted to new ideas, circuits, device applications, construction techniques, helpful hints, etc.

All published entries, upon publication, will earn $25. In addition, Panavise will donate their model 324 Electronic Work Center, having a value of $49.95. It combines their circuit-board holder, tray base mount, and solder station (see photo below). Selections will be made at the sole discretion of the editorial staff of **Radio-Electronics.**

I agree to the above terms, and grant **Radio-Electronics** Magazine the right to publish my idea and to subsequently republish my idea in collections or compilations of reprints of similar articles. I declare that the attached idea is my own original material and that its publication does not violate any other copyright. I also declare that this material had not been previously published.

Title of Idea		
Signature		
Print Name		Date
Street		
City	State	ZIP

Mail your idea along with this coupon to: **New Ideas Radio-Electronics, 200 Park Ave. South, New York, NY 10003**

computer products

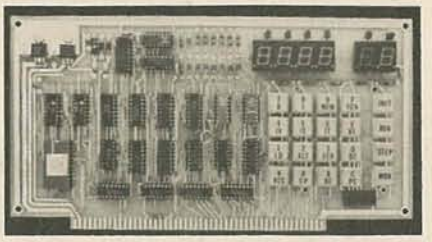
More information on computer products is available. Use the Free Information Card inside the back cover.

MICROCOMPUTER WORK STATION, the *CompuDesk,* features a split-level top for optimum positioning of components of a microcomputer

CIRCLE 121 ON FREE INFORMATION CARD

system. It has a compartment with two adjustable shelves and a self-closing door with an attached storage rack for manuals and magazines. The compartment is convection-cooled and a fan option is offered for high-heat systems. The *CompuDesk* is constructed of birch plywood with a walnut stain finish and formica tops. Price is $359, plus freight and a $25 packing charge where applicable.—**ComputerGoods,** P.O. Box 2635, Eugene, OR 97402.

S-100 FRONT PANEL for use with 8080 or Z-80 systems features a 20-key matrix and six-digit LED display. The keytops may be ordered blank or with lettering. The *S-100 Front Panel* comes with 256 bytes of RAM and is equipped to take a 2708 or 2716 EPROM, which may be pro-



CIRCLE 122 ON FREE INFORMATION CARD

grammed by the user to meet his particular requirements.

Pre-programmed EPROM's for working in machine language and engraved keyboards are available for either 8080 or Z-80 systems.

Price for a board with blank keytops and less EPROM is $139.50, assembled and tested. Add $55 for 8080 or Z-80 firmware.—**Pike Electronics,** 8190 Watsonville Rd., Gilroy, CA 95020.

INTERFACE ADAPTOR, *model 488-80B,* is designed for interfacing the *GPIB-488* to the Radio Shack *TRS-80 Model I* computer. Any *TRS-80 Model I* with a minimum of 16K RAM and Level II

CIRCLE 123 ON FREE INFORMATION CARD

BASIC can connect to as many as 15 *GPIB-488* peripherals with no extra hardware ports or software drivers required as new devices are added. Peripherals currently available include printers, plotters, digitizers, displays, and measurement and test equipment. A machine-level driver pro-

gram provided with this model, on tape or disk, interacts with Level II BASIC, Level III BASIC and Disk BASIC. Price is $225.00.—**Scientific Engineering Laboratories,** 11 Neil Dr., Old Bethpage, NY 11804.

MAGNETIC TAPE ERASER, *model 24-001,* is designed to erase computer cassettes and floppy disks. The device was originally designed to erase video tapes. To operate, the user sweeps the unit over the disk or cassette from which signals are to be removed. The unit's magnetic field then

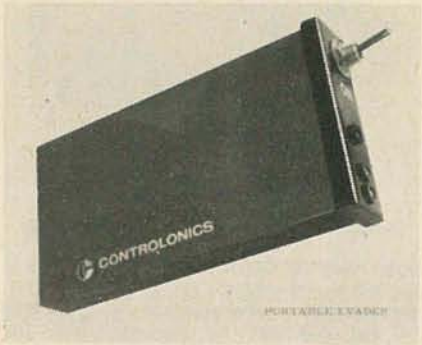
CIRCLE 124 ON FREE INFORMATION CARD

wipes clean the recorded signals. Measures 5 × 3½ inches and weighs 4 lbs. The *model 24-001* operates from a power source of 110 to 120 volts AC and is designed for intermittent duty. The suggested retail price is $58.50.—**Robins Industries Corp.,** 75 Austin Blvd., Commack, NY 11725. **R-E**

radio products

More information on radio products is available. Use the Free Information Card inside the back cover.

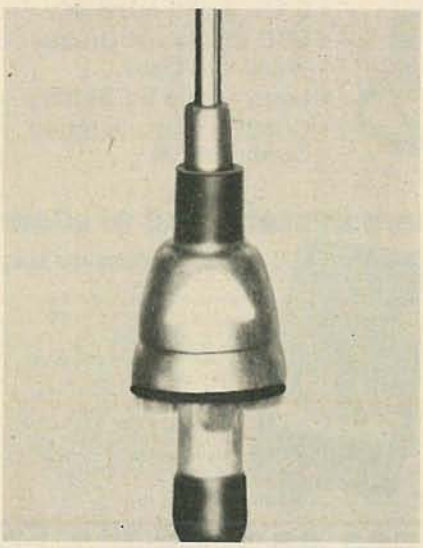
PORTABLE SCRAMBLER, the *Evader,* ensures privacy in two-way radio voice communications. A primary security-level scrambler, the portable *Evader* is compact and mounts directly on the radio using "hook-and-loop" pads. The rugged, water-resistant unit operates from the radio's



CIRCLE 111 ON FREE INFORMATION CARD

power supply. A standard-designation code module is internally wired. The scrambler principle used is audio-band inversion with the code module selecting the inversion frequency. This portable unit is compatible in all codes with all basic *Evader* models. Price is $547.—**Controlonics Corp.,** 410 Great Road, Littleton, MA 01460.

CUSTOM ANTENNA, FM-91, fits all General Motors and narrow-fender cars. The antenna has a single stainless-steel mast 31 inches long and a 72-inch cable. Shown is a close-up of the anten-



CIRCLE 112 ON FREE INFORMATION CARD

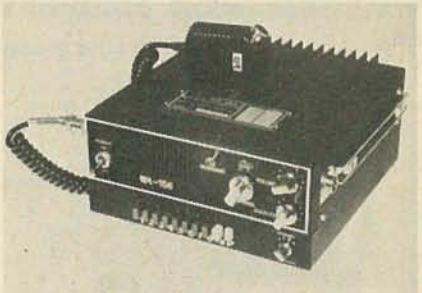
na's body-mount. Price for the *FM-91* is $7.37.—**Harada Industry of America, Inc.,** Dept. P, W. Artesia Blvd., Compton, CA 90220.

COMPACT AM/SW RECEIVER, the *model EP-8,* measures only 45 mm × 73 mm × 25 mm (1.77 × 2.95 × 0.98 inches) and weighs only 96 grams

CIRCLE 113 ON FREE INFORMATION CARD

(3.5 oz.). The receiver tunes the standard AM broadcast band and shortwave frequencies from 3.9 to 12 MHz. Controls include a BAND SELECT switch, tuning dial, and a volume control coupled with an on/off switch. Power is supplied by two hearing-aid-type batteries (included). The *EP-8* has built-in *Ferrite* rod antennas for both bands. Audio output is by means of an earphone. Price is $24.95.—**Radios International,** P.O. Box 6053, Richardson, TX 75080.

VHF/FM TRANSCEIVER, *model WR 156,* is a front-mount radio with a frequency range of 150-174 MHz and a frequency spread of 12 MHz. Twelve channels of any TX or RX frequency combination can be programmed with the 12-MHz spread, with full specs eliminating the need for



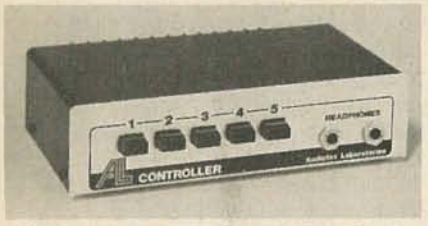
CIRCLE 114 ON FREE INFORMATION CARD

two separate radios. The performance of each channel in this model is equal to that of a single channel radio. Options available for the *WR-156* include a 12-channel priority scanner, CTCSS encode/decode, DTMF, and time-out timer, plus any signaling system desired. Price range is from $1,395 to $2,350.—**W R Communications,** 1165 Harrison St., Seattle, WA 98109. **R-E**

stereo products

More information on stereo products is available. Use the Free Information Card inside the back cover.

SPEAKER-SELECTOR SWITCH, *The Controller,* is a lightweight, compact unit that allows hookup and independent control of up to five pairs of stereo speakers. Any one pair or up to all five can be played simultaneously. Features include two headphone jacks, built-in amplifier protection, and barrier-type terminals for amp and speaker connections to help prevent short circuits. *The Controller* is compatible with all hi-fi amps, receivers, and headphones that operate into 4-ohms impedance: with a rating of 50 watts continuous per channel, its power is unlimited with the load switch off. Suggested retail price is $49.50.—**GC Electronics,** 400 So. Wyman St., Rockford, IL 61101.



CIRCLE 131 ON FREE INFORMATION CARD

CLEANING KIT, *model TX250,* is designed for cleaning audio-tape heads, and features *Audio Cleaning Pens*—one for pressure rollers, and one for heads. Each pen holds a *Clean-Wick* that can be cut to the shape needed for each task. The kit also contains the solvent, ten replacement *Clean-Wicks,* a cutter, a device that elevates the pressure rollers for cleaning, and a rack for the kit materials. Good for about 900 cleanings, the kit is priced at $27.50.—**Texwipe Co.,** 101 West St., Hillsdale, NJ 07642.

CIRCLE 132 ON FREE INFORMATION CARD

NOISE-REDUCTION SYSTEM, *model SAE 5000A,* removes impulse noises from records. The *SAE 5000A* is capable of removing even smaller pops and clicks than its predecessor while providing a cleaner sound than was previously attainable. Sophisticated logic circuits continually monitor the program material for those audio defects and automatically shut down the audio system upon detection of the impulses. A reconstruction circuit replaces the impulse noise with information extrapolated from the music appearing immediately before and after the impulse so that musical continuity is maintained. Since the entire process takes place in less than

CIRCLE 133 ON FREE INFORMATION CARD

1/1000 of a second, the listener remains unaware of it. Both THD and IM in the *SAE 5000A* are rated at less than 0.1%. Signal-to-noise ratio is greater than 90 dB and frequency response is 20 Hz to 20 KHz ±1 dB. Suggested retail price of the *SAE 5000A* is $225.—**Scientific Audio Electronics, Inc.,** 701 E. Macey St., Los Angeles, CA 90012.

STEREO CARTRIDGES, *model M72EJ* and *model M72B,* feature a new stylus assembly with a reduced tip mass that results in high-trackability performance. The cartridges have a tracking-force range of from 1½ to 3 grams, and are compatible with most turntables. The *model M72EJ* (shown), with biradial elliptical stylus is priced at $51.00; *Model M72B* with spherical stylus is

CIRCLE 134 ON FREE INFORMATION CARD

$45.70. Prices for stylus assembly alone are: *N72EJ* $17.45; *N72B* $14.05.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, IL 60204.

RECEIVER, the *STA-2000,* offers quartz-locked digitally synthesized AM/FM *Dolby* reception. It can scan the entire FM or AM band, stopping automatically, perfectly tuned, at each station. Its fluorescent readout displays the exact station frequency and also serves as a digital clock when the receiver is not in use. Any six FM and any six AM stations may be entered in the receiver's memory for instant access at the touch of a button. A SCAN button makes the microprocessor sample the programming on each station in the memory for a few seconds, and stops at the touch of the HOLD button. The *STA-2000* is rated at 60 watts-per-channel and carries a price tag of $599.95.—**Radio Shack,** One Tandy Center, Fort Worth, TX 76102. **R-E**

CIRCLE 135 ON FREE INFORMATION CARD

service clinic

Catastrophic failures in solid-state circuits can be a trouble-shooter's nightmare.

JACK DARR, SERVICE EDITOR

MOST OF US ARE ALL TOO FAMILIAR WITH the catastrophic failure in solid-state TV's, where some part blows up, and takes the horizontal output transistor and several others with it. That problem isn't limited to TV. I just ran across the identical problem in not one, but *two* high-power hi-fi amplifiers. This material was sent to me by Ric Church, the "Hi-Fi Doctor" of Bowling Green, KY. (To be frank, Ric did all the work; I'm just writing it up!)

Catastrophic failure can be a serious problem, and we both thought that it should be brought to the attention of readers so they'd have some ideas about where to start should they have the misfortune to run into it.

The basic problem was the same in both: a Sansui *AU20,000* audio amp and a Marantz *2325* receiver. By coincidence, it made its presence known in the left channel on both of them.

The symptoms for both were the same: At very irregular intervals, the units would make a very loud bang out of the left-channel speaker. Along with the bang went the final stage transistors and the woofer of the speaker system went with them. (Even more of a catastrophe than TV, considering the price of a good woofer!) In Ric's first letter, he gave me a clear description of the problem. I wasn't able to give him too much direct aid, to be honest. I did make some suggestions as to possible causes, tests, and so on. Later, he wrote back, saying he had solved it.

The bang was always at the same volume. That ruled out the preamps. The DC power supply was also eliminated since the problem was only in one channel. Switching the driver boards made no difference, so those were eliminated. The Sansui amplifier contains six transistors in the output stage which has an NPN side and a PNP side. (Marantz is almost the same but only four transistors.) When the bang occurred, it blew only two of the six transistors. The Sansui amplifier would continue to play with the four remaining output transistors and with no bangs. The Marantz blew all of the finals.

I suggested checking at reduced power with a variable-voltage line transformer (and a resistive load to save expensive speakers); also, using heat, cold, and physical jarring to see if the problem could be forced to show up. The reasoning was that anything in the signal path or bias circuitry that caused a very sharp transient would do damage when the transient was amplified. It should have been in the input circuits to the finals in order to get the gain needed to do the dirty work. These tests didn't show up anything at all for quite a while.

He finally found it! In the Sansui, it was caused by biasing transistor TR01, a 2SC1364. (See Fig. 1.) Since that is located on the power-output board, swapping other boards did no good. The actual cause was a *momentary* breakdown, which then *healed itself* and the amp went on working. A very rare bird indeed! The component apparently senses output levels and controls bias on the output stages. The breakdown itself caused the transient.

In the Marantz, the problem was basically the same, but the cause was a pair of bias diodes. Same thing; the diodes affect the bias on the high-power output stage. Now, I remember a very similar case, quite a long time ago, in a much smaller amplifier. All of a sudden . . . bang, no output transistors! I found the cause by moving the bias diode, which promptly broke in two in the middle and blew up the two new output transistors I'd just put in. Frankly, at that time I was quite green in dealing with solid-state audio amplifiers and I didn't think that an open bias diode would blow the outputs. Take my word, (and Ric's) for it now, that it *will*.

The Hi-Fi Doctor's recommended cure for that—and one with which I agree—is to locate the parts that could be suspected (bias diodes, bias transistors, etc.) and replace them! The bad parts heal themselves. When making replacements, go through the specs and pick a transistor or diode that *exceeds* the rating of the original part. **Do not** use the same part number or the problem will be back. Since that involves only a very few and comparatively inexpensive parts it would be a logical remedy.

I'll throw this one in from much experience—look the whole area over very closely for any signs of a bad solder joint on the PC boards. A bad joint could easily cause that type of transient; they're noted for it. Also, it would be a very good idea to use high-wattage resistive loads when making tests, instead of the expensive speakers.

Thanks again to Ric for all of the good work, and good luck to all of you if you fall over this kind of problem. **R-E**

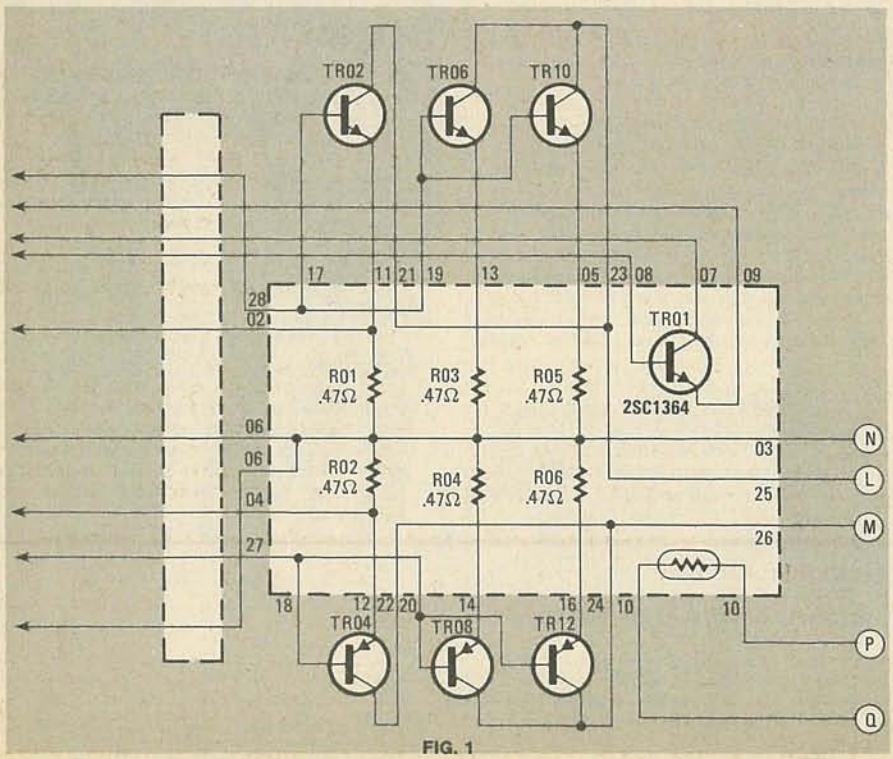


FIG. 1

service questions

COLOR BAR GENERATOR PROBLEMS

Edwin Menendez Inclan of Mexico City sends this feedback note: "I had two problems with my Sencore CG-141 color bar generator. The raster was short, vertically, on all patterns. (On TV signals, raster filled the screen). The other was the complete loss of the single horizontal line or dot pattern. You originally suggested checking or changing TR7, the vertical oscillator transistor. Although the original did not show any leakage, a new one did make the patterns fill the screen. They were vertically unstable, though.

"After much searching, I found that there was a slightly leaky capacitor in the collector circuit of TR7 (.05 μF at 600 volts). Also, by using a resistance substitution box, I found that a resistor in the same circuit must have changed value. By setting the sub-box to a value that made the line/dot show up, I got it working properly again!"

Thanks, Edwin.

ALL WET

I've got a Panasonic CT-702 that was bought by a friend at a flea-market. Looks as if it had been out in the rain for some time! No sound, no raster. Found a bad SCR and couple of transistors on S-board. No luck. Finally took S-board out and cleaned all the plug-in contacts. Got raster but no sound or picture. Cleaned all contacts on A-board, and got them back. Now, the only problem is that some of the controls don't work properly, such as the Pana-Brite, etc. ABL control doesn't work right. On the S-board, D811 had come in two. Can't find it on the parts list under "diodes."—A.K., Struthers, OH.

Are you sure the guy that bought that thing was really a *friend*? Anyhow, you've done all the right things; I'd suggest pulling *all* of the plug-in boards and giving them a good cleanup and contact tightening. That can't do anything but good.

D811 is *called* a diode but it isn't. It's apparently a VDR (*V*oltage-*D*ependent *R*esistor), and is listed only by part number. It is a shunt across TR851, the APF Output, which is just the voltage-regulator transistor. You should be able to get a replacement from Panasonic.

VERTICAL OSCILLATOR TIME-CONSTANT

This Zenith 19CC19's vertical oscillator is running too fast (rolling down). All parts seemed to be in tolerance. Changed C222, .01 μF; no luck. When I bridged it with another .01 μF the oscillator locked in. However, the vertical hold now has no effect at all! What's going on here?—R.A., N. Miami, FL.

The vertical-oscillator frequency here, and in lots of other TV's, is determined by an R–C *time-constant* developed in the oscillator-input circuitry. You doubled the size of a capacitor; that should indicate that, somewhere in there, one of the *resistors* in the circuit is off-value! The time-constant is entirely an R–C thing; the value of the resistors and capacitors set it.

Incidentally, the capacitor in question is in the feedback loop from the vertical-output tube plate, so its charging time would set the time of the oscillator stage's "firing" (from the sync). Check or replace some of the few resistors in the same circuit; don't overlook any of the other capacitors either!

PARTS WANTED

I need help in finding a flyback for a Broadmoor 6199C color TV. I think the company went out of business some time ago. Can you help?—T.W., Madison, WI.

I've had requests for this sort of thing before, and in a very few cases been able to find something by checking part numbers. Not in this case, unfortunately. If anyone out there has found a source for Broadmoor parts and data, I'd really appreciate getting the information, and so would a whole lot of others. **R-E**

continued from page 50

resistors R8 and R9, is not critical. I found that I could use values ranging from 2K to 10K for R8, and from 5K to 10K for R9, with essentially the same results.

Power supplies

Two separate power supplies are required if the computer-side and the TV-side of the interface are to be completely isolated from each other. The TV-side requires only +5-volts DC. Most TV sets have 12 volts DC available internally somewhere, and that can be reduced to five volts by means of IC6, a 7805 regulator. The TV chassis is used as ground for this end of the circuit.

The computer-side of the interface requires both +5-volts and approximately −8-volts. A simple power supply to deliver those voltages is shown in Fig. 3. A transformer with an output of around 100 mA is adequate for the circuit. The transformer's center-tap should be used as the ground for the entire computer-side of the isolator. Use heat sinks on both of the five-volt regulators to keep them running cool.

Installation and use

The best place to locate the interface board is inside the TV set's cabinet, where accidental contact with the TV's chassis ground will be impossible. Switch S1 can be mounted inconspicuously on the TV set's cabinet. (Make certain that none of its metal parts are in contact with any of the TV's.) That switch allows you to use the TV set either as a monitor or for its intended purpose.

As suggested by the schematic, the best place to inject the composite video signal from the interface is at the TV's first video-amplifier stage. Refer to your set's schematic or to a Sams *Photofact* folder. An excellent source of TV-interfacing information is Don Lancaster's *TV Typewriter Cookbook*, published by Howard W. Sams and Co., Indianapolis, IN 46268.

The total cost of this project, including the power supply, should be under $25. It would be hard to find a monitor at that price! **R-E**

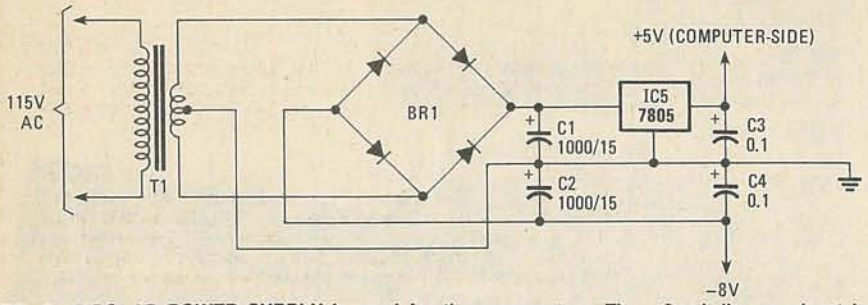


FIG. 3—BIPOLAR POWER SUPPLY is used for the comparators. The −8-volt line need not be regulated.

UNDER THE HOOD

continued from page 48

What's coming?

At least one manufacturer is in the early-development stages with a 100-bit-wide bit-slice microprocessor. That would allow a great number of operations, both internal and I/O (*I*nput/*O*utput), to happen simultaneously. It allows high throughput at relatively moderate processing speeds.

Self-diagnostics and increased communication capabilities with off-vehicle diagnostic systems are definite trends. The "ideal" under-hood system would have no full-failure modes, would provide back-ups for any faulty component, would alert the driver to any need for service, would tell the mechanic what's wrong, and would stretch every gallon of gas while controlling exhausts utterly.

Most of which we already have, in one form or another.

Now the job is improvement, both in terms of performance and in terms of cost. A thousand, or two thousand, dollars worth of under-hood electronics may save you that in gas and repairs in less than a year, but you still have to put it up to buy the car.

There's more to automotive electronics than engine controls and digital dashboards. Next month, we will take a look at bells and whistles—things that make driving more pleasurable. **R-E**

DON'T FORGET

USE YOUR READER SERVICE CARD

market center

CLASSIFIED COMMERCIAL RATE (for firms or individuals offering commercial products or services). **$1.65 per word prepaid (no charge for zip code)** . . . **MINIMUM 15 WORDS.** 5% discount for 6 issues, 10% for 12 issues within one year, if prepaid.

NON-COMMERCIAL RATE (for individuals who want to buy or sell a personal item) **85¢ per word prepaid** . . . no minimum.

ONLY FIRST WORD AND NAME set in bold caps. Additional bold face (not available as all caps) at 10¢ per word. All copy subject to publisher's approval. **ADVERTISEMENTS USING P.O. BOX ADDRESS WILL NOT BE ACCEPTED UNTIL ADVERTISER SUPPLIES PUBLISHER WITH PERMANENT ADDRESS AND PHONE NUMBER.** Copy to be in our hands on the 26th of the third month preceding the date of the issue (i.e., August issue closes May 26). When normal closing date falls on Saturday, Sunday, or a holiday, issue closes on preceding working day.

BUSINESS OPPORTUNITIES

MECHANICALLY inclined individuals desiring ownership of Small Electronics Manufacturing Business—without investment. Write: **BUSINESSES,** 92-R, Brighton 11th, Brooklyn, NY 11235

NEW tax loopholes discovered. Everyone eligible. Free sample newsletter. Write: **ULC,** Box 179-CU, Clarkston, GA 30021

CRT rebuilding machinery. Large profits can be made **rebuilding picture tubes** with our **patented** equipment. **Facts** don't lie. **Training provided.** Phone (312) 583-6565. Write: **LAKESIDE,** 4071 N. Elston, Chicago, IL 60618

PROJECTION TV . . . Make $200.00+ per evening assembling projectors . . . Easy . . . Results equal to $2,500 projectors . . . Your total cost less than $15.00 . . . **Plans, lens** & dealer's information $14.00 . . . Illustrated information **free . . . MACROCOMGEX,** Washington Crossing, PA 18977

START your own electronic assembly business with our unique plans. Write: **DELCRON,** 32 Fairington St., Catharines, Ont. Canada L2N 5W3

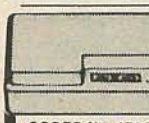
Burglar·Fire Protection

Protect Your Life, Home, Business, Auto, etc.

• Our catalog shows how. Install your own alarm systems and devices and save $$$$. We offer FREE write-in engineering service.

FREE CATALOG Lowest Prices on Reliable, High-Quality Alarm Systems and Devices

Burdex Security Co. Box 82802-RE Lincoln, Ne. 68501



39.95 ADD $2.50 FOR POSTAGE

30 CHANNEL CABLE TV CONVERTER

ORDER No. 171AE047

ETCO ROUTE 9N, PLATTSBURGH, N.Y. 12901 Tel.: (518) 561-8700.

FREE! UNUSUAL 96 PAGE ELECTRONIC PARTS & IDEAS CATALOG!

EDUCATION & INSTRUCTION

THE PA BIBLE from Electro-Voice, a professional guide addressing sound reinforcement and public address applications/specifications from the club/church/school level up through auditoriums/outside stadiums/road system situations. To receive your copy of this highly regarded tool, including all existing supplements, and to be put on the distribution list for future additions, send $2.00 to **ELECTRO-VOICE,** Box No. 124, 600 Cecil Street, Buchanan, MI 49107

MAKE hydrogen fuel: Build generators with material from Hardware stores. Illustrated manual; $10.95 ppd. **NEGEYE ENGINEERING,** Pennsboro, WV, 26415

ELECTRONICS books from world publishers. Lowest prices, ask catalog. **BUSINESS PROMOTION,** Lajpatrai Market, Delhi, India

UNIVERSITY degrees by mail! Bachelors, Masters, PhD's . . . Free revealing details. **COUNSELING,** Box 317-RE 1, Tustin, CA 92680

SUBSCRIPTION television education manual! Two scrambling/decoding systems, theory, circuits. Decoder dealers listed. $14.95. ABEX, P.O. BOX 26601-R2, San Francisco, CA 94126

PASS FCC EXAMS

The Original FCC Tests-Answers exam manual that prepares you at home for FCC First and Second class Radiotelephone licenses. Newly revised multiple-choice exams cover all areas tested on the actual FCC exam. Plus "Self-Study" Ability Test. Proven! $9.95 postpaid. Moneyback Guarantee.

COMMAND PRODUCTIONS Radio Engineering Division P.O. Box 26348 E San Francisco, CA 94126

SATELLITE TELEVISION

SATELLITE television...Howard/Coleman boards to build your own receiver. For more information write: **ROBERT COLEMAN,** Rt. 3, Box 58-ARE, Travelers Rest, SC 29690

ANTENNA azimuth and elevation for all geostationary satellite locations. $4.00 for Western Hemisphere satellites. $6.00 for satellites within your horizon. Send accurate lat/long. **DAVID FREY,** Box 2591, Satellite Beach, FL 32937

SATELLITE VISION
SATELLITE VISION
SATELLITE VISION

We manufacture the highest spec 3-meter data & video dish in the world 41db gain! We also sell direct. Immediate delivery or you pick up. Complete details including satellite TV information, aiming service and discount schedule. Send $1.25 for postage & handling to: TIGER TENNAS© P. O. Box 561 Casselberry, Florida 32707

BUY DIRECT

Satellite TV
FOR THE HOME

Sick of Network TV?

Our receiver lets you get over 75 channels of television directly from earth-orbiting cable TV satellites!: HBO, Showtime, super stations, sports and movies from around the world.

We don't just sell information! We Manufacture Hardware!

Our 94-page catalog and information book tell the whole story! Inexpensive dishes, high profeeds, computer aiming software! Specs, kits and more! Send $7.95 today!

24-hour C.O.D Hotline
(305) 339-7600

SPACECOAST RESEARCH
Dept. T, P.O. Box 442, Altamonte Springs, FL 32701

To run your own classified ad, put one word on each of the lines below and send this form along with your check for $1.65 per word (minimum 15 words) to:

Radio-Electronics, 200 Park Avenue South, N.Y., N.Y. 10003

ORDER FORM

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of $10.

( ) Plans/Kits ( ) Business Opportunities ( ) For Sale
( ) Education/Instruction ( ) Wanted ( )
Special Category: $10

(PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.)

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

PLEASE INCLUDE FOR OUR FILES YOUR PERMANENT ADDRESS AND PHONE NUMBER.

4Kx16 MEMORY BOARD with 64 IC chips (2102) in sockets. Super deal at $50 the complete board.

$29 AUTO SECURITY SYSTEM alarm system $7.00

SPACE MAN toy module PC board w/musical IC synthesizer chip. ROM has 5 programs, wierd noises blinking LEDs $3.00 each

DATA STATION CONSOLE w/keyboard 9 inch monitor, power supply. Logic boards broken. $80 Send for details on this one.

Computer video monitor chassis 9 inch, 12 volt used $40
Computer video monitor chassis 12 inch, new $50

8 INCH FLOPPY DISC DRIVE by MPI, with some data. Sold as is but visually OK $175.00

PIN BALL GAME, solid state, hand held, visual and audio, bumpers, flippers, etc. LED scoring and up to 4 players. Complete PC module w speaker $10.00

TOUCH PAD solid state w/LSI chip. Bell system compatible. For computers & phones $24.00

12 VOLT GEL-CELLS 2.5 AH $14.00 5 AH $17.00

12 INCH CRT bonded face plate. New with specs. Made for computers. $35.00

WALKY TALKIES Govt surplus used condition. 47-55.4 mc range. With schematics. Govt AN/PRC-6 $25 each 2 for $45. Ant. $5 each

ASCII KEYBOARD parallel $50
RED LED's . . . . . 10 for $1.00

MIN ORDER $10.00

Shipping extra on all merchandise

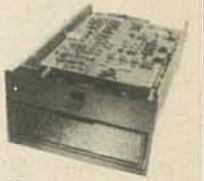
Meshna Inc., PO Box 62, E. Lynn, Mass. 01904

CIRCLE 15 ON FREE INFORMATION CARD

CFR Associates EXCLUSIVE!

SURPLUS COMPUTER BARGAINS

8 INCH FLOPPY DRIVES



Used, removed from systems. Mfd. by MPI Division of Control Data. These are *the* CDC floppy! Includes schematics & I/O data. Sold 'As-Is' but *complete and whole!* An incredible BARGAIN, easy to interface with most commercial controllers. Features "hard" sectoring.

Special Price ..... **Only $229.00ea.**
Buy 3 and SAVE BIG!! ..... **3/$599.00**
Plus Shipping

CASE STYLE MAY DIFFER

DAISY TERMINALS

featuring the DIABLO HyType Daisy Printer. This exciting terminal features: RS232C ASCII, 110-1200 BAUD, KSR operation plus fantastic *PLOTTER* mode with bi-directional horiz. & vert'l movement, 1/60"H & 1/48"V increments. 15" platen, prints at 10, 15 & 30 cps! Uses plastic printwheel and has many more exciting features. Includes operator's manual & schematics. Used & refurbed.

Now Only **$1499.00**
Add $30.00 for Shipping Crate. Pay Shipping On Delivery

* SELECTRIC Typewriter Terminals

USED, off-lease. Features IBM Selectric Printer RS232 I/O. Takes BCD code type elements. Whole and complete. "AS-IS" (may need some adjustments). *SEE OUR OCT. 1980 ADVERTISEMENT* in this magazine. 15" carriage, type ball included. 110 VAC includes power supply, I/O and printer circuits and more.

Only **$469.00**
Add $18.00 for Shipping Crate. Pay Shipping On Delivery
Maintenance Manuals Available... **$25.00**

2/$750

*IBM Trademark

GET YOUR COPY OF OUR LATEST FLYER!
Circle the Bingo Card Number or Send a 1st Class Stamp for a Free Copy.

CFR ASSOCIATES, INC.
18 Granite Street
Haverhill, Mass. 01830

617-372-8536
Phone Orders Welcome

CIRCLE 30 ON FREE INFORMATION CARD

INTERNATIONAL ELECTRONICS UNLIMITED

IMMEDIATE DELIVERY OF QUALITY RESISTORS

CARBON FILM RESISTORS 1/4 & 1/2 watt

CARBON FILM ±5%
1/4watt (R.Ohm R25)
.095"dia X .250"long (body)
1/2watt (R.Ohm R50)
.146"dia X .354"long (body)

PRICING

total quantity	ea	pk-10	pk-100	pk-1000
1-999	$.10	.45	2.00	
1000-	.10	.40	1.80	15.00
5000-	.10	.30	1.70	14.50
10000-	.10	.25	1.55	13.00

25 or more resistors - not individually packaged - mixed - specify any assortment of values $.04ea

.5	3.9	16	68	300	1.2K	5.1K	22K	91K	390K	1.6M	*6.2M
1.0	4.3	18	75	330	1.3K	5.6K	24K	100K	430K	1.8M	*6.8M
1.1	4.7	20	82	360	1.5K	6.2K	27K	110K	470K	2.0M	*7.5M
1.2	5.1	22	91	390	1.6K	6.8K	30K	120K	510K	2.2M	*8.2M
1.3	5.6	24	100	430	1.8K	7.5K	33K	130K	560K	2.4M	*9.1M
1.5	6.2	27	110	470	2.0K	8.2K	36K	150K	620K	2.7M	*10M
1.6	6.8	30	120	510	2.2K	9.1K	39K	160K	680K	3.0M	*11M
1.8	7.5	33	130	560	2.4K	10K	43K	180K	750K	3.3M	*12M
2.0	8.2	36	150	620	2.7K	11K	47K	200K	820K	3.6M	*13M
2.2	9.1	39	160	680	3.0K	12K	51K	220K	910K	3.9M	*15M
2.4	10	43	180	750	3.3K	13K	56K	240K	1.0M	4.3M	(* 1/2w
2.7	11	47	200	820	3.6K	15K	62K	270K	1.1M	4.7M	only)
3.0	12	51	220	910	3.9K	16K	68K	300K	1.2M	5.1M	
3.3	13	56	240	1.0K	4.3K	18K	75K	330K	1.3M	5.6M	
3.6	15	62	270	1.1K	4.7K	20K	82K	360K	1.5M		

Rohm QUALITY RELIABILITY

METAL FILM RESISTORS

METAL FILM ±1%
RN60 (R.Ohm CRB60FY) 1/4watt
Low temp coef - 50ppm/°;
.138"dia X .355"long (body)
color banded

total quantity	ea	pk-10	pk-25	pk-100	pk-250
1-999	$.25	1.00	2.00	7.50	17.50
1000-	.20	.90	1.80	7.00	16.25
5000-	.20	.85	1.70	6.50	15.00
10000-	.20	.80	1.55	6.00	13.75

10 or more resistors - not individually packaged - mixed - specify any assortment of values $.15ea

VALUES STOCKED (ohms)
Standard 1% metal film values from 10 ohm to 475K ohm

10.0	12.1	14.7	17.8	22.6	27.4	33.2	40.2	48.7	59.0	71.5	88.7
10.2	12.4	15.0	18.2	23.2	28.0	34.0	41.2	49.9	60.4	73.2	90.9
10.5	12.7	15.4	18.7	23.7	28.7	34.8	42.2	51.1	61.9	75.0	93.1
10.7	13.0	15.8	19.1	24.3	29.4	35.7	43.2	52.3	63.4	76.8	95.3
11.0	13.3	16.2	19.6	24.9	30.1	36.5	44.2	53.6	64.9	80.6	97.6
11.3	13.7	16.5	20.0	25.5	30.9	37.4	45.3	54.9	66.5	82.5	
11.5	14.0	16.9	20.5	26.1	31.6	38.3	46.4	56.2	68.1	84.5	
11.8	14.3	17.4	22.1	26.7	32.4	39.2	47.5	57.6	69.8	86.6	

and multiples of 10 of the above values to 475K
i.e. 10.0 100 1.0K 10.0K 100K etc (total 448)

Rohm QUALITY RELIABILITY

VOLTAGE REGULATORS — **10% OFF ON $25.00 — 15% OFF ON $50.00**

LM320T-5	Negative 5 V reg (7905)	1.19
LM320T-12	Negative 12 V reg (7912)	1.19
LM320T-15	Negative 15 V reg (7915)	1.19
LM340T-5	Positive 5 V reg (7805)	1.19
LM340T-8	Positive 8 V reg (7808)	1.19
LM340T-12	Positive 12 V reg (7812)	1.19
LM340T-15	Positive 15 V reg (7815)	1.19

DISCRETE LED'S

JUMBO LED
.20"dia, diffused
Red, Clear or White 10/$1.00 25/$2.00 100/$7.50
Green or Yellow 7/$1.00 25/$2.85 100/$9.75
SUBMINITURE LED
.125"dia, diffused
Red or Clear 10/$1.00 25/$2.00 100/$7.50
Green or Yellow 7/$1.00 25/$2.85 100/$9.75

2N3904 NPN TO-92 10/$1.50
2N3906 PNP TO-92 25/$3.00
100/$11.00

1N4148 400mw 15/$1.00 100/$5.00
1N4001 rectifier 12/$1.00 100/$7.00
1N4007 rectifier 10/$1.00 100/$9.00

Payment by check, M.O., UPS-COD, M/C or VISA. Add $1.00 shipping/handling in US, Canada & Mexico. Other countries $1.00 + 5% of order. California residents add sales tax. Minimum order $10.00

INTERNATIONAL ELECTRONICS UNLIMITED
225 Broadway Jackson Ca 95642
phone 209 223 3870

CIRCLE 62 ON FREE INFORMATION CARD

MICRO MART

552 Summit Ave.
Westfield, N.J. 07090
(201) 654-6008

SUBSCRIPTION TV DECODER KIT

Please refer to this month's Radio Electronic's feature article for information regarding our kit.

Complete kit $75.00
Manual & drilled & etched project board $20.00
Additional boards (with one board & manual) $15.00

DIRECT LINE FOR *ORDERS ONLY*—201-654-6029

7 SEG Displays (comp. grade) .3"/95¢-.6"/1.45 (specify ann. or cath.)

AM/FM RADIO CHIP—(#4408) 2.00 or 3/5.00 Complete AM/FM IC-external IF required

DIPPED TANTALUMS .47 µf 35V (1" leads) 10/1.00

SUPER SUB MINI LYTICS (1" rad. leads, by Nichicon) 1000µf 50V (1⅜" L X ¾" W), 75¢ or 10/6.00 47 µf 25V (⅞" L X ⅜" W), 10/$1.00 400µf 330V (photo flash or laser circuits)-2/1.00

COMPUTER GRADE TWIST LOCKS 3200µf 50V (ideal for power supplies) 2.00 1000µf 50V—1.00 1000µf 185V—2.00

DISCS—.001 1KV 25/1.00, .1 50V 15/1.00

HEAT SENSITIVE SWITCH—4/1.00 self contained unit opens at 150 C

9 DIGIT FLUORESCENT DISPLAY by NEC complete with driving circuitry-2.50

MOTION DETECTOR: Features include transparent, optical IC completely assembled on circuit board with necessary capacitors. Extensive specs and application notes included./$5.00

CRYSTALS—3.579545 MHz 99¢
6.0 MHz 2.95

JUMBO LED's
Green, 7/1.00-Yellow, 7/1.00-Red, 10/1.00
100/13.00 100/13.00 100/9.00

MOUNTING CLIPS—12/1.00

EXTRA LOUD 9V BUZZER—3/2.00

FREQUENCY COUNTER CHIP ICM 7225 IPL (40 pin), with on board dividers, decoders/drivers. 18.95-specs included

ZENER DIODES—20V 1 amp 10/1.00

LINEAR

LM 323K	5.00	LM 1303	1.50
LM 300H	.75	LM 1304	.95
LM 301AN	.33	LM 1305	1.15
LM 307H	.50	LM 1307	.90
LM 307	.35	LM 1307E	.90
LM 308H	.95	LM 1310	1.75
LM 308	.90	LM 1391	1.50
LM 310	1.05	LM 1414	2.25
LM 311H	.85	LM 1800	2.90
LM 317K	5.00	LM 1808	2.75
LM 318H	1.25	LM 1820	1.75
LM 320K-15	1.15	LM 1828	1.75
LM 320K-12	1.15	LM 1830	1.50
LM 324	1.25	LM 1841	1.75
LM 325	1.85	LM 1848	1.75
LM 339J	1.00	LM 1889	4.50
LM 340K-12	1.25	LM 2111	1.60
LM 341P-12	1.25	LM 2113	1.75
LM 343H	3.50	LM 2907	2.40
LM 373	2.95	LM 2917	1.95
LM 377	2.00	LM 3046	1.10
LM 380	1.15	LM 3054	1.50
LM 381	1.60	LM 3064	2.00
LM 384	1.85	LM 3065	1.50
LM 386	1.50	LM 3067	2.50
LM 389	1.50	LM 3070	2.50
LM 390	1.95	LM 3071	2.00
LM 746	2.50	LM 3075	2.75
LM 748CN	.39	LM 3089	1.75
		LM 3900	.75

Terms MICRO-MART accepts Visa, MC, and telephone COD'S. Foreign orders $50.00 minimum plus shipping-US funds only. Orders under $10.00 include $2.00 for shipping/handling. All components guaranteed or money refunded. Immediate shipping. N.J. residents add 5% sales tax.

MICRO-MART • 552 SUMMIT AVE., WESTFIELD, N.J. 07090 • (201) 654-6008

Telephone Listening Device

Record telephone conversations in your office or home. Connects between any cassette or tape recorder and your telephone or telephone LINE. Starts automatically when phone is answered. Records both sides of phone conversation. Stops recorder when phone is hung up. This device is not an answering service.

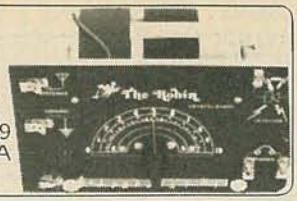
Each $18.95
Qty. Disc. Avail

Super Powerful
Wireless Mic

10 times more powerful than other mics. Transmits up to ¼ mile to any FM radio. Easy to assemble kit. 15V battery (not incl.)

Call (305) 725-1000 or send $18.95 + $1.00 shipping per item to USI Corp., P.O. Box RE-2052, Melbourne, FL 32901. COD's accept. For catalog of transmitters, voice scramblers and other specialty items, enclose $2.00 to USI Corp.

CRYSTAL RADIO Complete! $25.00 ppd. BOB RYAN PO Box 3039 Anaheim, CA 92803



AMAZING ELECTRONIC PROJECTS and PRODUCTS: Lasers Super Powered, Burning Cutting, Rifle, Pistol. Pocket. See in Dark—Shotgun Directional Mike—Unscramblers—Giant Tesla—Stunwand—TV Disrupter—Energy Producing, Surveillance, Detection, Electrifying, Ultrasonic, CB, Auto and Mech. Devices, Hundreds More—All New Plus INFO UNLTD PARTS SERVICE. Catalog $1. **Information Unlimited, Dept. R8 Box 716 Amherst, N.H. 03031.**

HIGHLY PROFITABLE
ONE-MAN ELECTRONIC FACTORY

Investment unnecessary, knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! **Postcard will do. Barta-RE-I, Box 248, Walnut Creek, CA 94597.**

BIOPHYSICAL MONITORING

TELEMETRY transmitter detects arterial pulses with pressure sensitive transducer placed over wrist artery. Each detected pulse transmitted as audio tone, (beep), to standard FM radio. Flashing LED provides visual indication. Completely assembled. Transducer, wrist strap, and battery included. Size: 4.4" x 2.4" x 1.2". Order model BPT-17. $39.50 plus $2.00 shipping. **OMNI-TEK,** Box 1318, Longmont, CO 80501

TELEMETRY transmitters: EKG—$27.50, arterial pulse—$39.50. Free information. **OMNI-TEK,** Dept. RE, BOX 1318, Longmont, CO 80501

WANTED

BASEBALL cards, other sport and non-sport cards, sports memorabilia of all types. I will buy/sell/sell on consignment. **J. LANNING MYERS,** 6609 Horseshoe Rd. Clinton, MD 20735. 301-868-1510

WE buy sell used vacuum pumps, diffusion pumps and **picture tube** rebuilding equipment. Phone—(312) 583-6565. Write—**LAKESIDE,** 4071 N. Elston, Chicago, IL 60618

PLANS & KITS

PRINTED circuit boards from sketch or artwork. Kit projects. Free details. **DANOCINTHS INC.,** Box 261, Westland, MI 48185

DIGITAL multimeter kits handheld, best quality 0.1% accuracy. The lowest price in America $67.50 write: **E. G. TRONICS,** 8254 Greenleaf Circle, Tampa FL 33615

SOUND effects synthesizer. Uses voltage controlled circuits to make unlimited sounds. Imitates drum synthesizer. Build it yourself and save. PC board plus complete plans only $9.95 or send stamp for information. **WAVEFORM PROCESSING,** 7 Bradford Avenue, Pittsburgh, PA 15205

CIRCLE 3 ON FREE INFORMATION CARD

DECODE Morse and RTTY signals off the air with new **Morse-a-Word** or **RTTY reader.** Morse keyboard also available. Kits or factory wired. Send for details. **MICROCRAFT,** Box 513R, Thiensville, WI 53092 (414) 241-8144.

CRYSTAL radio builders . . . $1.00 brings you two sets plans, details, price list. **BOB RYAN,** P.O. BOX 3039, Dept. R., Anaheim, CA 92803

PICTURE tube restorer. New method. Plans—$5.00. **PAYETTE ENTERPRISES,** BOX 250, Echo Bay, Ontario P0S 1C0

BUILD microcomputer trainer. Send $5.00 for 2 complete instruction manuals. **PACCOM,** 14905 NE 40th, Dept. PRE120, Redmond, WA 98052

PROJECTION TV. . . . Convert your TV to project 7 foot picture. Results equal to $2,500 projector. Total cost less than $20.00. Plans & lens $16.00. Illustrated information **free. MACRO-COMGE** Washington Crossing, PA 18977

SCRAMBLED TV decoder. Complete circuit/instructions $10.00. **G&C,** P.O. Box 1055, Dedham, MA 02026

TREASURE finder plans, schematics and pictorials, single and multiple stage $5.00. **EVANS,** Box 402, Mt. Lookout, WV, 26678

RESISTORS ¼ watt 5% carbon film factory fresh 1.65 per hundred, 12.00 per thousand. Integrated circuits 4116 dynamic RAM 8 for 34.00, 2716 @ 11.00, 2732 @ 37.00, IC sockets, capacitors, trim pots, and more. Free catalog. **WESTLAND ELECTRONICS,** 34245 Ford Rd., Westland, MI 48185. (313) 728-0650

PLANS: Subscription television decoder, UHF over the air type, $10.00. **Telephone memory dialer,** stores 32 numbers, $3.00. **Negative ion generator,** easy to build, $3.00. We sell complete plan sets which include detailed instructions and circuit board patterns. Parts and kits also available. **COLLINS ELECTRONICS,** Box 6424, San Bernardino, CA 92408

TWELVE bands/channel $100.00 kit still available; see May 1978 R/E cover story or write: **SYMMETRIC SOUND SYSTEMS,** 912 Knobcone PL, Dept. R, Loveland, CO 80537

ROBOT info—booklet, $4; basic plans, $6.50; advanced plans, $9.45. **OMEGA ENTERPRISES INC.,** "The Robot People", P.O. Box 4143, Dept. RE, Tulsa, OK 74104

SAVE 90%. Build your own minicomputer. Free details. **DIGITRONICS CORPORATION,** 273E W. Butler Dr., Phoenix, AZ 85021

VINTAGE tubes of World War II era . . . never used, in original factory boxes. #957 "acorn" = 18 for $5.00 postpaid. 1¼-volt filament. Supply limited. **BOB RYAN,** P.O. BOX 3039, Anaheim, CA 92803

SUBSCRIPTION TV decoder circuits. Detailed plans $4.60, **JOE,** PO Box 61, Cumberland, RI 02864

DISCOUNT TRS-80® DEALER A301
COMPUTER SPECIALISTS

FREE COMPUTI CATALOC UPON REQUEST.

Up to 15% Discount on TRS-80's

26-1051 4K LEVEL I	$ 424.00
26-1056 16K LEVEL II	670.00
26-4002 64K I DRIVE	3466.00

1-800-841-0860 TOLL FREE
MICRO MANAGEMENT SYSTEMS, INC.
Downtown Plaza Shopping Center
115 C. Second Av., S.W.
Cairo, Georgia 31728
(912) 377-7120 Ga. Phone No.

FOR SALE

SCANNER/monitor accessories—kits and factory assembled. Free catalog. **CAPRI ELECTRONICS,** Route 1R, Canon, GA 30520

FREE catalog, IC's, semi's, parts. **CORONET ELECTRONICS,** 649A Notre Dame W., Montreal, Que., Canada H3C 1H8. U.S. inquiries.

SAVE up to 50% on name brand test equipment. Free catalog and price list. **SALEN ELECTRONICS,** Box 82-M, Skokie, IL 60077

GOVERNMENT surplus receivers, transmitters, snooperscopes, parts, fantastic 72 page catalog 25¢. **MESHNA,** Nahant, Mass. 01908

100 W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:
- Output power: 100W RMS into 8-ohm
  125W RMS into 4-ohm
- Frequency response: 10Hz - 100 KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: ±40V @ 5 amp

TA-1000 KIT $51.95
Power transformer $15.00 each

PROFESSIONAL 10 OCTAVE STEREO GRAPHIC EQUALIZER!!

Graphic equalizer have been used for years in sound studios and concert arenas but were too expensive to be considered for home use. Now we offer you the facility at an affordable price. This unit can extend your control of your Hi-Fi system by minimizing the non-linearities of the combined speaker/room system. Fantastic features as follows:
- 10 double slide controls for two channels
- Cut out rumble, surface noise and hiss
- Minimizes speaker/room non-linearities
- Frequency response from 30Hz to 16KHz
- 10 tone controls plus defeat, monitor and tape selector.
- Control range ± 12dB in 10 octaves (30Hz, 60Hz, 120Hz, 240Hz, 500Hz, 1KHz, 2KHz, 4KHz, 8KHz, 16KHz.)
- Operating voltage 117V 50/60Hz.

FACTORY ASSEMBLED UNIT, NOT A KIT
SPECIAL PRICE **$69.50** ea.

SUB MINI SIZE FET CONDENSER MICROPHONE

Specification:
Sensitivity: — 65dB ± 3db
FEQ. Response: 50 Hz 8 KHz
Output Impedance: 1K ohm max.
Polar Pattern: Omni-directional
Power Supply: 1.5V 10V D.C.
Sound Pressure Level: Max. 120dB
EM4RP **$2.50** ea. or **2** for **$4.50**

NEW MARK III 9 Steps 4 Colors LED VU

Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large, from —30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V - 9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output!

IN KIT FORM $18.50

2 WATT AUDIO AMP

Pre assembled units. All you need is to hook up the speaker and the volume control. Supply voltage from 9~15V D.C. measures only 2" x 3½", making it good for portable or discrete applications. Comes with hook up data.

BUY 2 FOR **$4.99**

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from —36dB ~ +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6~12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!

Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.

MARK IV KIT **$31.50**

NEW MARK V 15 STEPS LED POWER OUTPUT INDICATOR KIT

All functions same as Mark IV but this is with heavy duty aluminum front plate and case. Can be easily slot into the front panel of your auto, truck or boat. Operates on 12V DC.

$41.50 EACH KIT

BATTERY POWERED FLUORESCENT LANTERN

MODEL 888 R

FEATURES
- Circuitry: designed for operation by high efficient, high power silicon transistor which enable illumination maintain in a standard level even the battery supply drops to a certain low voltage.
- 9" 6W cool/daylight miniature fluorescent tube.
- 8 x 1.5V UM-1 (size D) dry cell battery.
- Easy sliding door for changing batteries.
- Stainless reflector with wide angle increasing lumination of the lantern.

$10.50 EA

30W+30W STEREO HYBRID AMPLIFIER KIT

It works in 12V DC as well! Kit includes 1 PC SANYO STK-043 stereo power amp. IC LM 1458 as pre amp, all other electronic parts, PC Board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 60 watts (30 watts per channel) yet gives out less than 0.1% total harmonic distortion between 100Mz and 10KHz.

$32.50 PER KIT

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Suply 6 18V DC
ONLY $6.00 EACH

PROFESSIONAL PANEL METERS

Type MU-52E

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

All meters white face with black scales. Plastic cover.

SPECIAL 0.5" LED SALE ALARM CLOCK MODULE

ASSEMBLED! NOT A KIT!

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

ONLY **$7.00 EACH**
SPECIAL TRANSFORMER FOR CLOCK
$2.50

DIGITAL AUTO SECURITY SYSTEM

4 DIGITS PERSONAL CODE!!
SPECIAL $19.95

- proximity triggered
- voltage triggered
- mechanically triggered

This alarm protects you and itself! Entering protected area will set it off, sounding your car horn or siren you add. Any change in voltage will also trigger the alarm into action. If cables within passenger compartment are cut, the unit protects itself by sounding the alarm. **3-WAY PROTECTION!**

All units factory assembled and tested — Not a kit!

SANYO HYBRID AUDIO POWER AMPLIFIER I.C.

Typical ratings
Operating case temp. 85°C.
T.H.D. = 0.5% f = 20~20KHZ
Input resistance Po = 0.1W 30K
Power band width 20HZ~20KHZ
Freq. response 10HZ~100KHZ
Output resistance = 8
With built in protection circuit.
All units come with data sheet.

PART	OUTPUT (W)	SUPPLY VOLTAGE	PRICE
STK040	10W+10W Stereo	±16V D.C.	**$14.50**
STK041	15W+15W Stereo	±20V D.C.	**$18.50**
STK043	20W+20W Stereo	±22V D.C.	**$22.50**
STK054	23 WATTS	±23V D.C.	**$13.50**
STK056	30 WATTS	±22V D.C.	**$18.50**
STK050	50 WATTS	±35V D.C.	**$26.50**
STK070	70 WATTS	±42V D.C.	**$32.50**
STK1050	100 WATTS	±50V D.C.	**$40.50**

PROFESSIONAL FM WIRELESS MICROPHONE

TECT model WEM-16 is a factory assembled FM wireless microphone powered by an AA size battery. Transmits in the range of 88-108MHz with 3 transistor circuits and an omni-directional electric condenser. Element built-in plastic tube type case; mike is 6¼" long. With a standard FM radio, can be heard anywhere on a one-acre lot; sound quality was judged very good.

$16.50

FLASHER LED

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

2 for $2.20

BIPOLAR LED RED/GREEN

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

2 FOR $1.60

LCD CLOCK MODULE!

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

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

SANYO UHF VARACTOR TUNER

For UHF CH 14~83
Tuning voltage + 1V~+ 28V/D.C. Input impedance 75 OHM. I.F. band width 7~16 MHZ. Noise figure 11.5 dB MAX. Size 2⅜" x 1¼" x ¾". Supply voltage 15V D.C. Sound I.F. = 58.0 MHZ. Video I.F. = 62.5 MHZ

All units are brand new from Sanyo.
MODEL 115-B-405A
$35.00 EACH

FLUORESCENT LIGHT DRIVER KIT

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

With Case Only $6.50 Per Kit

SUPER FM WIRELESS MIC KIT — MARK III

This new designed circuit uses high FEQ. FET transistors with 2 stages pre amp. Transmits FM Range (88-120 MHz) up to 2 blocks away and with the ultra sensitive condenser microphone that comes with the kit, allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, OSC coils, and P.C. Board. Power supply 9V D.C.

FMC-105
$11.50 PER KIT

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT

EXCLUSIVE!! **$3.95 ea**
Model F-179

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

ELECTRONIC DUAL SPEAKER PROTECTOR

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

KIT FORM
$8.75 EA.

"FISHER" 30 WATT STEREO AMP

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

Super Buy Only $18.50

SPACE WAR SOUND GENERATOR BOARD

Brand new preassembled module for a toy factory. The board gives out 6 different selectable space sound with LED light effect. Sounds include UFO take-off, space gun blast, wave, and space chime. 7 LED on the board will work with the sound. Requires 9V battery to operate. Speaker not included.
SPECIAL **$3.99** EACH SPEAKER **$1.25** EACH

ELECTRONIC PIEZO BEEP BUZZER

Unique surplus ⅞" Dia. piezo ceramic disc on circuit board gives a distinct high freq. buzz. Unit contains an I.C., 2 caps, 6 resistors and is already preassembled. Requires 9V battery to operate.
SPECIAL 2 FOR **$2.99**

2 BIT COUNTER, WARBLE PULSE ALARM BOARD

This new assembly easily converts to a counter, stop watch, warble and pulse alarm generator by adding a few components. We supply the data and typical applications. Requires 9V battery to operate.
SPECIAL 2 FOR **$1.99**

PUSH-BUTTON SWITCH

N/Open Contact
Color: Red, White, Blue, Green, Black
3/$1.00
N/Close also Available
50¢ each
LARGE QTY. AVAILABLE

HEAVY DUTY CLIP LEADS

10 pairs — 5 colors Alligator clips on a 22" long lead. Ideal for any testing.
$2.20/pack

BATTERIES

PK/$10.00
2 PKS/$19.00
ILLUSTRATED LESS COVER

NICKEL CADMIUM BATTERY PACK 'D' SIZE

Output: 3.6 Volts @ 3.0 Amp/Hour. Consists of three each, 1.2 Volt "D" size Nickel Cadmium Cells stacked and plastic film encapsulated. Tabs are provided at each end for electrical connections. The individual cells can be cut apart if desired. Rated recharge rate is 30 mA, 14-18 hours. Size: 1¼" dia. x 7" long. New. Shpg. Wt. each pack, 1 lb.

"C" SIZE BATTERY PACK

10 C size ni-cd battery in dng pack, gives out 12.5V D.C. 1.8 amp per hour. All fresh code, pull-out from movie cameras. Can be disconnected to use as single c cells. Hard to find **$15.00** per pack of 10 batteries.

NI-CD BATTERY SALE

12V Pack 450 MZ/HR Size 3" x 1" x 2"
$8.00 PER PACK

4 AA Pack 450 MA/HR
$3.50 PER PACK

All above batteries are used but late date code and we guarantee to take back all bad ones for exchange.

ELECTRONIC PIN BALL MACHINE

That sounds and plays like the real thing. All units are brand new but without the case. Functions of the game include double flipper control, kicker control, 1-4 players, 3 speed ball control, tilt switch, automatic score, extra bonus cave and many more. All solid state with LED panel, no moving parts. Requires 9V battery to operate, speaker not included.

A perfect gift for yourself or friends.
SPECIAL **$8.99** EACH
SPEAKER **$1.25** EACH

ULTRASONIC SWITCH KIT

Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC. **$15.50**

COMPLETE TIME MODULE

0.3" digits LCD Clock Module with month and date, hour, minute and seconds. As well as stop watch function!! Battery and back up light is with the module. Size of the module is 1" dia. Ideal for use in auto panel, computer, instrument and many others! **$8.95 EACH**

SOUND ACTIVATED SWITCH

All parts completed on a PC Board SCR will turn on relay, buzzer or trigger other circuit for 2 - 10 sec. (adjustable). Ideal for use as door alarm, sound controlled toys and many other projects. Supply voltage 4.5V 9V D.C.

$1.75 ea. **2 for $3.00**

FM WIRELESS MIC KIT

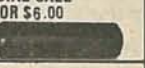
It is not a pack of cigarettes. It is a new FM wireless mic kit! New design PC board fits into a plastic cigarette box (case included). Uses a condensor microphone to allow you to have a better response in sound pick-up. Transmits up to 350 ft.! With an LED indicator to signal the unit is on #FMM2 **KIT FORM $7.95**

REGULATED DUAL VOLTAGE SUPPLY KIT

±4 30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.
$12.50 PER KIT

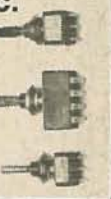
AA SIZE NI-CD

SPECIAL SALE 4 FOR $6.00
RECHARGEABLE BATTERIES
LIMITED QUANTITY AVAILABLE



SUB MINIATURE TOGGLE SWITCH 6 AMP 125V A.C.

SPDT	$1.20
SPDT MOMENTARY	$1.40
DPDT	$1.80
DPDT MOMENTARY	$1.80
DPDT (CENTER OFF)	$2.20
3PDT	$2.20
3PDT (CENTER OFF)	$2.50
4PDT	$2.80
4PDT (CENTER OFF)	$3.80



POWER SUPPLY KIT

0-30V D.C. REGULATED
Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts.

Transformer for Power Supply, 2 AMP 24V x 2 **$8.50**
0-30 Power Supply **$10.50 each**

I.C. TEST CLIPS

Same as the E-Z clips With 20" Long Leads In Black and Red Colors **$2.75 per pair**

SOUND GENERATOR I.C.

Creates almost any type of sound — gun shot, explosion, train, car crash, star war, birds, organ ext. A built-in audio amplifier provides high level output. Operates from one 9V battery, 28 pin dip; we supply the datas. **$2.90 EACH**

ELECTRONIC SWITCH KIT

CONDENSER TYPE
Touch On Touch Off
uses 7473 I.C. and 12V relay
$5.50 each

1 WATT AUDIO AMP

All parts are pre-assembled on a mini PC Board. Supply Voltage 6 9V D.C. **SPECIAL PRICE $1.95 ea.**

LOW TIM DC STEREO PRE-AMP KIT TA-10 20

Incorporates brand-new D.C. design that gives a frequency response from OHz — 100KHz ±0.5dB! Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation!
Specifications: • T.H.D. less than .005% • T.I.M. less than .005% • Frequency response: DC to 100KHz ±0.5dB • RIAA deviation: ±0.2dB • S/N ratio: better than 70dB • Sensitivity: Phono 2MV 47K/Aux. 100MV 100K • Output level: 1.3V • Max. output: 15V • Tone control: bass ±10dB @ 50Hz/treble ±10dB @ 15Hz • Power supply: ±24 D.C. @ 0.5A
Kit comes with regulated power supply, all you need is a 48V C.T. transformer @ 0.5A.

ONLY $44.50
X'former
$4.50 ea.

SOLID STATE ELECTRONIC BUZZER

Mini size 1" x ¾" x ¾"
Supply voltage 1.5V - 12V
Ideal for Alarm or Tone Indicator

$1.50 each

FORMULA INTERNATIONAL INC.

11/80

	SHIPPING AND HANDLING CHARGES Under $50.00 purchase	Over $50.00 purchase
Inside California	10%	5%
Outside Calif. (includes Mexico & Canada)	15%	10%
Overseas	25%	20%

Minimum Order $10.00/Calif. Residents Add 6% Sales Tax
Phone Orders Accepted on Visa or MC ONLY, NO C.O.D./Store Hours 10-7 Mon. thru Sat.

Send $1.00 For Detailed Catalogue

12603 CRENSHAW BLVD., HAWTHORNE, CA 90250
PHONE: (213) 973-1921 • (213) 679-5162

CIRCLE 22 ON FREE INFORMATION CARD

National Semiconductor Clock Modules

12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal time-base. ±0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

MA1003 Module $16.95

MA1023 .7" Low Cost Digital LED Clock Module	8.95
MA1026 .7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036 .3" Low Cost Digital LED Clock/Timer	6.95
MA1002 .5" LED Display Dig. Clock & Xformer	9.95

National Semiconductor RAM SALE

MM5290N-4 (MK4116/UPD416) . . $4.95 each
16K DYNAMIC RAM (250NS)
(8 EACH $39.95) (100 EACH $450.00/lot)

MM5290J-2 (MK4116/UPD416) . . $6.95 each
16K DYNAMIC RAM (150NS)
(8 EACH $49.95) (100 EACH $550.00/lot)

MM5298J-3A . . . . . $3.25 each
8K DYNAMIC RAM (LOW HALF OF MM5290J) 200NS
(8 EACH $23.95) (100 EACH $250.00/lot)

MM2114-3 . . . . . $5.95 each
4K STATIC RAM (300NS)
(8 EACH $43.95) (100 EACH $450.00/lot)

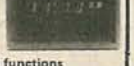
MM2114L-3 . . . . . $6.25 each
4K STATIC RAM (LOW POWER 300NS)
(8 EACH $44.95) (100 EACH $475.00/lot)

EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E $79.50

Jumbo 6-Digit Clock Kit



- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE747 . . . . . $29.95

6-Digit Clock Kit

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701 . . . . . $19.95

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 . . . . . $14.95

ADAPTER BOARD —Adapts to JE200— ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XFMR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 . . . . . $12.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	7.95
DP8253	Prog. Interval Timer	14.95
DP8255	Prog. Peripheral I/O (PPI)	9.95
DP8257	Prog. DMA Control	19.95
DP8259	Prog. Interrupt Control	14.95
DP8275	Prog. CRT Controller	49.95
DP8279	Prog. Keyboard/Display Interface	19.95
DP8300	Octal Bus Receiver	6.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	14.95
MC6802CP	MPU with Clock and RAM	19.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	10.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	19.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	13.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	15.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MC6802	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N-4	MPU - 8-Bit (6MHz)	16.95
INS8039N-4	CPU—Sgl. Chip 8-Bit (128bytes RAM)	19.95
INS8040N-4	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	19.95
INS8900	CPU—16-Bit	29.95
TMS9900JL	MPU—16-Bit	49.95

SHIFT REGISTERS

MM5001H	Dual 25-Bit Dynamic	.50
MM5013H	Dual 50-Bit Dynamic	.50
MM5016H	Dual 100-Bit Static	.50
MM5018H	Dual 64-Bit Accumulator	.50
MM1402	256-Bit Dynamic	3.95
MM5013	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	.89
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	3.95
2518N	Hex 20-Bit Static	4.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Pass Filter	19.95
AF125-1CJ	Touch Tone Low Pass Filter	19.95
LM308AH	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	2.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	4.95
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1006LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	300 BAUD UART	5.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
2102L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114-3	1024x4 Static 300ns	7.49
2114L-3	1024x4 Static 300ns Low Power	7.95
2117	16,384x1 Dynamic 550ns (housemarked)	4.95
4116 (UPD416)	16K Dynamic 250ns	4.95
MM2147J	4096x1 Fast 70ns	19.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.25
MM5280/2107	4096x1 Dynamic	4.95
MM5290J-2(4136)	16K Dynamic 150ns (UPD436)	6.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	4.95
7489	16x4 Static	1.75
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	14.95
TMS4045	1024x4 Static	14.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	9.95
TMS2716	16K EPROM (-5V, +5V, +12V)	19.95
2716(Intel(2516)T)	16K EPROM (Single +5V)	17.95
2732(Intel(2532)T)	32K EPROM	49.95
2758	8K EPROM (450ns) (Single +5V)	7.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	4.95
82S115	4096 Bipolar PROM	19.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	4.95
82S185	8K PROM	29.95

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95
2516N	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

NMOS READ ONLY MEMORIES

MCM66710P	128x8x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x8x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha, Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

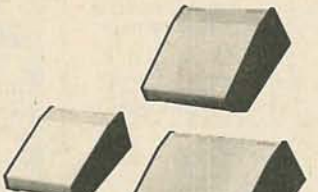
SPECIAL FUNCTION

DS0026CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2661N	Communication Chip	19.95
MM5837N	Microprocessor Real Time Clock	8.95
MM5837N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	20-Seg.VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

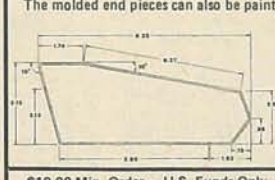
AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53200N	Push Button Pulse Dialer	7.95
MM57409N	96/144-Key Serial Keyboard Encoder	8.95

DESIGNERS' SERIES
Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top / bottom panels .080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:
The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus $1 Insurance

Spec Sheets — 25¢
Send 41¢ Postage for your FREE 1981 JAMECO CATALOG

NEW 1981 CATALOG!

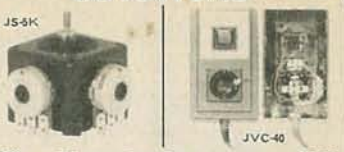
Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

1/81

JOYSTICKS



JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case	$5.95

AC and DC Wall Transformers

Ideal for use with clocks, games, power supplies or any other type of AC or DC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95
AC1000	117V/60Hz	12 VAC 1 amp	$5.95
DV9200	117V/60Hz	9 VDC 200mA	$3.25
DC 900	120V/60Hz	9 VDC 500mA	$3.95

CONNECTORS

DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80
16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
★8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
★Documentation for Conversion

TRS-16K2 *150NS $49.95
TRS-16K4 *250NS $39.95

JE610 ASCII
Encoded Keyboard Kit

The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK (as pictured above) . . . $124.95
JE610 Kit 62-Key Keyboard, PC Board, & Components (no case) . . . . $ 79.95
K62 62-Key Keyboard (Keyboard only) . . . $ 34.95
DTE-AK (case only — 3⅛"Hx11"Wx8¾"D) $ 49.95

JE600
Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT
19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3⅛"H x 8¾"W x 8¾"D

JE600/DTE-HK (as pictured above) $99.95
JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) . . $59.95
K19 19-Key Keyboard (Keyboard only) . . . $14.95
DTE-HK (case only — 3⅛"Hx8¾"Wx8¾"D) $44.95

7400

SN7400N	.25			SN74156N	.79
SN7401N	.20			SN74157N	.69
SN7402N	.25	SN7472N	.29	SN74160N	.89
SN7403N	.25	SN7473N	.35	SN74161N	.89
SN7404N	.25	SN7474N	.35	SN74162N	.89
SN7405N	.29	SN7475N	.49	SN74163N	.89
SN7406N	.35	SN7476N	.35	SN74164N	.89
SN7407N	.35	SN7479N	5.00	SN74165N	.89
SN7408N	.29	SN7480N	.50	SN74166N	1.25
SN7409N	.29	SN7482N	.99	SN74167N	2.79
SN7410N	.25	SN7483N	.69	SN74170N	1.95
SN7411N	.29	SN7485N	.89	SN74172N	4.95
SN7412N	.35	SN7486N	.35	SN74173N	1.39
SN7413N	.40	SN7489N	1.75	SN74174N	.99
SN7414N	.69	SN7490N	.49	SN74175N	.89
SN7416N	.29	SN7491N	.59	SN74176N	.79
SN7417N	.29	SN7492N	.45	SN74177N	.79
SN7420N	.25	SN7493N	.45	SN74179N	1.49
SN7421N	.29	SN7494N	.69	SN74180N	.79
SN7422N	.45	SN7495N	.69	SN74181N	2.25
SN7423N	.29	SN7496N	.69	SN74182N	.79
SN7425N	.29	SN7497N	3.00	SN74184N	2.49
SN7426N	.29	SN74100N	1.49	SN74185N	2.49
SN7427N	.25	SN74107N	.35	SN74190N	1.25
SN7429N	.39	SN74109N	.39	SN74191N	1.25
SN7430N	.25	SN74116N	1.95	SN74192N	.89
SN7432N	.29	SN74121N	.39	SN74193N	.89
SN7437N	.25	SN74122N	.55	SN74194N	.89
SN7438N	.40	SN74123N	.59	SN74195N	.69
SN7439N	.25	SN74125N	.49	SN74196N	.89
SN7440N	.20	SN74126N	.49	SN74197N	.89
SN7441N	.89	SN74132N	.75	SN74198N	1.49
SN7442N	.59	SN74136N	.75	SN74199N	1.49
SN7443N	1.10	SN74141N	.99	SN74221N	1.25
SN7444N	1.10	SN74142N	3.25	SN74251N	.99
SN7445N	.89	SN74143N	3.49	SN74276N	1.95
SN7446N	.79	SN74144N	3.49	SN74279N	.79
SN7447N	.69	SN74145N	.79	SN74283N	1.49
SN7448N	.79	SN74147N	1.95	SN74284N	3.95
SN7450N	.20	SN74148N	1.29	SN74285N	3.95
SN7451N	.20	SN74150N	1.25	SN74365N	.69
SN7453N	.20	SN74151N	.69	SN74366N	.69
SN7454N	.20	SN74152N	.69	SN74367N	.69
SN7459A	.25	SN74153N	.79	SN74368N	.69
SN7460N	.20	SN74154N	1.25	SN74390N	1.49
SN7470N	.29	SN74155N	.79	SN74393N	1.49

74LS

74LS00	.29			74LS192	1.15
74LS01	.29			74LS193	1.15
74LS02	.29	74LS92	.75	74LS194	1.15
74LS03	.29	74LS93	.75	74LS195	1.15
74LS04	.35	74LS95	.99	74LS197	1.19
74LS05	.35	74LS96	1.15	74LS221	1.19
74LS08	.29	74LS107	.45	74LS240	1.95
74LS09	.35	74LS109	.45	74LS241	1.95
74LS10	.29	74LS112	.45	74LS242	1.95
74LS11	.75	74LS113	.49	74LS243	1.95
74LS12	.35	74LS114	.49	74LS244	1.95
74LS13	.59	74LS122	.89	74LS245	2.95
74LS14	.99	74LS123	1.25	74LS247	1.19
74LS15	.35	74LS125	.89	74LS248	1.19
74LS20	.29	74LS126	.55	74LS249	1.19
74LS21	.35	74LS132	.99	74LS251	1.49
74LS22	.35	74LS133	.89	74LS253	.99
74LS26	.35	74LS136	.49	74LS257	.89
74LS27	.35	74LS138	.89	74LS258	.99
74LS28	.35	74LS139	.89	74LS260	.69
74LS30	.29	74LS151	.89	74LS266	.69
74LS32	.35	74LS153	.89	74LS273	1.95
74LS33	.59	74LS154	1.75	74LS279	.75
74LS37	.45	74LS155	1.19	74LS283	1.09
74LS38	.49	74LS156	1.19	74LS290	.99
74LS40	.35	74LS157	.89	74LS293	.99
74LS42	.89	74LS158	.99	74LS298	1.25
74LS47	.89	74LS160	1.15	74LS352	1.29
74LS48	1.15	74LS161	1.15	74LS353	1.29
74LS49	1.15	74LS162	1.15	74LS365	.75
74LS51	.29	74LS163	1.15	74LS366	.75
74LS54	.29	74LS164	1.25	74LS367	.75
74LS55	.29	74LS165	1.25	74LS368	.75
74LS73	.45	74LS168	1.19	74LS373	1.95
74LS74	.45	74LS169	1.19	74LS374	1.95
74LS75	.59	74LS170	2.49	74LS375	.89
74LS76	.45	74LS173	1.39	74LS386	.69
74LS78	.49	74LS174	.99	74LS393	2.49
74LS83	.89	74LS175	.99	74LS399	2.49
74LS85	1.25	74LS181	2.95	74LS670	2.49
74LS86	.45	74LS190	1.25	81LS95	1.95
74LS90	.59	74LS191	1.25	81LS97	1.95

74S

74S00	.50			74S244	3.25
74S02	.50			74S251	1.45
74S03	.50	74S133	.55	74S253	1.45
74S04	.55	74S134	.69	74S257	1.35
74S05	.55	74S135	1.19	74S258	1.35
74S08	.50	74S136	1.75	74S260	.79
74S09	.50	74S138	1.35	74S280	2.95
74S10	.50	74S139	1.35	74S287*	4.95
74S11	.50	74S140	1.15	74S288*	4.95
74S15	.50	74S151	1.35	74S373	3.49
74S20	.50	74S153	1.35	74S374	3.49
74S22	.50	74S157	1.35	74S387*	5.95
74S30	.50	74S158	1.35	74S471*	19.95
74S32	.55	74S174	1.59	74S472*	19.95
74S40	.55	74S175	1.59	74S473*	19.95
74S51	.50	74S188	4.95	74S474*	21.95
74S64	.50	74S194	1.95	74S475*	21.95
74S65	.50	74S195	1.95	74S570*	7.95
74S74	.79	74S196	3.95	74S571*	7.95
74S86	.79	74S240	2.95	74S572*	19.95
74S112	.79	74S241	2.95	74S573*	19.95
74S113	.79	74S242	3.25	74S940	3.15
74S114	.79	74S243	3.25	74S941	3.15

* LIMITED AVAILABILITY ON THESE PROMS

CA–LINEAR

CA3013H	2.15			CA3089N	3.75
CA3023H	3.25			CA3096N	3.95
CA3039H	1.35			CA3130H	1.39
CA3046N	1.30	CA3081N	2.00	CA3140H	1.25
CA3059N	3.25	CA3082N	2.00	CA3160H	1.25
CA3060N	3.25	CA3083N	1.60	CA3401N	.59
CA3080H	1.25	CA3086N	.85	CA3600N	3.50

CD–CMOS

CD4000	.39			CD4082	.39
CD4001	.39			CD4093	.99
CD4002	.39			CD4098	2.49
CD4006	1.19			CD4506	.75
CD4007	.25	CD4041	1.49	CD4507	.99
CD4009	.49	CD4042	.99	CD4508	3.95
CD4010	.49	CD4043	.89	CD4510	1.39
CD4011	.39	CD4044	.89	CD4511	1.29
CD4012	.25	CD4046	1.79	CD4514	3.95
CD4013	.49	CD4047	2.50	CD4515	2.95
CD4014	1.39	CD4048	1.35	CD4516	1.49
CD4015	1.19	CD4049	.49	CD4518	1.79
CD4016	.59	CD4050	.69	CD4519	.89
CD4017	1.19	CD4051	1.19	CD4520	1.29
CD4018	.99	CD4052	1.19	CD4526	1.79
CD4019	.49	CD4053	1.19	CD4528	1.79
CD4020	1.19	CD4056	2.95	CD4529	1.95
CD4021	1.39	CD4059	9.95	CD4543	2.79
CD4022	1.19	CD4060	1.49	CD4562	11.95
CD4023	.29	CD4066	.79	CD4566	2.79
CD4024	.79	CD4068	.39	CD4583	2.49
CD4025	.23	CD4069	.45	CD4723	1.95
CD4026	2.95	CD4070	.55	CD4724	1.95
CD4027	.69	CD4071	.49	MC14409	14.95
CD4028	.89	CD4072	.49	MC14410	14.95
CD4029	1.49	CD4073	.39	MC14411	14.95
CD4030	.49	CD4075	.39	MC14412	11.95
CD4035	.99	CD4076	1.39	MC14419	4.95
CD4040	1.49	CD4081	.39	MC14433	13.95

JE608 PROGRAMMER
2708 EPROM PROGRAMMER

- 3 separate Display Registers: 8 LED's for Hex Key entries; 16 LED's (2" 2") for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip.
- Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board.
- Rapid checking verification of programmed data changes.
- User may move data from a master to RAM's or write into RAM's with keyboard entries.
- Allows manual stepping manipulation (up and down) at any address location.
- Stand alone EPROM Programmer consisting of: A 16 key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W.
- Compact desk top enclosure: Color coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3½"H x 11"W x 8½"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can simulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board with 25 IC's and including power supplies of: −5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel Board are separate assemblies within the system.

JE608K KIT $399.95
JE608A Assembled and tested $499.95

DISCRETE LEDS

XC556R	.200" red	5/$1	MV50	.085" red	6/$1	XC111R	.190" red	5/$1
XC556G	.200" green	4/$1	XC209R	.125" red	5/$1	XC111G	.190" green	4/$1
XC556Y	.200" yellow	4/$1	XC209G	.125" green	4/$1	XC111Y	.190" yellow	4/$1
XC556C	.200" clear	4/$1	XC209Y	.125" yellow	4/$1	XC111C	.190" clear	4/$1
XC22R	.200" red	5/$1	XC526R	.185" red	5/$1			
XC22G	.200" green	4/$1	XC526G	.185" green	4/$1			
XC22Y	.200" yellow	4/$1	XC526Y	.185" yellow	4/$1			
MV10B	.170" red	4/$1	XC526C	.185" clear	4/$1			

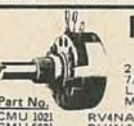
INFRA-RED LED
¼"x¼"x1/16" flat
IRL — 5/$1

DISPLAY LEDS

C.A. — Common Anode   C.C. — Common Cathode

Type	Polarity	Ht	Price	Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95	DL741	C.A.—red	.600	1.25
MAN 2	5x7 D.M.—red	.300	4.95	DL746	C.A.—red ± 1	.630	1.49
MAN 3	C.C.—red	.125	.25	DL747	C.A.—red	.600	1.49
MAN 52	C.A.—green	.300	1.25	DL750	C.C.—red	.600	1.49
MAN 54	C.C.—green	.300	1.25	DL33B	C.C.—red	.110	.35
MAN 71	C.A.—red	.300	.75	FND358	C.C. ± 1	.357	.99
MAN 72	C.A.—red	.300	.75	FND359	C.C.	.357	.75
MAN 74	C.C.—red	.300	1.25	FND503	C.C. (FND500)	.500	.99
MAN 82	C.A.—yellow	.300	.49	FND507	C.A. (FND510)	.500	.99
MAN 84	C.C.—yellow	.300	.99	HDSP-3401	C.A.—red	.800	1.50
MAN 3620	C.A.—orange	.300	.49	HDSP-3403	C.C.—red	.800	1.50
MAN 3630	C.A.—orange ± 1	.300	.99	5082-7613	C.C.,R.H.D.—red	.300	1.25
MAN 3640	C.C.—orange	.300	.99	5082-7620	C.A.,L.H.D.—yel.	.300	1.25
MAN 4610	C.A.—orange	.400	.99	5082-7623	C.C.,R.H.D.—yel.	.300	1.25
MAN 6610	C.A.—orange—DD	.560	.99	5082-7730	C.A.,L.H.D.—red	.300	.99
MAN 6630	C.A.—orange ± 1	.560	.99	5082-7731	C.A.,R.H.D.—red	.300	1.25
MAN 6640	C.C.—orange—DD	.560	.99	5082-7750	C.A.,L.H.D.—red	.430	1.75
MAN 6650	C.C.—orange ± 1	.560	.99	5082-7751	C.A.,R.H.D.—red	.430	1.25
MAN 6660	C.A.—orange	.560	.99	5082-7760	C.C.,R.H.D.—red	.430	1.75
MAN 6710	C.A.—red—DD	.560	.99	5082-7300	4x7 sgl. dig. RHD	.600	22.00
MAN 6750	C.C.—red ± 1	.560	.99	5082-7302	4x7 sgl. dig. LHD	.600	22.00
MAN 6780	C.C.—red	.560	.99	5082-7304	Overnge. char. (±1)	.600	19.95
DL704	C.C.—red	.300	1.25	4N28	Photo Xsistor Opto-Isol.		.99
DL707	C.A.—red	.300	1.25	LIT-1	Photo Xsistor Opto-Isol.		.69
DL728	C.C.—red	.500	1.49	MOC3010	Optically Isol. Triac Driver		1.25

POTENTIOMETERS



$2.95 each
2 Watt @ 70°C ± 10%
7/8" Slotted Shaft
Linear Taper
Meets Mil-R-94

Part No.		
CMU 1021	RV4NAY SD - 102A	1K
CMU 5021	RV4NAY SD - 502A	5K
CMU 1031	RV4NAY SD - 103A	10K
CMU 2531	RV4NAY SD - 253A	25K
CMU 5031	RV4NAY SD - 503A	50K
CMU 1041	RV4NAY SD - 104A	100K
CMU 1052	RV4NAY SD - 105A	1Meg

$1.35 each
3/4 Watt @ 70°C
15 turn pot. Linear taper. Printed circuit mount.

Part No.	Part No.	Part No.
830P- 50ohm	830P- 5K	830P-100K
830P-100ohm	830P-10K	830P-200K
830P-500ohm	830P-20K	830P-500K
830P-1K	830P-50K	830P-1Meg
830P-2K		

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5ea.	10 Ohm 27 Ohm	12 Ohm 33 Ohm	15 Ohm 39 Ohm	18 Ohm 47 Ohm	22 Ohm 56 Ohm	50pcs.	$1.95
ASST. 2	5ea.	68 Ohm 180 Ohm	82 Ohm 220 Ohm	100 Ohm 270 Ohm	120 Ohm 330 Ohm	150 Ohm 390 Ohm	50pcs.	$1.95
ASST. 3	5ea.	470 Ohm 1.2K	560 Ohm 1.5K	680 Ohm 1.8K	820 Ohm 2.2K	1K 2.7K	50pcs.	$1.95
ASST. 4	5ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	50pcs.	$1.95
ASST. 5	5ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	50pcs.	$1.95
ASST. 6	5ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	50pcs.	$1.95
ASST. 7	5ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	50pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)						$10.95 ea.

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage — Add 5% plus $1 Insurance

Spec Sheets — 25¢
Send 41¢ Postage for your
FREE 1981 JAMECO CATALOG

NEW 1981 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

1/81

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	22.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	28.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	9.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	11.10
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.50
8212CPA	Volt Ref/Indicator	2.50

* INTERSIL'S EVALUATION KITS

74C

74C00	.39			74C195	1.59
74C02	.39			74C221	1.95
74C04	.39			74C240	2.25
74C08	.39	74C106	.75	74C244	2.25
74C10	.39	74C107	1.89	74C373	2.49
74C14	.75	74C151	2.95	74C374	2.59
74C20	.39	74C154	3.95	74C901	.89
74C30	.39	74C157	2.25	74C903	1.15
74C42	1.39	74C160	1.69	74C911	10.95
74C48	1.95	74C161	1.60	74C912	10.95
74C73	.79	74C162	1.49	74C915	1.69
74C74	.79	74C163	1.69	74C917	10.95
74C85	1.95	74C164	1.59	74C922	5.49
74C86	.99	74C173	1.39	74C923	5.75
74C89	6.95	74C174	1.39	74C925	7.50
74C90	1.29	74C175	1.39	74C926	7.50
74C93	1.29	74C192	1.69	80C95	.79
74C95	1.59	74C193	1.69	80C97	.79

LINEAR

LH0002CN	6.85			NE570N	4.95
LM10CLH	4.50			LM702H	.79
LM11CLH	4.75			LM703CN	.89
LH0070-OH	6.05	LM340T-5	1.25	LM709N	.29
TL071CP	.79	LM340T-12	1.25	LM710N	.79
TL072CP	1.39	LM340T-15	1.25	LM711N	.79
TL074CN	2.49	LM341P-5	.75	LM723N	.69
LH0082CD	35.80	LM341P-12	.75	LM733N	1.00
TL082CP	1.19	LM341P-15	.75	LM739N	1.19
TL084CN	2.19	LM342P-5	.69	LM741CN	.35
LH0094CD	36.80	LM342P-12	.69	MC1741SCG	3.00
LM300H	.99	LM342P-15	.69	LM747N	.79
LM301CN	.35	LM348N	1.25	LM748N	.59
LM302H	1.95	LM350K	5.75	LM1014N	2.75
LM304H	1.95	LF351N	.60	LM1310N	1.95
LM305H	.99	LF353N	1.00	LM1458CN	.59
LM307CN	.45	LF355N	1.10	LM1488N	1.25
LM308CN	1.00	LF356N	1.10	LM1489N	1.25
LM309H	1.95	LM358N	1.00	LM1496N	1.95
LM309K	1.25	LM359N	1.79	LM1556V	1.75
LM310CN	1.75	LM370N	4.49	LM1800N	2.95
LM311H	.90	LM373N	3.25	LM1877N-9	3.25
LM312H	2.49	LM377N	2.95	LM1889N	3.20
LM317MP	1.15	LM380N	1.25	LM1896N	1.75
LM317T	1.75	LM381N	1.95	LM2002T	1.49
LM317K	3.95	LM382N	1.79	LM2877P	2.05
LM318CN	1.95	LM384N	1.95	LM2878P	2.25
LM319N	1.95	LM386N-3	1.29	LM2896P-1	2.25
LM320K-5	1.35	LM387N	1.45	LM3189N	2.95
LM320K-12	1.35	LM389N	1.35	LM3900N	.69
LM320K-15	1.35	LM392N	.69	LM3905CN	1.25
LM320T-5	1.25	LF398N	4.00	LM3909N	1.15
LM320T-12	1.25	LM399H	5.00	LM3914N	3.95
LM320T-15	1.25	TL494CN	4.49	LM3915N	3.95
LM323K-5	5.95	TL496CP	1.75	LM3916N	3.95
LM324N	.99	NE510A	6.00	RC4136N	1.25
LM329DZ	.65	NE529A	4.95	RC4151NB	3.95
LM331N	3.95	NE531H	3.95	RC4194TK	5.95
LM334Z	1.30	NE536H	6.00	RC4195TK	5.49
LM335Z	1.40	NE540H	6.00	KB4428	4.25
LM336Z	1.75	NE544N	4.95	KB4429	5.95
LM337T	1.95	NE550A	1.30	LM4500A	3.25
LM337MP	1.15	NE555V	.39	ICL8038B	4.95
LM338K	6.95	LM556N	.99	LM13080N	1.29
LM339N	.99	NE564N	3.95	LM13600N	1.49
LM340K-5	1.35	LM565N	1.25	75138N	1.95
LM340K-12	1.35	LM566CN	1.95	75450N	.89
LM340K-15	1.35	LM567V	1.25	75451CN	.39

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

CIRCLE 10 ON FREE INFORMATION CARD

ADVANCED COMPUTER PRODUCTS

FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!

1. Proven Quality Factory tested products only.
2. Guaranteed Satisfaction
3. Over $1,000,000.00 Inventory

1981 CATALOG AVAILABLE SOON.

Send $2.00 for your copy of the most complete catalog of computer products.
A must for the serious computer user.

STATIC RAM BOARDS

Now... less than 1¼¢ per bit!

- **S-100 32K** (uses 2114)

	ASSEMBLED	Kit
450ns.	459.00	429.00
250ns.	489.00	459.00
Bare Board	43.95	
Bare Board w/all parts less mem.	99.95	

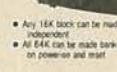
MODEL 2065
64K DYNAMIC RAM MODULE $600.00

- Designed to IEEE Proposed S-100 bus standards
- Supports IMSAI-type front panels
- Operates with either an 8080 or Z-80 based S-100 system, providing processor-transparent refreshes with both
- Bank-select system allows system memory expansion and is compatible with Cromemco products
- Bank select port's address is jumper-selectable
- Any 16K block can be made bank-independent
- All 64K can be made bank-enable on power-on and reset

California Computer Systems

The VISTA V-80 Disk Drive System
- 23% more storage capacity than TRS-80
- 120 day warranty
- 40 track patch at NO CHARGE

TRS80 ADD-ON
SALE $299.00



THE VISTA V-200 FOR EXIDY
Price: Starting as low as $1199.00

Item	Storage Capacity	Drive Configuration	Shipping Weight	Price
V200 E-20	400	2 Drive, Single Head	25 lbs.	1199.00
V200 E-22	800	2 Drive, Double Head	25 lbs.	1549.00
V200 E-30	600	3 Drive, Single Head	32lbs.	1524.00
V200 E-32	1.2 MEG	3 Drive, Double Head	32 lbs.	1999.00

ATTENTION VIDEO HOBBYISTS!!!
★ BOX BUILDERS
★ USE AS REMOTE TUNER/TIMER
★ FULL SCHEMATICS AVAILABLE
★ FOR ONLY $5.90! – FREE W/PURCHASE

A Recent Special Purchase Allows Us To Present The Following:

NEW, UNUSED COMPONENTS
From The RCA VDT-201 Videocassette Recorder

1. UHF/VHF Tuner-Subassembly with all knobs and Video Demodulator — $59.95
2. RF Modulator with Audio & Video inputs. Channel 3 or 4 Output — $39.95
3. Digital Clock Module AM/PM Fluorescent Readout (Green) — $19.95
4. 300 Ohm to 75 Ohm Matching or — $ 2.49
   Subtotal $123.34
5. Complete Set of All The Above for Only — $74.95

Please Call For Volume Discounts

RAM BOARDS SPECIAL
16K Altair Mits Dynamic RAM Boards
Assem. & Tested $119.95 Untested $95.00 **16K**

LOW COST FLOPPY DISK SUBSYSTEM
Siemens FDD 120-8 (2) VISTA Floppy Controller (S-100), Case, Power Supply & Cable, CP/M Disk Operating System Assembled & Tested Walnut Wood Sides: $1499.00
★CHECK OUR FLOPPY DISK PRICING ON THIS PAGE★
SAVE $300.00 ($1799.00 VALUE)

WATANABE MIPLOT
Max pen speed 50 mm/sec; resolution .10 mm typically .05 mm; built-in character generator sizes and 4 degrees of rotation; absolute draw, relative draw, alpha; plotting done with simple commands.
$1195.00

IMS STATIC RAM BOARDS

	250 ns.	450 ns.
8K Static	$209.00	$189.00
16K Static	$449.00	$399.00
32K Static	$729.00	$629.00

CENTRONICS PRINTER
Model 737
- Centronics complete printer
- The 737 has everything. Check and compare the features.
- New low price $835.00

SALE! SD SYSTEMS BOARDS
TAKE 10% OFF!

	KIT	ASSEM
SBC 100 Single Board Computer (2MHz)	$265.00	$ 349.00
SBC 200 Single Board Computer (4MHz)	299.00	399.00
Z80 Starter System	319.00	449.00
VDB 8024 Video Display Board	335.00	459.00
Versa-Floppy II	325.00	429.00
Expanda-PROM	115.00	225.00
SD100 Computer System w/64K	–	6995.00
SD200 Computer System w/64K	–	7995.00

6800 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp. (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Arith. Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

APPLE/EXIDY/EXPANDO TRS 80 16K-UPGRADE KIT

$49.95 TRS-80/APPLE $49.95
MEMORY EXPANSION KITS,
4116's, 16K (200/250 ns.)
8 pcs for **$49.95**
w/instructions & jumpers
Call For Volume Pricing

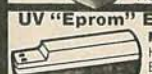
★ Special: TRS80 Schematic.....$ 4.95
★ Expansion Interface Schematic..$ 4.95
★ Expansion Interface Connector.... 7.95

EXPANDORAM II MEMORY KITS
★ Bank Selectable ★ Uses 4116 200 ns.
★ Write Protect ★ Power 8VDC, ±16VDC
★ Phantom NEW LOW PRICES ★ Up to 4 MHz

Expando 64 Kit (4116) Assem. & Tested Add $50.

16K $269.00	48K $435.00
32K $349.00	64K $505.00

PERSCI MODEL 299B DISKETTE DRIVE
3.2 Mbytes capacity (unformatted), max. seek time 100MS.
ACP Price.....**$2,199.00**



UV "Eprom" Eraser
Model UVs-11E $69.95
Holds 4 Eprom's at a time. Backed by 45 years experience.
Model S-52T...$265.00
Professional Industrial Model

EMAKO-20.. Reg. $777.00 **$599.00**

UNBELIEVABLE!!
125 Caps, 60 lpm-Vertical Format. Unit - 96 Characters - Upper/Lower Case - 4.5" to 9.5" Adjustable - 80 col/40 col double width - Full 96 char. ASCII

EMAKO-22.....$799.00
Prints a 132 col/line. Available with parallel or serial output at same price.

VISTA V-300 PRINTER

25 CPS, Full Character Daisy Wheel, 136 Column Model
No. FP1500 **$1995.00**

BASE II PRINTER
80 Column Impact Printer
- 60 Lines Per Minute
- 115/230 VAC, 50 or 60 Hz
- 72, 80, 96, 120 or 132 Char/Line
- Self-Test Switch

REG. $699.00
WITH ALL OPTIONS ACP PRICE **$599.00**
Option "M" Terminal Screen Buffer (1920 Char.).....$50.00
Option "S" High Speed Paper Advance & Graphics.....50.00
Option "T" Tractor Feed.....50.00

Z-80/Z-80A/8080 CPU BOARD
★ On board 2708 ★ 2708 included (450ns.)
★ Power on jump ★ Completely socketed.
★ Z-80 Assembled and Tested.....$185.00
★ Z-80 Kit.....$129.95
★ Z-80 Bare PC Board.....$ 34.95
★ For 4MHz Speed Add $15.00

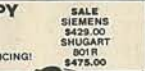
8080A Kit.....$ 99.95
8080A Assembled.....$149.95

S-100 MOTHERBOARD SPECIAL
8 slot expandable w/9 conn.
reg $69.95.....NOW $52.95

SIEMEN'S FLOPPY
SALE SIEMENS $429.00 SHUGART 801R $475.00
- Special buy while supply lasts.
- 8" Drive with Double-Density
- 90 Day Warranty

★CHECK OUR FLOPPY DISK PRICING! ON THIS PAGE

ACOUSTIC MODEM



149.95
NOVATION CAT™ 0-300 Baud Bell 103 Answer, Originate

'D' CAT MODEM NOW AVAILABLE $199.00

MONITORS

Sanyo 12" Data Display		Zenith 13" Color Monitor	499.00
DM5112CX	$325.00	MGA 13" Color TV	349.00
Motorola 12", High Resolution, 22 MHz, OEM Model #M3000-340	219.00	VAMP 19" Color Monitor	575.00
		VAMP 15" Color Monitor	449.00
Motorola 5"		Sanyo 9"	169.95
Model #1000-155 (OEM)	119.95	Sanyo 15"	279.00
		Leedex 12"	139.95

DATA BOOKS • COMPUTER BOOKS

1980 IC Master	$59.95
INTEL Data Book	7.50
INTEL MCS 85 Manual	7.50
SALE • OSBORNE BOOKS • SALE	**Sale**
Intro to Micros Vol. 0	12.50
Intro to Micros Vol. I	12.50
8080A Programming	12.50
6800 Programming	12.50
Z80 Programming	16.00
Vol. II Some Real Microprocessors w/Binder	27.50
Vol. III Some Real Support Devices w/Binder	18.50
Intro to Micros Vol. III	18.50

SALE • SYBEX COMPUTER BOOKS • SALE

6502 Games	$12.95
Intro. to Personal & Business Computing	12.95
Microprocessors From Chips to Systems	12.95
Microprocessor Interfacing Techniques	12.95
Programming the Z80	12.95
Programming the Z8000	12.95
Programming the 6502	12.95
6502 Applications Book	12.95
CPM Handbook	12.95

MICROPROCESSORS

Z8001 16 bit to 8Mb	$189.00
Z8002 16 bit to 64K	149.00
Z80	**10.75**
Z80A	14.50
F-8 (3850)	16.95
2650	18.95
CD1802	13.95
8080A	8.50
8080A-4MHz	19.95
SALE 8085	14.95
8008-1	14.95
2901	9.90
2901A	14.95
2903 4-bit Superslice	29.95
TMS 9900JL	49.95
CP1600	39.95
6502	11.50
6502A	16.95
IM6100	29.95
6800	**11.75**
6800B 2.0 MHz	19.95
6802P	17.95
8035	19.95
8755	49.95
8748	69.95
6809	37.95
8086	69.95

ADVANCED SUPPORT

AM9511 Arith. Processor	175.00
9512 Arith Processor	175.00
9513 Univ. Timing	79.95
AM9517 DMA Controller	18.95
AM9519 Universal Interrupt	18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	36.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHz	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

8155/8156 I/O	24.95
8755 I/O with Eprom	64.95
8202 Dyn. Ram Cont.	34.95
8205/74S 138 Decoder	3.95
8212 8 bit I/o	2.75
8214 Priority Int.	5.25
8216 Bus Driver	2.75
8224 Clock Gen.	2.95
8224-4 (4MHz)	9.75
8226 Bus Drivar	3.95
8726 Bus Driver	2.95
8228 Sys. Control	5.50
8238 Sys. Cont.	5.50
8251 Prog. I/O	6.95
8253 Int. Timer	12.95
8255 Prog. I/O	6.50
8257 Prog. DMA	16.95
8259 Prog. Int.	17.95
8275 CRT Controller	49.95
8279 Prog. Keyboard	15.95

6800 SUPPORT CHIPS

6810 128 x 8 Ram	4.75
6820 PIA	5.95
6821 PIA	6.50
6828 Priority Int.	9.95
6834-1 512 x 8 Eprom	16.95
6845/HD46505 CRT Cont.	39.95
6847 Color CRT	49.95
6850 ACIA	5.95
6852 Serial Adapter	5.95
6860 Modem	10.95
6862 Modulator	11.95
6871A 1.0MHz OSC.	25.95
6875	6.95
6880 Bus Driver	2.95
MC68488	19.95
68047	24.95

SHIFT REGISTER SALE

2503V	1.49	2525	1.49
2504V	1.49	2527	1.49
2507V	1.49	2528	1.49
2517V	1.49	2529	1.49
2524V	1.49	2533	1.49

6502 SUPPORT CHIPS

6520 PIA	7.50
6522 Mult.	11.95
6530-002,003,004,005	21.95
6532	19.95
6551	19.95

PROMS

2708 450 ns.	8.25
2708-6 650 ns.	7.50
1702A	4.95
2732	74.95
2716-5V	14.95
2716-5V, 12V	29.95
2758-5V	19.95
5203AQ	13.95
5204AQ	14.95
IM 5610	3.90
SALE 8223 32 x 8	**2.95**
82S115 512 x 8 (TS)	16.95
82S123 32 x 8	4.90
82S126 256 x 4	4.90
82S129 256 x 4 (TS)	4.90
82S130 512 x 4 (OC)	6.50
82S23	6.95
82S131	14.95
82S137	14.95

NOTE: WE PROGRAM PROMS

CHARACTER GEN.

2513-001 (5V) Upper	9.50
2513-005 (5V) Lower	10.95
2513-ADM3 (5V) Lower	14.95
MCM6571	11.75
MCM6571A	11.75
MCM6574	14.50
MCM6575	14.50

UARTS/BAUD RATE

TR1602B (5V, 12V)	3.95
AY5-1013 (5V, 12V)	4.95
AY51014A/1612 (5-14V)	6.95
AY5-1015A/1863 (5V)	6.95
TMS 6011 (5V, 12V)	5.50
IM6402	7.95
IM6403	8.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	**9.95**
MC14411	11.95
4702	14.95
WD1941	9.95
COM 5016	16.95

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75
HD0165	9.95
74C922	9.95
74C923	9.95

STATIC RAMS

	SALE 2102 '89	1-24	25-99	100
21L02 450ns.		1.30	1.25	.99
21L02 250ns.		1.59	1.55	1.15
2111		3.75	3.65	3.55
2112-1		2.95	2.85	2.65
2101-1		2.90	2.70	2.55
2114L-250ns. (4045)		6.50	5.95	5.50
2114L-450ns. (4045)		5.50	5.25	**4.75**
4044 250 ns.		8.95	7.50	6.90
4044-450ns.		5.95	5.95	**4.75**
EMM4200A		9.75	8.75	7.95
EMM4402		7.95	7.25	6.25
AMD9140/41		10.95	10.25	9.25
AMD9130/31		12.95	11.95	10.25
1101		1.95	1.75	1.25
P2125/93425 (45ns.)		9.95	8.35	8.25
6518-1 K x 1 CMOS		7.95	7.95	7.25
2147 Low Power 4K Static		19.95	18.95	16.95
93415		9.95	8.95	8.50
TMS4046		11.95	10.95	10.50

DYNAMIC RAMS

416/4116 16K (16 Pin)	8.75
Set of 8 416's	49.95
4115 8K (16 Pin)	6.95
4050 4K x 1 (18 Pin)	4.95
4060 4K x 1 (22 Pin)	4.95
4096 4K x 1 (16 Pin)	3.95
2104 4K x 1 (16 Pin)	4.75
4027 4K x 1 (16 Pin)	4.95

64K RAMS

5261	1.95	1103	1.95
5262	1.95	4008L	4.95
5270	4.95	6605	7.95
5280	4.95	6604	4.95
5290	12.45	6002	1.50

$159.95

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Gold
8	15	32	45
14	19	36	59
16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	1.10
24	38	85	1.20
28	43	1.10	1.49
36	58	1.25	1.69
40	60	1.40	1.89

ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

LED READOUTS

Part No.	Size	Color	Description	Price
DL704	.300	Red	Comm. Cathode	99
DL707	.300	Red	Comm. Anode	99
FND357	.357	Red	Comm. Cathode	99
FND501	.500	Red	Comm. Cathode (+1)	99
FND503 (500)	.560	Red	Comm. Cathode	99
FND507 (510)	.500	Red	Comm. Anode	99
FND508	.560	Red	Comm. Anode (+1)	99
FND530	.500	Green	Comm. Cathode	1.49
FND550	.500	Orange	Comm. Cathode	1.49
FND803 (800)	.800	Red	Comm. Cathode	1.75
FND807 (810)	.800	Red	Comm. Anode	1.75
HP5082-7340	.600	Red	4 x 7 Hexadecimal	20.95
HP5083-7300	.600	Red	4 x 7 Sq. Digit (HH)	18.95
HP5082-7731	.300	Red	Comm. Anode	75
TIL305	–	Red	Array 5 x 7	7.95
TIL308	.270	Red	Numerical Display	10.95
TIL309	.270	Red	Numerical Display	9.95
TIL311	.270	Red	4 x 7 Hexidecimal	10.95
MAN7A	.320	Red	Array	5.95
MAN10A	.320	Red	Single Numeric	8.95
XAN3061	.300	Red	Comm. Anode Right DP	1.25
XAN3062	.300	Red	Comm. Anode Left DP	1.25
XAN3063	.300	Red	Overflow, CA, Left DP	1.25
XAN3064	.300	Red	Comm. Cathode Right DP	1.25
XAN3051	.300	Green	Comm. Anode Right DP	1.99
XAN3052	.300	Green	Comm. Anode Left DP	1.99
XAN3053	.300	Green	Overflow CA, Left DP	1.99
XAN3054	.300	Green	Comm. Cathode, Right DP	1.99
XAN3081	.300	Yellow	Comm. Anode, Right DP	2.10
XAN3082	.300	Yellow	Comm. Anode, Left DP	2.10
XAN3083	.300	Yellow	Overflow CA, Left DP	2.10
XAN3084	.300	Yellow	Comm. Cathode, Right DP	2.10

IC SPECIAL PURCHASE

LF 13508 JFET Analog Multi 8 bit	8.95
ICM 7045 Precision StopWatch	23.95
ICM 7205 CMOS LED Stopwatch/Timer	19.95
ICM 7207 Oscillator Controller	7.50
ICM 7208 Seven Decade Counter	18.95
ICM 7209 Clock Generator	6.95
ICL 7107 3½ Digit A/D (LED)	14.95
MC14433P 3½ Digit A/D Converter	13.95
ICL 8211 Voltage Reference	1.95
LM 1850N Ground Fault IC	3/1.00
LM 2900N Quad Amplifier	2/1.00
LM 2917N Freq. to Volt Conv.	2/1.99
AY-3-3550 4½ digit DMM	24.95
AY-5-3507 40MHz DVM	9.95
MEM 4963 Mosfet Smoke Detector	11.95
2708 32 x 8 PROM (IM 5600)	2.95
G115M 6 channel Mosfet	1.49
ULN 2003A 7 channel Driver	.99
2101AL-4	1.95
MCM 14505 64 bit Static Ram	6.95
MOC 1003 (4N28) Opto Coupler	3/1.00
SPX33 Opto Coupler	3/1.00
7520/25 .50	LM 387 1.25
1488/1489 2/1.99	LM 3302 3/1.99
MK5014 Calc. 3/1.99	LM 4558 3/1.99
74S89 3/1.99	RC 4136 2/1.99
LM323K 4.95	RC 4131 2/1.99
MC1372 8.95	COM 5027 39.95
MM5298-4A/B 2.95	COM 5037 49.95
LM 377 1.25	DAC100 15.95

VERBATIM DISKETTES
100% CERTIFIED ERROR-FREE!

• 35 TRACKS, DOUBLE DENSITY, SINGLE-SIDED 5¼

TYPE	DESCRIPTION	PRICE/BOX 10
525-01	Soft Sectored TRS 80, etc.	$27.25
525-10	10 Hole Hard NS Apple etc	27.25
525-16	16 Hole Hard Micropolis	27.75

• 40 & 77 TRACK DOUBLE DENSITY – SINGLE SIDED 5¼" W/HUB REINFORCEMENT RING

577-01	Soft Sectored TRS 80, etc	$32.25
577-10	10 Hole Hard NS Apple etc	32.25
577-16	16 Hole Hard Micropolis	32.25

• 40 TRACKS, DOUBLE SIDED, DOUBLE DENSITY 5¼

550-01	Soft Sectored SA 450 MPI 32	$39.50
550-10	10 Hole Hard BASF, WANGCO	39.50
550-16	16 Hole Hard Micro	39.50

• 8" 100% CERTIFIED DISKETTES

FD800-01	Soft, Single Density, 3740	$33.50
FD800-32	32 Hard Single Density Shug	33.50
FD802-01	Soft, Double Density, 3740	44.80
FD850-01	Soft, Double Sided, Double Density, 3740	49.80

VOLUME DEALER PRICING AVAILABLE
WE ALSO STOCK DYSAN-CALL

FLOPPY DISK I/O

1771-01 8" & Minifloppy	24.95
uPd372 Nec Floppy	49.95
1781 Dual Floppy	29.95
1791-01 Dual Floppy	39.95
uPd 765 Floppy	49.95

A/D CONVERTERS

8700 8 bit Binary	13.50
8701-10 bit Binary	22.00
8703 8 bit TS	13.50
9400 Volt to Freq. Conv.	7.25
8750 3½ Digit BCD	13.95
1408L6 6 bit	3.95
1408L8 8 bit	5.95
DAC02 D to A	5.95
DAC08	9.95
DAC 100	15.95

TV CHIPS/SOUND

AY38500-1 6 Games B/W	4.95
AY38515 Color Converter	2.95
AY38603-1 Roadrace Game	8.95
AY38606-1 Wipeout Game	9.50
AY38607-1 Shooting Gallery	8.95
AY38910 Sound Generator	12.95
SN76477 TI Sound Generator	3.95
MM5320/21 TV Synch Gen.	9.95
MM5369 Prescaler	3.95
LM1889 RF Modulator	3.95
MM57100 NSC Color TV	6.95
MM57104 Clock Gen.	3.75
RF Modulator w/Audio	8.95
M&R Modulator	29.95

WAVEFORM GEN.

8038 Function Gen.	3.95
MC4024VCO	2.95
LM566 VCO	1.95
XR2206 Function Generator	5.25

SHIFT REGISTERS

MM500H Dual25	.50
MM5056N Dual 256	2.95
MM5060N Dual 128	2.95
2510A Dual 100	1.95
2847 Quad 80	4.95
3341 Dual 80	4.95
3351 40 x 9 FIFO	17.95
3357 Quad 80	6.95
9403 16 x 4 FIFO	24.95
9408-10 Bit Sequencer	9.95
3347	5.95

CTS DIPSWITCHES

CTS206-2	1.75	CTS206-7	1.75
CTS206-4	1.75	CTS206-8	1.95
CTS206-5	1.75	CTS206-9	1.95
CTS206-6	1.75	CTS206-10	1.95

CONNECTORS (GOLD)

DB25P (RS232)	3.25
DB25S Female	3.75
Hood	1.25
Set w/Hood, Sale	$7.50
22/44 W/W, S/T, KIM	2.95
43/86 W/W, S/T, MOT	6.50
50/100 S-100 Connector w/w	4.95
50/100 S-100 Connector s/t	3.95

NAKED PC

Z-80 CPU (Ithaca)	a34.95
8080A CPU	34.95
8K Static RAM (Logos)	24.95
16K Static RAM (2114)	29.95
32K Static RAM (2114)	29.95
8K Eprom (2708)	24.95
1702 Eprom Board	30.00
2708/2716 Eprom (Ithaca)	34.95
2708/2716 Eprom (WMC)	30.00
Realtime Clock	34.95
ACP Proto Bd. (3M Conn.)	27.95
Vector 8800 Proto	22.20
Vector 8803 11 slot MB	29.95
ACP Extender w/Conn	18.95
Video Interface (SSM)	31.95
Parallel Interface (SSM)	31.95
13 Slot MotherBoard (WMC)	32.95
9 Slot MotherBoard (WMC)	29.95
8 Slot Mother (expandable)	34.95
Proc-Tech Bare Boards	CALL
WMC Floppy PCB	34.95

COMPUTER SPECIALS

DISCOUNTS!

	LIST	SALE
Apple II Plus w/16K	1195.	990.
PET 2001-16N	995.	895.
Exidy Sorcerer w/16K		1099.
Cromemco Sys III	6990.	6290.
Horizon I w/32K		CALL
Pascal Microengine	1995.	1595.
IPSI 1620 Diablo RO	3295.	2695.
Anadex DP 8000	995.	875.
Centronics Micro S-1	595.	525.
Soroc IQ 120	995.	795.
Teletype Model 43	1349.	1150.
HiPlot Plotter	1065.	899.
HiPlot Digitizer	795.	735.
Interlube II	895.	784.
Atari 800	999.	750.
Atari 400	549.	449.
TI 99/4	1150.	1025.
Leedex 12" Monitor	149.	139.
Centronics 737	995.	899.
Trencom T-100	375.	349.
Trencom T-200	595.	525.
Sanyo 9" Monitor	220.	169.
Sanyo 15" Monitor	295.	249.
Mot 22 MHz Monitor	296.	219.

SOCKET SPECIALS

14 Pin w/w-2L	$ .35
18 Pin w/w-2L	.55
20 Pin w/w-2L	.75
18 Pin s/t	.15
22 Pin s/t	.15
Call for volume pricing.	

TERMS: Use check, M/O, VISA, AMEX, CB, or COD. COD requires 25% deposit. Charge Orders please include expiration date. Foreign pay U.S. Funds. Order by phone, mail or TWX. MINIMUM $10.00. Please include magazine issue and phone no. SHIPPING: U.S.A. add $2.00 for first 2 lbs. For surface add 30C for additional lbs. For air add 70C for additional lbs. FOREIGN: Add 10% shipping and handling. COD's $1.85 extra. Not responsible for typos. Some items subject to prior sale. We reserve right to limit quantities, some items subject to precious metal adder. Retail pricing may vary from Mail Order. We reserve the right to substitute manufacturer.

RETAIL STORES OPEN MON-SAT

STORE #1 1310 "B" E. Edinger Santa Ana, CA 92705 Showrooms, Retail, Warehouse

STORE #2 674 El Camino Real Tustin, CA 92680 Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1310 E. Edinger (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

CIRCLE 67 ON FREE INFORMATION CARD

7400

SN7400N	.19	SN74123N	.59
SN7401N	.22	SN74125N	.39
SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.95
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.69
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	.99
SN7416N	.29	SN74151N	.67
SN7417N	.29	SN74152N	.67
SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.82
SN7423N	.29	SN74156N	.89
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.29	SN74160N	.95
SN7429N	.45	SN74161N	.95
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.29	SN74164N	.97
SN7438N	.29	SN74165N	.97
SN7439N	.29	SN74166N	1.20
SN7440N	.24	SN74167N	1.95
SN7441N	.79	SN74170N	1.69
SN7442N	.57	SN74172N	5.95
SN7443N	.79	SN74173N	.79
SN7444N	.79	SN74174N	.89
SN7445N	.79	SN74175N	.89
SN7446N	.79	SN74176N	.85
SN7447N	.59	SN74177N	.85
SN7448N	.79	SN74179N	1.80
SN7450N	.23	SN74180N	.75
SN7451N	.23	SN74181N	1.75
SN7453N	.23	SN74182N	.75
SN7454N	.23	SN74184N	1.95
SN7459N	.29	SN74185N	1.95
SN7460N	.23	SN74186N	9.95
SN7470N	.39	SN74188N	3.90
SN7472N	.34	SN74190N	1.15
SN7473N	.38	SN74191N	1.15
SN7474N	.36	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.36	SN74194N	.85
SN7479N	4.60	SN74195N	.85
SN7480N	.59	SN74196N	.85
SN7481N	1.10	SN74197N	.85
SN7482N	1.10	SN74198N	1.39
SN7483N	.55	SN74199N	1.39
SN7485N	.65	SN74221N	1.39
SN7486N	.39	SN74251N	.95
SN7489N	1.75	SN74273N	1.05
SN7490N	.39	SN74279N	.89
SN7491N	.65	SN74283N	2.15
SN7492N	.52	SN74284N	3.90
SN7493N	.49	SN74285N	3.90
SN7494N	.72	SN74290N	1.25
SN7495N	.65	SN74298N	.95
SN7496N	.72	SN74365N	.68
SN7497N	3.10	SN74366N	.68
SN74100N	.99	SN74367N	.79
SN74107N	.32	SN74368N	.79
SN74109N	.53	SN74390N	1.90
SN74116N	1.95	SN74393N	1.90
SN74121N	.29	SN74490N	1.90
SN74122N	.39		

74LS00

74LS00N	.35	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.89
74LS04N	.39	74LS169N	1.89
74LS05N	.28	74LS170N	1.99
74LS08N	.39	74LS173N	.89
74LS09N	.39	74LS174N	.99
74LS10N	.28	74LS175N	.99
74LS11N	.39	74LS181N	2.20
74LS12N	.39	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	1.25	74LS192N	.98
74LS15N	.39	74LS193N	.98
74LS20N	.26	74LS194N	1.15
74LS21N	.38	74LS195N	.95
74LS22N	.38	74LS196N	.89
74LS26N	.39	74LS197N	.89
74LS27N	.39	74LS221N	1.49
74LS28N	.39	74LS240N	1.95
74LS30N	.26	74LS241N	1.90
74LS32N	.39	74LS242N	1.95
74LS37N	.79	74LS243N	1.95
74LS38N	.39	74LS244N	1.95
74LS40N	.26	74LS245N	4.95
74LS42N	.79	74LS247N	1.10
74LS47N	.79	74LS248N	1.10
74LS48N	.79	74LS249N	1.69
74LS51N	.26	74LS251N	1.79
74LS54N	.35	74LS253N	.98
74LS55N	.35	74LS257N	.98
74LS73N	.45	74LS258N	.98
74LS74N	.49	74LS259N	2.95
74LS75N	.68	74LS260N	.69
74LS76N	.45	74LS261N	2.49
74LS78N	.65	74LS266N	.59
74LS83AN	.99	74LS273N	1.75
74LS85N	1.19	74LS275N	4.40
74LS86N	.45	74LS279N	.59
74LS90N	.75	74LS283N	1.10
74LS92N	.75	74LS290N	1.29
74LS93N	.75	74LS293N	1.95
74LS95N	.88	74LS295N	1.10
74LS96N	.98	74LS298N	1.29
74LS107N	.45	74LS324N	1.75
74LS109N	.45	74LS347N	1.95
74LS112N	.49	74LS348N	1.95
74LS113N	.49	74LS352N	1.65
74LS114N	.55	74LS353N	1.65
74LS122N	.55	74LS363N	1.49
74LS123N	1.19	74LS365N	.99
74LS124N	1.35	74LS366N	.99
74LS125N	.89	74LS367N	.73
74LS126N	.89	74LS368N	.73
74LS132N	.79	74LS373N	2.75
74LS136N	.59	74LS374N	2.75
74LS138N	.89	74LS375N	.69
74LS139N	.89	74LS377N	1.95
74LS145N	1.25	74LS385N	1.95
74LS148N	1.49	74LS386N	.65
74LS151N	.79	74LS390N	1.95
74LS153N	.79	74LS393N	1.95
74LS154N	2.49	74LS395N	1.70
74LS155N	1.19	74LS399N	2.95
74LS156N	.99	74LS424N	2.95
74LS157N	.99	74LS668N	1.75
74LS158N	.75	74LS670N	2.29
74LS160N	.98	81LS95N	1.99
74LS161N	1.15	81LS96N	1.99
74LS162N	.98	81LS97N	1.99
74LS163N	.98	81LS98N	1.99

CMOS

CD4000	.35	CD4093	.99
CD4001	.35	CD4094	2.95
CD4002	.35	CD4098	2.49
CD4006	1.39	CD4099	2.25
CD4007	.29	MC14408	12.95
CD4008	1.39	MC14409	12.95
CD4009	.49	MC14410	12.95
CD4010	.49	MC14412	12.95
CD4011	.35	MC14415	8.95
CD4012	.29	MC14419	4.95
CD4013	.49	CD4501	.39
CD4014	1.39	CD4502	1.65
CD4015	1.15	CD4503	.69
CD4016	.59	CD4505	8.95
CD4017	1.19	CD4506	.75
CD4018	.99	CD4507	.95
CD4019	.49	CD4508	3.95
CD4020	1.19	CD4510	1.39
CD4021	1.19	CD4511	1.39
CD4022	1.15	CD4512	1.39
CD4023	.38	CD4515	3.95
CD4024	.79	CD4516	1.69
CD4025	.38	CD4518	1.39
CD4027	.65	CD4520	1.39
CD4028	.85	CD4555	4.95
CD4029	1.29	CD4556	.99
CD4030	.45	CD4566	2.25
CD4031	3.25	74C00	.39
CD4032	2.15	74C02	.39
CD4034	3.25	74C04	.39
CD4035	.95	74C08	.49
CD4037	1.95	74C10	.49
CD4040	1.29	74C14	1.65
CD4041	1.25	74C20	.39
CD4042	.95	74C30	.39
CD4043	.85	74C32	.99
CD4044	.85	74C42	1.85
CD4046	1.75	74C48	2.39
CD4047	1.25	74C73	.85
CD4048	.99	74C74	.85
CD4049	.69	74C85	2.49
CD4050	.69	74C89	4.95
CD4051	1.10	74C90	1.85
CD4052	1.10	74C93	1.85
CD4053	1.10	74C95	1.85
CD4055	3.95	74C107	1.19
CD4056	2.95	74C151	2.49
CD4059	9.95	74C154	3.50
CD4060	1.39	74C157	2.10
CD4066	.75	74C160	2.39
CD4069	.35	74C161	2.30
CD4070	.49	74C163	2.39
CD4071	.35	74C164	2.39
CD4072	.35	74C173	2.59
CD4073	.35	74C174	2.75
CD4075	.35	74C175	2.75
CD4076	1.29	74C192	2.39
CD4077	.35	74C193	2.39
CD4078	.35	74C195	2.39
CD4081	.35	74C922	7.95
CD4082	.35	74C923	6.95
CD4085	1.95	MM80C95	1.50
CD4089	2.95	MM80C97	1.25

LINEAR

78H05	5.95	LM1414N	1.90
78M06	1.49	LM1458CN/N	.49
78M.G.	1.49	MC1488N	1.49
LM105H	.99	MC1489N	1.49
LM108AH	2.95	LM1496N	.89
LM300H	.79	LM1556N	1.50
LM301CN/H	.35	LM1800N	.79
LM304H	.98	LM1820N	.95
LM305H	.89	LM1850N	.95
LM306H	3.25	LM1889N	3.95
LM307CN/H	.29	LM2111N	1.75
LM308CN/H	.98	LM2900N	.99
LM309K	1.49	LM2901N	2.50
LM310CN	1.25,	LM2917N	2.95
LM311D/CN/H	.98	CA3013T	2.29
LM312H	1.75	CA3018T	1.99
LM317T	2.75	CA3021T	3.49
LM318CN/H	1.49	CA3023T	2.99
LM319N/H	1.25	CA3035T	2.75
LM320K-XX*	1.49	CA3039T	1.49
LM320T-XX*	1.25	CA3046T	1.29
LM320H-XX*	1.25	LM3053N	1.49
LM323K	4.95	CA3059N	3.25
LM324N	1.25	CA3060N	3.25
LM339N	.95	CA3062N	4.95
LM340K-XX*	1.49	LM3065N	1.49
LM340T-XX*	1.25	CA3080N	1.29
LM340H-XX*	1.25	CA3081N	1.69
LM344H	1.95	CA3082N	1.69
LM348N	1.85	CA3083N	1.99
LM358CN	.98	CA3086N	1.29
LM360N	1.49	CA3089N	2.75
LM372N	1.95	CA3096N	2.49
LM376N	3.75	CA3097N	1.99
LM377N	3.75	CA3130T	2.49
LM380CN/N	1.25	CA3140T	2.49
LM381N	1.79	CA3146N	2.49
LM383T	1.95	CA3160T	1.49
LM386N	1.49	CA3190N	1.95
LM387N	1.49	CA3401N	.69
LM390N	1.95	MC3423N	1.49
NE531V/T	3.75	MC3460N	3.95
NE555V	.39	SG3524N	3.95
NE556N	.98	CA3600N	3.50
NE561T	19.95	LM3900N	.59
NE562B	7.95	LM3905N	1.49
NE565N/H	1.25	LM3909N	.98
NE566H/V	1.75	RC4131N	2.95
NE567V/H	1.50	RC4136N	1.10
NE592N	2.75	RC4151N	4.50
LM702H	2.99	RC4194	4.95
LM709N/H	.29	RC4195	4.40
LM710N/H	.98	ULN2001	1.25
LM711N/H	.39	ULN2003	1.50
LM715N	1.95	SN75450N	.59
LM723N/H	.75	SN75451N	.49
LM733N/H	.98	SN75452N	.49
LM739N	1.15	SN75453N	.49
LM741CN/H	.33	SN75454N	.49
LM741CN-14	.19	SN75491N	.89
LM747N/H	.79	SN75492N	.89
LM748N/H	.39	SN75493N	.89
LM760CN	2.95	SN75494N	.89
LM1310N	1.90		

16K UPGRADE ONLY $49.95 SPECIFY COMPUTER

ADVANCED COMPUTER PRODUCTS

NEW! We Now Have The **Apple Silentype** IN STOCK

With Apple Intelligent Interface Card. Reg. **$595.00**

Interface Card Has All Software For Hi-Res, Graphics & Pascal Use.

NOW ONLY **$549.00**

BECKMAN Digital Multimeters

MODELS TECH 300 AND TECH 310

AS LOW AS $100

Choice of Models – The TECH 310 has all above features, 7 functions, 29 ranges, plus 0.25% Vdc accuracy.

The TECH 300 has a 0.5% Vdc accuracy and all the above features, but without Insta-Ohms™ continuity function or the 10 amp current ranges.

TECH 300 Digital Multimeter	$100.
TECH 310 Digital Multimeter	$130.
VC-201 Vinyl Carrying Case	$10.
DC-202 Deluxe Carrying Case	$24.
HV-211 High Voltage Probe	$35.
RP-221 RF Probe	$35.
CI-231 AC Current Clamp	$42.
DL-241 Deluxe Test Lead Kit	$10.
TL-242 Spare Test Leads	$6.

NEW! Vista™ **MUSIC MACHINE 9© WITH 9 VOICES!**

- NEW! Uses latest State of the Art LSI Technology
- Requires only one slot for 9 voices
- Uses three AY3-8910's to produce nine voices
- Plays music generated by the ALF Board
- ALF software required
- APPLE™ II compatible

ASSEMBLED AND TESTED **$129.95**

FLOPPY DISK DRIVES

MPI B51-5¼", 40 tracks	279.00
Shugart SA400-5¼" 35 tracks	295.00
Shugart 800/801R 8"	475.00
Siemens Shugart Compatible Model FDD-120-8D	429.00
PERSCI Model 277 Dual	1195.00
WANGO/SIEMENS 5¼" Drive	290.00
MPI B52 5¼" Dual	348.00
WANGO/SIEMENS 282 Dual 5¼"	395.00
WANGO/SIEMENS 82	290.00

CONTINENTAL SPECIALTIES

Model LM-3 40-channel Logic Monitor	585.00
Model LM-1 Logic Monitor	60.00
Model LM-2 Logic Monitor	147.00
MAX-100 100 MHz Portable Frequency Counter	149.00
Model LP-1 Digital Logic Probe	50.00
Model LP-2 Economy Logic Probe	28.00
Model LP-3 High Speed Logic Probe	77.00
Model LPK-1 Logic Probe Kit	21.95
Model LTC-1, LTC-2 Logical Analysis Kits	220/250

Proto Clips

14-Pin Clip	PC-14	$	4.25
16-Pin Clip	PC-16	$	4.50
24-Pin Clip	PC-24	$	9.50
40-Pin Clip	PC-40	$	14.95

Proto Boards

PB-6	16.95	PB-104	54.00
PB-100	18.00	PB-203	97.00
PB-101	21.00	PB-203A	149.00
PB-102	25.00	PB-203A-Kit	129.00
PB-103	43.00		

SEMICONDUCTORS ☆SPEAK!☆ DIGITALKER™

Speech Synthesis System

The DIGITALKER is a speech synthesis system consisting of multiple N-channel MOS integrated circuits. It contains a speech processor chip (SPC) and speech ROM and when used with external filter, amplifier, and speaker, produces a system which generates high quality speech including the natural inflection and emphasis of the original speech. Male, female, and children's voices can be synthesized.

- Completely independent system, not requiring a processor controller
- Designed to be easily interfaced to most popular microprocessors.
- 256 possible addressable expressions
- Male, female, and children's voices
- Natural inflection and emphasis of original speech
- Addresses 128k of ROM directly
- Communicates with static or clocked dynamic ROMs
- TTL compatible
- MICROBUS™ compatible

DIGITALKER™ DT1000. Self contained board that – with just a speaker and a power supply – can rattle off any desired combination of 144 words. $485.00

DIGITALKER™ DT1050. Chip set for building Digitalker into your own evaluation design. $79.00

National Semiconductor

Apple II. 16K or Apple II. Plus $990

DISK SYSTEM SPECIAL

Apple II Plus w/48K Supermod Video Modulator
Disk II w/Controller Integer Based ROM Card.
Reg. $2,220.00, ACP Price $1819.00 SAVE **$401.00**

Hi-Speed Serial I/O	$189.00	DS65 Digi-Sector	$349.00	Integer ROM Card	$189.00
Centronics Printer I/O	180.00	Apple Graphics Tablet	675.00	Proto Card	21.95
Applesoft II Firmware	189.00	D.C. Hayes Modem II	349.95	N. & R. Modulator	29.95
Apple Clock	269.00	Disk II w/Controller & Dos 3.3	595.00	Sanyo Cassette	54.95
Introl X-10 System	179.95	Disk II	459.00	16K Upgrade Kit	54.95
Introl X-10 Controller	269.95	Pascal Lang. System	450.00	Desktop Plan	98.00
All Music Synthesizer	259.95	Parallel Printer Card	165.00	8" Floppy Controller	350.00
16 Ch. Analog Input	249.95	Communications Card	189.00	Heuristics Speechlab	179.00
2 Ch. Analog Output	164.95	Business Software Pkg.	625.00	Romplus +	169.00
13-Key Keypad	119.95	Corvus 10 Megabyte Drive		Supertalker	279.00
Visi-Calc	125.00		4625.00	Cashier	250.00

NEW! California Computer Systems APPLE Clock. Only **$124.95**

NEW! Z80 Softcard for APPLE CPM 2.2 & M BASIC 5.0 **$325.00**

NEW! California Microproducts Keypad for APPLE **$175.00**

NEW! APPLE Z-80 CP/M Software Call for Price

ATARI® 800 & 400 Personal Computer System

ATARI 800 $825.00
ATARI 400 $449.00

ATARI 800 Includes: Computer Console, BASIC Lang. Cartridge, Education System Master Cartridge, BASIC Language Programming Manual, 800 Operator's Manual w/Notebook, 16K RAM Module, Power Supply, TV Switch Box.

Peripherals		**Education System Cassette Programs**		Spelling	35.00
Disc Drive	599.00	U.S. History	35.00	Basic Electricity	35.00
Printer	499.00	U.S. Government	35.00	Basic Algebra	35.00
Program Recorder	89.00	Supervisory Skills	35.00	**Basic Game and Program Cassettes**	
Software – ROM Cartridges		World History (Western)	35.00	Guide to BASIC Programming	19.00
Education System Master Cartridge	28.00	Basic Sociology	35.00	BASIC Game Programs	19.00
Atari BASIC	55.00	Counseling Procedures	35.00	**Add-On Memory**	
Assembler Debug	55.00	Principles of Accounting	35.00	8K RAM Memory Module	110.00
Basketball	42.00	Physics	35.00	16K RAM Memory Module	225.00
Life	42.00	Great Classics (English)	35.00	**Diskettes**	
Super Breakout™	42.00	Business Communications	35.00	Blank Diskettes	
Music Composer	55.00	Basic Psychology	35.00	Disk Fire Manager	5.00
Super Bug™	42.00	Effective Writing	35.00	**Accessory Controllers**	
Computer Chess	55.00	Auto Mechanics	35.00	Driving Controller Pair	18.00
Home Finance	55.00	Principles of Economics	35.00	Paddle Controller Pair	18.00
				Joystick Controller Pair	18.00

TEXAS INSTRUMENTS INCORPORATED 99/4 PERSONAL COMPUTER

Superior Color, Music, Sound and Graphics – and a Powerful Extended Basic – All Built In.

TI 99/4 Console only available for $659.00 **$1099.00**

Commodore PET AS LOW AS $775.00

DISCOUNT PRICES

2001-8K	775.00	2023 80-Col Plain Paper Printer	695.00
2001-16K	975.00	2040 Dual Mini Disk Drive	1250.00
2001-16KB (reg)	975.00	Per IV IEEE Cable	39.95
2001-32KN	1250.00	IEEE to IEEE Cable	49.95
2001-32KB (reg)	1250.00	C2N External Cassette Deck	95.00
2022 80 Col Dot Matrix Printer	795.00		

SINGLE BOARD COMPUTER SELECTION GUIDE

BOARD	PROCESSOR	ACP PRICE	ENCLOSURE	BOARD	PROCESSOR	ACP PRICE	ENCLOSURE
KIM-1	6502	169.00	Add 29.95	SC-SBC100	Z80	239.00	N/A
SYM-1	6502	239.00	Add 29.95	AIM 65	6502	375.00	Add 49.95
Cromemco	Z80	409.00	N/A	Cosmac Vip	1802	199.00	Inc.

ACP'S COMPUTER PRODUCTS & GADGETS

You won't believe your earbones... **THE BONE FONE**

- SKIERS
- JOGGERS
- SKATERS
- CYCLERS

You must hear it and feel it to believe it!

AM/FM stereo surrounds and fills your body with sound. No earplugs. You wear it!

$65.95

QUARTZ LCD WATCH WITH SNOOZE ALARM

The looks and functions of the expensive models at an affordable price.

NEW!
6 FUNCTIONS

- HOURS
- MINUTES
- SECONDS
- MONTH
- DATE
- DAY

All in a smart seventone metal with matching bracelet.

An Outstanding ACP Value

ONLY **$21.95**

LCD CALENDAR CLOCK GEAR SHIFT KNOB

Time and Date Digital Display with Backlight for Night Use.

- Full Finger Grip
- Genuine Walnut
- Quartz LCD
- Time, Date, Seconds
- Easily Installed

NEW!

$26.95

RETAIL STORES OPEN MON-SAT

STORE #1 1310 "B" E. Edinger Santa Ana, CA 92705 Showrooms, Retail, Warehouse

STORE #2 674 El Camino Real Tustin, CA 92680 Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1310 E. Edinger (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

CPU's & SUPPORT CHIPS

8080A	6.95
8085A	12.95
AMD 2901	13.95
8205	3.95
8216	2.90
8228	4.50
8251	6.95
8259	9.95
8257 (AM9517)	8.95
Z80A SIA	8.95
8275	34.95
MC6845	24.95
FD1791	34.95

RAM's

2114L-3	4.50
4116-3	4.95
4116-2	6.75
21L02-3	.99
2102-4	.90
MK4027-3	3.50
MK4096-11	2.95
TMS4045-25	6.50
MS4050-NL	3.95
2101-1	2.45
2107B/5280	3.50
MM5270	3.45
MK4008P	1.95

UART's

AYS-1013	3.75
1602B	3.95
AY3-8500	1.95
PT14828	3.25

ROM's

2708	6.95
2716	16.00
2516	18.00
2532	49.00
8223	3.95
82S23	2.95
82S112	7.95
82S123	4.95
82S126	2.95
82S129	3.25
82S130	3.45
82S131	3.95
AM9218C	6.95

INTERFACE & DRIVERS

1488	1.40
1489	1.25
8130	2.50
8131	2.50
8830	2.50
8833	2.50
8834	2.00
8837	2.00
8838	2.00
8T380	2.00

C/MOS (DIODE CLAMPED)

4001	.35	4027	.45	4081	.35	74C74	.90
4002	.35	4028	.90	4082	.48	74C76	.70
4006	1.10	4029	.95	4093	.95	74C83	1.30
4007	.27	4030	.35	4099	1.75	74C85	1.40
4008	.95	4035	2.10	4501	.90	74C86	.90
4009	.45	4035	.97	4510	.90	74C90	.90
4010	.45	4040	1.00	4511	.95	74C93	.95
4011	.35	4042	.95	4514	1.95	74C151	1.75
4012	.35	4043	1.00	4515	1.95	74C157	1.75
4013	.45	4044	.90	4516	1.00	74C160	1.20
4014	1.20	4046	1.95	4518	1.00	74C161	1.15
4015	1.00	4048	.79	4520	1.00	74C163	1.15
4016	.45	4050	.45	74C00	.27	74C165	1.25
4017	1.05	4051	1.10	74C02	.27	74C173	1.30
4018	.90	4052	1.10	74C04	.45	74C175	1.20
4019	.45	4053	1.10	74C08	.30	74C192	1.30
4020	1.10	4066	.70	74C10	.27	74C901	.50
4021	1.10	4069	.45	74C14	1.30	74C926	6.95
4022	1.00	4071	.35	74C20	.27		
4023	.35	4072	.35	74C32	.45		
4024	.75	4076	1.00	74C73	.75		
4025	.35	4077	.35				

TRANSISTOR SPECIALS

2N1303 PNP GE TO-5	3/$1.00
2N1307 PNP GE TO-3	$ .40
2N404A PNP GE TO-5	3/$1.00
HEP G6014 — PNP GE TO-3	$ .85
TIP 121 — NPN Si SWITCHING	$ .95
2N6233 NPN SWITCHING POWER	$1.95
MRF-8004 a CB RF TRANSISTOR NPN	$ .75
2N3772 NPN Si TO-3	$1.00
2N4908 PNP Si TO-3	$1.00
2N5086 PNP Si TO-92	4/$1.00
2N3137 NPN Si RF	$ .55
2N3919 NPN Si TO-3 RF	$1.50
2N1420 NPN Si TO-5	3/$1.00
2N3767 NPN Si TO-66	$ .70
2N2222 NPN Si TO-18	5/$1.00
2N2907 NPN Si TO-18	4/$1.00
2N3055 NPN Si TO-3	$ .60
2N3904 NPN Si TO-92	6/$1.00
2N3906 PNP Si TO-92	6/$1.00
2N5296 NPN Si TO-220	$ .55
2N6109 PNP S. TO-220	$ .55
TIP 31B NPN Si TO-220	$ .60
TIP 32B PNP Si TO-220	$ .65
TIP 34 PNP Si	$ .95

TTL IC SERIES

7400	.17	7450	.17	74161	.80
74101	.17	7472	.35	74162	1.20
7402	.17	7473	.35	74163	.95
7403	.17	7474	.42	74164	.85
7404	.24	7475	.49	74165	.85
7405	.24	7476	.45	74166	1.05
7406	.33	7480	.45	74167	1.35
7407	.35	7483	.60	74170	1.60
7408	.27	7485	.75	74173	1.30
7409	.24	7486	.42	74174	.85
7410	.17	7489	1.60	74175	.75
7411	.22	7490	.50	74176	.75
7412	.22	7491	.55	74177	.75
7413	.42	7492	.50	74180	.75
7414	.90	7493	.50	74181	1.90
7416	.33	7494	.60	74190	1.20
7417	.37	7495	.60	74191	1.20
7420	.17	7496	.60	74192	.79
7425	.35	74107	.35	74193	.79
7426	.33	74121	.35	74194	.85
7427	.35	74122	.39	74195	.65
7430	.17	74123	.42	74196	.85
7432	.27	74125	.45	74197	.87
7437	.27	74126	.45	74279	.95
7438	.27	74145	.75	74325	2.25
7440	.17	74150	1.10	74365	.80
7441	.85	74151	.65	74367	.80
7442	.50	74153	.55	74368	.65
7445	.70	75154	1.10	74390	1.50
7446	.75	74155	.75	75325	1.50
7447	.75	74157	.65	75491	1.05
7448	.75	74160	.85	8T98	1.10

SPECIAL VALUES

ALL 7400 SERIES IC's 15% OFF LIST

ALL REGULATORS 20% OFF LIST

SPECIALS GOOD THRU JANUARY 1981

PRINTED CIRCUIT BOARD

4" x 6" DOUBLE SIDED EPOXY BOARD 1/16" thick

$.60 ea . . . . . 5/$2.60

EPOXY GLASS VECTOR BOARD

1/16" thick with 1/10" spacing

4½" x 6½" $1.95

DATEL'S DAC-08BC

8 bit DAC — $9.95

8" DISKETTES HARD SECTOR

$1.75, 10/$16.00

74S00 .30	74S20 .40	74S153	1.10
74S02 .30	74S30 .40	74S151	1.25
74S05 .45	74S32 .40	74S157	1.25
74S08 .40	74S89 1.90	74S158	1.25
74S11 .35	74S112 .85	74S174	1.40
74S15 .40	74S140 1.00	74S257	1.50
		74S258	1.40

7 WATT LD 65 LASER DIODE IR $8.95

25 watt Infra Red Pulse (SG 2006 equiv.) Laser Diode (Spec sheet included) $24.95

2N3820 P FET	$ .45
2N 5457 N FET	$ .45
2N2646 UJT	$ .45
ER 900 TRIGGER DIODES	4/$1.00
2N 6028 PROG. UJT	$ .65

TTL REED RELAY — SPST 5V 20ma $1.00

CLOCK CHIPS

MM5387AA	$5.95
MM5314	$4.75
MM5316	$4.95

TANTALUM CAPACITORS

.22UF 35 V	5/$1.00	10UF 10V	$ .40
.47UF 35 V	5/$1.00	22UF 10V	$ .30
.68UF 35 V	5/$1.00	15UF 16V	3/$1.00
1UF 35V	5/$1.00	30UF 6V	5/$1.00
2.2UF 20V	5/$1.00	33UF 20V	$ .60
3.3UF 20V	4/$1.00	100UF 15V	$ .70
4.7UF 15V	5/$1.00	150UF 15V	$ .95
6.8UF 35V	3/$1.00		

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS	$ 7.50
Si 1020 G 20 WATTS	$13.75
Si 1050 G 50 WATTS	$26.90

200 PRV 1A LASCR .95

RS232 CONNECTORS

DB 25P male	$3.25
DB 25S female	$4.25
HOODS	$1.50

CRYSTALS $3.45 ea.

2.000 MHz	6.144 MHz
4.000 MHz	8.000MHz
3.000 MHz	10.000 MHz
3.57 MHz	18.000 MHz
5.000 MHz	18.432 MHz
6.000 MHz	20.000 MHz

RIBBON CABLE FLAT (COLOR CODED) #30 WIRE

16 cond. - .40/per foot
40 cond. - .75/per foot
50 cond. - .90/per foot

MINIATURE MULTI-TURN TRIM POTS

100, 5K, 10K, 20K, 250K, . . . $.75 each . . 3/2.00

NO. 30 WIRE WRAP WIRE SINGLE STRAND 100' $1.40

ALCO MINIATURE TOGGLE SWITCHES

MTA 106 SPDT	$1.05
MTA 206 DPDT	$1.70
MTA 206 P-DPDT CENTR OFF	$1.85
MSD 206 P-DPDT CENTER OFF LEVER SWITCH	$1.85

SCR's

	1.5A	6A	35A	110A
100	.45	.60	1.40	
200	.70	.80	1.90	9.00
400	1.20	1.40	2.60	12.00
600		1.80	3.60	15.00

TRIAC's

PRV	1A	10A	25A
100	.45	.80	1.55
200	.84	1.30	2.10
400	1.30	1.90	3.10
600	2.00	2.75	4.30

FP 100 PHOTO TRANS	$ .50
RED, YELLOW OR GEEN LARGE LED's. „2"	6/$1.00
RED/GREEN BIPOLAR LED's	$ .55
MLED92 R LED	$ .75
MRD14B PHOTO DARL. XTOR	$ .75
TIL-118 OPTO-ISOLATOR	$ .75
IL-5 OPTO-ISOLATOR	$ .80
1 WATT ZENERS: 3.3, 4.7, 5.1, 5.6, 6.8, 8.2, 9.1, 10, 12, 15, 18, or 22V	6/$1.00

SFC 3301 — 50 PRV 30A FAST RECOVERY DIODE (35ns) . . $2.25

SILICON POWER RECTIFIERS

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.35	.90	3.70	5.00
200	.07	.20	.40	1.30	4.25	6.50
400	.09	.25	.65	1.50	6.50	9.60
600	.11	.30	.80	2.00	8.50	12.50
800	.15	.35	1.00	2.50	10.50	16.50
1000	.20	.45	1.25	3.00	12.50	20.00

IN 4148 (IN914) . . . . . 15/$1.00

.1 or .01 uf 25V ceramic disc. capts. 16/$1.00, 100/$5.00

REGULATORS

LM317T	$2.50	LM305G	$ .75
LM337	$2.50	340K-12, 15 or 24V	$1.50
323K-5V 3A	$5.75	340T-5, 6, 8, 12, 15	
79HGKC-5V at 5A	.6.95	18 or 24V	$1.10
723	$ .50	320M5	$ .75
350T-5, 12, or 15V	$1.10	LAS1412 + 12V 3A	$3.95

LED READOUTS

FCS 8024 - 4 digit

C.C. 8" display	$5.95	DL-707 C.A. .3"	$ .75
FND 503 C.C. .5"	$ .85	DL 747 C.A. .6"	$1.50
FND 510 C.A. .5"	$ .85	HP3400 .8" CA	$1.95
DL-704-.3" C.C.	$ .85	HP3405 .8" CC	$1.95

FULL WAVE BRIDGE

PRV	2A	6A	25A
100			1.40
200	.80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

DIP SOCKETS

8 PIN	.17	22 PIN	.30
14 PIN	.20	24 PIN	.35
16 PIN	.22	28 PIN	.40
18 PIN	.25	40 PIN	.60

74LS SERIES

74L500	.28	74LS139	1.30
74LS01	.29	74LS151	1.19
74LS03	.28	74LS153	1.19
74LS03	.28	74LS155	1.19
74LS04	.35	74LS156	1.19
74LS05	.35	74LS157	.85
74LS08	.35	74LS160	1.10
74LS09	.35	74LS161	1.10
74LS10	.30	74LS162	1.10
74LS11	.45	74LS163	1.20
74LS12	.35	74LS164	1.20
74LS13	.55	74LS168	1.25
74LS14	1.20	74LS170	1.70
74LS15	.35	74LS173	1.30
74LS20	.30	74LS174	1.00
74LS21	.55	74LS175	1.00
74LS22	.35	74LS181	2.50
74LS26	.35	74LS190	1.25
74LS27	.45	74LS191	1.15
74LS38	.45	74LS192	1.00
74LS30	.35	74LS193	1.10
74LS32	.40	74LS194	1.95
74LS37	.45	74LS195	1.10
74LS38	.55	74LS196	1.30
74LS40	.40	74LS197	1.10
74LS42	1.00	74LS240	2.50
74LS47	1.05	74LS241	2.95
74LS51	.35	74LS242	3.00
74LS54	.35	74LS243	2.75
74LS73	.60	74LS244	2.50
74LS74	1.05	74LS251	1.29
74LS76	.45	74LS253	1.50
74LS83	.95	74LS257	.90
74LS85	1.10	74LS258	1.50
74LS86	.45	74LS259	1.50
74LS90	.90	74LS266	.70
74LS92	.90	74LS273	1.75
74LS93	.90	74LS279	.70
74LS107	.47	74LS290	.80
74LS112	.45	74LS293	.80
74LS113	.45	74LS365	.80
74LS114	.55	74LS366	.80
74LS123	1.10	74LS367	.80
74LS125	.45	74LS368	.80
74LS126	.50	74LS375	.95
74LS132	.95	74LS377	2.75
74LS136	.80	74LS386	.50
74LS138	1.25	74LS393	1.50

LINEAR CIRCUITS

LM201	.75	LM348	.90	703	.85
LM301/748	.30	LM358	.70	709	.25
741CV	.30	LM361	1.75	710	.45
741C	.35	LM377	1.60	711CH	.40
747	.50	LM380	.95	LM1310	1.95
1458	.50	LM382	1.25	LM1808	1.75
4136	.95	LM386	.80	LM1810	2.20
3900	.55	LM387	1.25	LM1889	1.99
LM307	.30	LM553	2.25	CA3018	1.95
LM308	.75	LM556	.49	CA3046	.85
LM324	.95	LM563	.85	CA3080	.95
LM339	1.10	565	.95	CA3086	.95
LF355	1.25	566	1.25	NE540L	2.50
LM370	1.50	567	1.10	8038CC	3.90
LM311	.75	702	.95	NE592A	1.50
LM318	1.20				

POSTAGE RATES: ADD 10% FOR ORDERS UNDER $20.00. ADD 5% FOR ORDERS BETWEEN $20.00 AND $50.00. ADD 3% FOR ORDERS ABOVE $50.00.

TERMS: FOB CAMBRIDGE MASS. SEND CHECK OR MONEY ORDER. MINIMUM TELEPHONE, C.O.D. PURCHASE ORDER OR CHARGE $20.00 MINIMUM MAIL ORDER $5.00.

SEND .25 FOR OUR CATALOG FEATURING TRANSISTORS & RECTIFIERS. 145 HAMPSHIRE ST., CAMBRIDGE, MASS. 02139

SOLID STATE SALES
P.O. BOX 74D
SOMERVILLE, MASS. 02143

TEL. (617) 547-7053

WE SHIP OVER 95% OF OUR ORDERS THE DAY WE RECEIVE THEM

CIRCLE 52 ON FREE INFORMATION CARD

LOWEST EXPANSION PRICE EVER!!! 8/$37

16K DYNAMIC RAMS

Just what you've come to expect from us: the lowest price ever on 16K dynamic RAMs, backed up with a 1 year warranty. Top quality, low power, high speed (200 ns) parts. Expands memory in TRS-80* -I and -II, Apple, Heath H89, newer PETs, similar computers. Add $3 for 2 dip shunts + TRS-80* conversion instructions. **Hurry! 16K dynamic RAM prices may never be this low again.**

*TRS-80 is a trademark of the Tandy Corporation

OTHER SPECIALS

soldertail sockets

8 pin	100/$5.95
14, 16 & 18 pin	50/$4.95
20 pin	40/$4.95
24, 28 pin	30/$4.95
40 pin	20/$4.95

RCA phono jacks - these are super quality, closed circuit jacks that are the best we've seen in years. American made. 20/$1.95

2102 low power 1K static RAM 10/$9.90

General purpose silicon **signal diodes** 50/$2

GT5306 NPN darlington, min gain 17000, 25V 200 mA, TO92 package 100/$8.95

NPN transistor similar 2N3904 100/$7.95

PNP transistor similar 2N3906 100/$8.95

4N28 opto-coupler 6 pin minidip, MCT-2/IL-1 pinout 5/$2

SN76477 complex sound generator 1/$2.50

MA1003 12V DC clock module w/case $19.95

Opto-Isolator Grab Bag - 50 mixed opto-isolators from a major manufacturer. Unmarked 6 and 8 lead minidips include single and dual types with diode, transistor, and darlington outputs. Test them yourself and save! Not recommended for beginners. 50/$4

TERMS: All items are limited quantity. Cal res add tax. Allow min 5% shipping; excess refunded. Orders under $15 add $2 handling. VISA ® and Mastercard ® orders ($25 min) call (415) 562-0636, 24 hrs. Include street address for UPS. Prices subject to change without notice.

GODBOUT

GODBOUT ELECTRONICS
Bldg. 725, Oakland Airport, CA 94614

CIRCLE 26 ON FREE INFORMATION CARD

XENON STROBE TUBE & TRIGGER COIL

STROBE LIGHT SCHEMATICS INCLUDED

C24061 $1.75

LED Flasher Kit

Simple to build kit uses the popular 555 timer IC to alternately flash a red and green LED. Comes complete with all parts, including the PC board. 18V battery is not included.

C23387 $2.49

SOUND EFFECTS GENERATOR BASIC KIT

NOW IT'S POSSIBLE TO BUILD YOUR OWN SOUND EFFECTS GENERATOR WITHOUT SPENDING A FORTUNE. WE SUPPLY YOU WITH THE T176477 SOUND CHIP PLUS AN ETCHED AND DRILLED GLASS EPOXY PC BOARD WITH SCHEMATIC AND LAYOUT INSTRUCTIONS. THIS BOARD MAKES IT SIMPLE TO BUILD A GENERATOR CAPABLE OF PHASER SOUNDS, LOCOMOTIVE, SIRENS, AIRPLANES, CLOCKS, ETC. DOES NOT REQUIRE DIP SWITCHES OR OTHER EXPENSIVE/UNUSUAL COMPONENTS. YOU SUPPLY A FEW STANDARD RESISTORS, CAPACITORS, SWITCHES, POTS, SPEAKER, 2N2222 TRANSISTOR AND 9V BATTERY.

C23883 ONLY $5.95 — BASIC KIT CONTAINING T176477, PC BOARD AND INSTRUCTIONS.

2N2222 TRANSISTOR FOR ABOVE C23884 .35 EACH

ELECTRONIC WARNING FLASHER KITS

Battery operated device emits intense bursts of light at approximately 1 per second rate. Complete with all parts & PC board. (Less battery)

3VDC MODEL C23207 $6.95

6VDC MODEL C23808 $8

12VDC MODEL C23976 $10.95

ELECTRONIC STROBOSCOPE KIT

SALE

TREMENDOUS AID FOR TROUBLESHOOTING OR DEMONSTRATING OPTICAL PHENOMENA. OPTICALLY STOPS MOTION OF FANS, WHEELS, PULLEYS, FLYWHEELS, ETC. THE STROBOSCOPE OPERATES FROM STANDARD 115VAC AND FEATURES BRIGHT XENON FLASH TUBE AND IC DESIGN. CONTINUOUSLY VARIABLE FLASH RATE FROM 100-5000RPM. THE KIT COMES WITH ALL COMPONENTS INCLUDING PC BOARD, LINE CORD AND KNOB. DOES NOT INCLUDE CASE. SIZE OF BOARD: 3 1/2"W x 4 3/4"L.

C24070 SALE $29.95

120 VAC Xenon Strobe Kit

Complete variable rate strobe light kit. Contains all parts, PC board, line cord and instructions.

C23011 $7.50

Wheel of Fortune

Popular game device uses LED's, transistors & IC to give the effect of a bright red ball spinning around numbers. Unit emits sound as it spins & finally stops on a number. Incl. all parts, faceplate & PC board.

C23006 $8.99

CHANEY electronics inc.

- Minimum order $5.00
- Please include $1.00 for postage
- Visa, MC and COD accepted
- Phone orders are welcome

P.O. BOX 27038, DENVER, CO. 80227 (303) 781-5750

Send for our free giant catalog of unique items !!!

CIRCLE 6 ON FREE INFORMATION CARD

ramsey the first name in Counters !

9 DIGITS 600 MHz $129.95 WIRED

PRICES

CT-90 wired, 1 year warranty	$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack +AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally; an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
MINI-100 Kit, 90 day part warranty	59.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current:	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	10.1% basic DC volts
Power:	4 'C' cells

AUDIO SCALER

For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

ACCESSORIES

Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

ramsey electronics, inc.
2575 BAIRD RD. • PENFIELD, NY 14526

PHONE ORDERS
CALL 716-586-3950

TERMS Satisfaction guaranteed - examine for 10 days, if not pleased, return in original form for refund. Add 5% for shipping & insurance to a maximum of $10. Overseas add 15%. COD add $2. Orders under $10., add $1.50. NY residents add 7% tax.

CIRCLE 7 ON FREE INFORMATION CARD

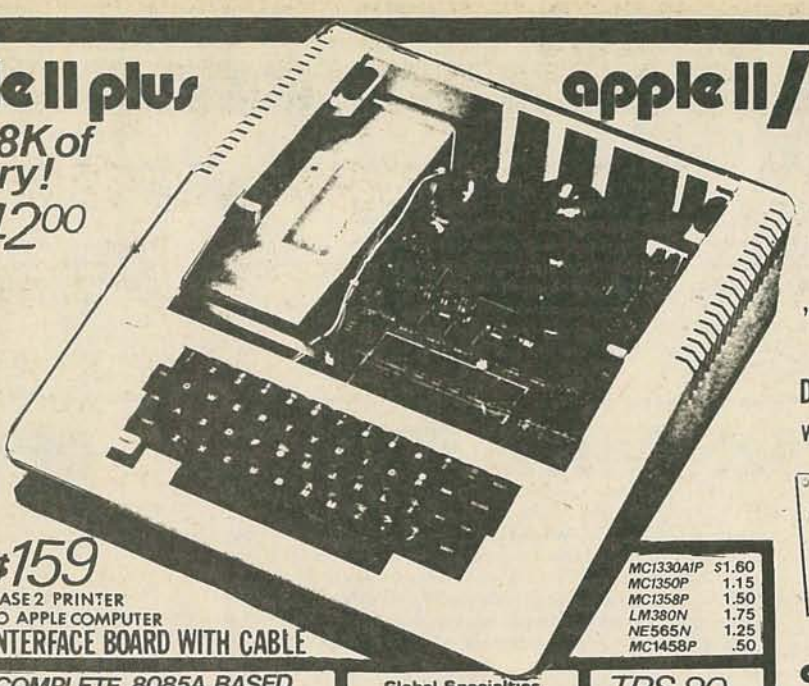
apple II plus

With 48K of memory!

$1042.00

With the purchase of the APPLE II select from the below SPECIAL PRICING!

Base 2 printer	$599.00
Disk II w/cont	585.00
Disk II	475.00
Sec. Printer Cd	179.00
Sup'R'Mod	23.00
3way I/O Select	33.00
Video 100 12"	119.00
Firmware Card	149.00
UHF to RCA Cable	5.00



apple II/apple II plus

With 60K of memory!

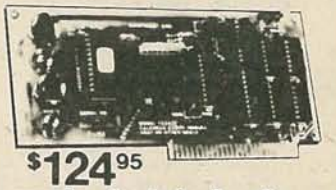
$1259.00

- Switch from "APPLESOFT" to "INTEGER BASIC" and back again.
- With Disc Operating System DOS 3.3 run PASCAL program without need for a PASCAL card.

MC1330A1P	$1.60
MC1350P	1.15
MC1358P	1.50
LM380N	1.75
NE565N	1.25
MC1458P	.50

$159

BASE 2 PRINTER TO APPLE COMPUTER
INTERFACE BOARD WITH CABLE



$124.95

apple clock/calendar

- Seconds, minutes, hours, day-of-week, month, date, & year.
- On board batteries with one year life.
- Uses MSM5832 crystal controlled.

California Computer Systems

74LS00	.20
74LS02	.26
74LS03	.26
74LS04	.26
74LS08	.28
74LS09	.26
74LS10	.26
74LS20	.26
74LS21	.28
74LS22	.26
74LS26	.49
74LS27	.26
74LS30	.28
74LS32	.32
74LS38	.32
74LS42	.65
74LS48	.78
74LS51	.25
74LS54	.35
74LS74	.38
74LS75	.60
74LS83	.44
74LS85	.95
74LS86	.95
74LS90	.69
74LS93	.69
74LS107	.45
74LS112	.38
74LS113	.48
74LS122	.48
74LS123	.95
74LS126	.69
74LS138	.69
74LS151	.44
74LS153	.44
74LS155	1.15
74LS158	.75
74LS160	.95
74LS161	.85
74LS162	.95
74LS163	1.60
74LS164	.65
74LS165	.65
74LS170	1.75
74LS174	.75
74LS175	.75
74LS190	.75
74LS193	.95
74LS195	.95
74LS196	.85
74LS221	1.40
74LS240	1.65
74LS241	1.65
74LS243	1.45
74LS244	1.45
74LS245	2.25
74LS253	.95
74LS257	.95
74LS258	.95
74LS259	2.85
74LS279	.44
74LS283	1.00
74LS293	1.85
74LS298	1.20
74LS366	.95
74LS367	.55
74LS368	.55
74LS373	1.39
74LS374	1.39
74LS386	.65

COMPLETE 8085A BASED MICRO-COMPUTER

AND MICROPROCESSOR TRAINING UNIT

YOU GET:

- Fully assembled and tested 8085A Microcomputer with 1K RAM, 1K PROM, & 1K EPROM. Programmable I/O, Keyboard unit, CPU card, 20 ma Asynchronous serial port, Display and Operating system.
- 8085A Cookbook: 362 pages takes you from basic concepts to actual design.
- 8080/8085A Software Design Book 1" with detailed examination of all 244 instructions. 336 pages include sample programs using all basic instructions and typical assembly language.

$295.00

Global Specialties

Logic Probes

LP1 — $37.49

LP2 — $21.49

LP3 — $58.49

TRS 80

16K Memory Add-On

$439.95

KIT CONTAINS DIP SWITCHES AND DETAILED INSTRUCTIONS

APPLE EXPANSION KIT

16K Memory Add-On $39.00

MEMORY ADD-ON KIT INCLUDES INSTRUCTIONS

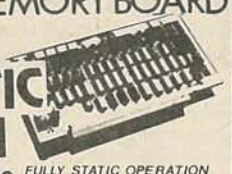
VOLTAGE REGULATORS

NEGATIVE	POSITIVE
7905/5V	7805/5V
7908/8V	7806/6V
7915/15V	7808/8V
7918/18V	7812/12V

95¢

S-100 MEMORY BOARD

16K STATIC RAM



$249.00

ASSEMBLED & TESTED

FULLY STATIC OPERATION
4K BANK ADDRESSABLE EXTENDED MEMORY MGMT.
MEETS IEEE PROPOSED S-100 SIGNAL STANDARDS
4 MHZ OPERATION

California Computer Systems

EPROMS

2708	1K×8	$ 6.75	8 for $49
2716	2K×8	12.95	8 for $110
2732	4K×8	44.95	2 for $100

SINGLE 5 VOLT FOR 2716 & 2732

FRT. CHARGES

am't	frt. chg.
$ 10-49	$ 2.00
50-99	4.00
100-249	7.00
250-499	8.00
500-999	10.00
1000 up	inquire

*note

video 100

$125

Leedex Corp.

12" BLACK & WHITE LOW COST VIDEO MONITOR

SN7400N	.20
SN7402N	.22
SN7404N	.22
SN7408N	.24
SN7410N	.22
SN7412N	.28
SN7413N	.35
SN7414N	.49
SN7416N	.29
SN7417N	.29
SN7423N	.28
SN7425N	.25
SN7430N	.23
SN7437N	.29
SN7438N	.24
SN7440N	.22
SN7442N	.57
SN7443N	.78
SN7445N	.78
SN7451N	.20
SN7454N	.20
SN7474N	.32
SN7475N	.32
SN7482N	1.05
SN7492N	.50
SN7493N	.48
SN7495N	.60
SN7496N	.70
SN74122N	.39
SN74136N	.95
SN74141N	.69
SN74151N	.65
SN74153N	.65
SN74154N	1.25
SN74155N	.80
SN74157N	.69
SN74160N	.95
SN74161N	.65
SN74163N	.85
SN74164N	.87
SN74165N	.87
SN74174N	.95
SN74175N	.69
SN74180N	.75
SN74181N	1.15
SN74393N	1.69

2114L

1024×4 Static RAM

300nsec $3.99
200nsec 4.75

555 TIMER 27¢

8038C

VCO Waveform Gen w/sine $2.65

$87.50

No "Glitches", Surges Or Interference

The MPD 117 is the low-cost solution to your power distribution problems. The MPD 117 has a high-performance EMI filter, built-in circuit breaker, two direct and six switched outlets, illuminated "on-off" switch for switched outlets, and is built with rugged UL-approved components and housing in an all-steel chassis with convenient mounting flanges.

MODEL 800B IMPACT PRINTER

- Dot resolution graphics in six densities
- 1920 character buffer
- Fully adjustable tractors to 9-1/2"

$649.00

base 2, inc.

S-100 16K ADD-ON BARE BOARD

WITH DOCUMENTATION AND DETAILED INSTRUCTION BOOK

$289.95

$17.95

LOGIC PROBE KIT

Ask about QUANTITY DISCOUNT

SOROC TECHNOLOGY, INC.

IQ120 $689

CONCORD COMPUTER COMPONENTS

1971 SOUTH STATE COLLEGE ANAHEIM, CA. 92806

VISA MASTERCHARGE
CHECK OR M O
NO COD

(714) 937-0637

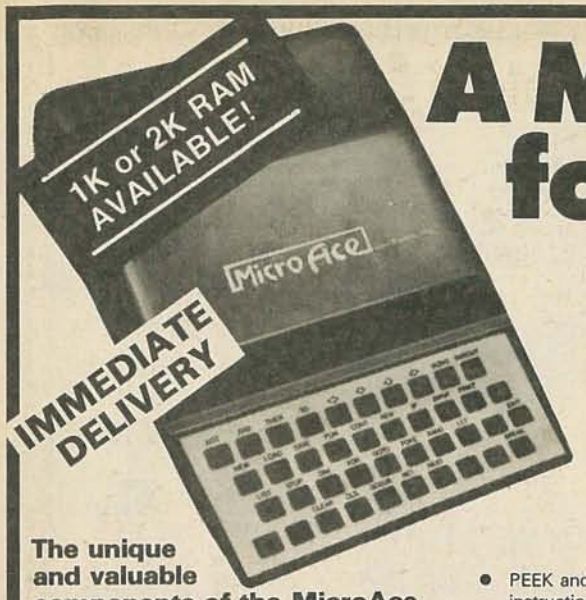
We stock and sell over 12,000 types of semiconductors

MINIMUM ORDER $10.00
ADD FRT
CAL RES ADD 6%

MSM5832 MICROPROCESSOR REAL-TIME CLOCK/CALENDAR $7.45

GENERAL DESCRIPTION

The MSM5832 is a monolithic, metal-gate CMOS integrated circuit that functions as a real time clock/calendar for use in bus-oriented microprocessor applications. The on-chip 32.768 Hz crystal controlled oscillator time base is counted down to provide addressable 4-bit I/O data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4-bit address, chip select, read, write and hold inputs. Other functions include 12H/24H format selection, leap year identification and manual + 30 second correction.



Licenced by Sinclair Research Ltd.

A Microcomputer for everyone at a Micro Price

The MicroAce - a new generation of miniature computers

A COMPLETE COMPUTER for $149.00 for 1K Kit

Post and Packing FREE

(Add 6% Tax for Shipments inside California)

The unique and valuable components of the MicroAce

The MicroAce is not just another personal computer. Quite apart from its exceptionally low price, the MicroAce has two uniquely advanced components: the powerful BASIC interpreter, and the simple teach yourself BASIC manual.

The unique versatile BASIC interpreter offers remarkable programming advantages:

- **Unique 'one-touch' key word entry: the MicroAce eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability — takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The MicroAce also has string input — to request a line of text when necessary. Strings do not need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

'Excellent value' indeed!

For just $149.00 (including handling charge) you get everything you need to build a personal computer at home... PCB, with IC sockets for all ICs; case; leads for direct connection to a cassette recorder and television (black and white or color); everything!

Yet the MicroAce really is a complete, powerful, full-facility computer, matching or surpassing other personal computers at several times the price.

The MicroAce is programmed in BASIC, and you can use it to do quite literally anything, from playing chess to managing a business.

The MicroAce is pleasantly straightforward to assemble, using a fine-tipped soldering iron. It immediately proves what a good job you've done: connect it to your TV ... link it to the mains adaptor ... and you're ready to go.

Fewer chips, compact design, volume production-more power per Dollar!

The MicroAce owes its remarkable low price to its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER ROM, for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the MicroAce 1K byte RAM (expandable to 2K on board) is roughly equivalent to 4K bytes in a conventional computer — typically storing 100 lines of BASIC. (Key words occupy only a single byte.)

The display shows 32 characters by 24 lines.

And Benchmark tests show that the MicroAce is faster than all other personal computers.

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

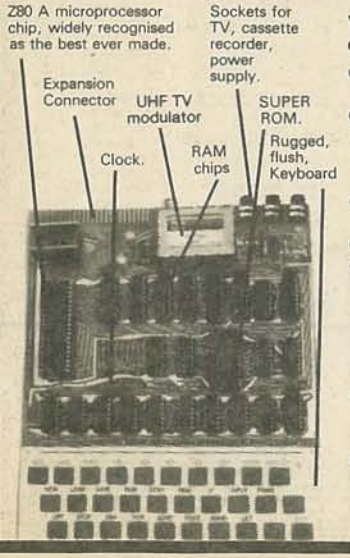
The MicroAce teach-yourself BASIC manual.

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

A hardware manual is also included with every kit.

The MicroAce Kit: $149.00 with IK COMPLETE $169.00 with 2K

Demand for the MicroAce is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. If you are unsuccessful in constructing your kit, we will repair it for a fee of $20.00, post and packing FREE. Of course, you may return your MicroAce as received within 14 days for a full refund. We want you to be satisfied beyond all doubt — and we have no doubt that you will be.



Your MicroAce kit contains...

- Printed circuit board, with IC sockets for all ICs.
- Complete components set, including all ICs-all manufactured by selected world-leading suppliers.
- New rugged keyboard, touch-sensitive, wipe-clean.
- Ready-moulded case.
- Leads and plugs for connection to domestic TV and cassette recorder. (Programs can be SAVEd and LOADed on to a portable cassette recorder.)
- Mains adaptor of 600 mA at 9VDC nominal unregulated.
- FREE course in BASIC programming and user manual.

JOIN THE REVOLUTION - DON'T GET LEFT BEHIND - ORDER YOUR MICRO ACE NOW!!

Send Check, Money Order or quote your Credit Card No. to:
MicroAce 1348 East Edinger, Santa Ana, California, Zip Code 92705.
or phone (714) 547 2526 quoting your Credit Card Number.

Quantity	Description	Unit Price	TOTAL
	MicroAce Kit 1K	$149.00	
	MicroAce Kit 2K	$169.00	
	Manual	$10.00	
	1K Upgrade Kit	$29.00	
Shipments inside California add 6% TAX		**TOTAL**	

☐ Amex.
☐ Diners
☐ Check
☐ Money Order
☐ Master Charge
☐ Visa

Card No. _____

_____

Exp. Date _____

Name _____

Address _____

City _____ State _____ Zip _____

LOWEST PRICES FOR PRIME ICs!

ORDER DESK: 800 - 325 - 0101

In addition to the broadest line of digital integrated circuits offered anywhere, I.C.C. offers the complete line of products from the following well known manufacturers of electronic components and subsystems.

74xx		74125	$0.49	74LS12	$0.36	74LS196	$1.25	74S189	$3.35	74C907	$0.75	4089	$2.75	LM741CH	$0.55
		74126	0.49	74LS13	0.55	74LS197	1.25	74S194	2.15	74C908	1.19	4093	0.99	LM748CN	0.35
		74132	0.75	74LS14	1.10	74LS221	1.90	74S200	3.95	74C909	2.15	4099	2.10	LM1458N	0.58
7400	$0.20	74141	0.79	74LS15	0.34	74LS240	2.25	74S206	4.55	74C910	6.00	4503	0.98	LM1496N	0.69
7401	0.20	74145	0.79	74LS20	0.34	74LS241	2.25	74S253	1.15	74C914	1.45	4507	0.99	LM1889N	2.25
7402	0.20	74147	1.70	74LS21	8.36	74LS244	2.25	74S257	1.45	74C918	1.49	4508	3.00	LM2111N	1.55
7403	0.20	74148	1.29	74LS22	0.36	74LS253	1.01	74S258	1.45	74C925	7.80	4510	1.15	MC1357P	1.55
7404	0.25	74150	1.10	74LS26	0.36	74LS257	0.86	74S280	2.75	74C926	7.80	4511	1.25	MC1455P1	0.35
7405	0.20	74151	0.59	74LS27	0.36	74LS258	0.86	74S287	3.90	74C927	7.80	4512	1.25	MC1496P1	0.95
7406	0.29	74152	0.59	74LS30	0.34	74LS260	0.39	74S288	4.35	74C928	7.80	4516	1.22	MC1456CV	0.95
7407	0.29	74153	0.59	74LS32	0.40	74LS266	0.49	74S387	5.70			4518	1.15	MC1458P1	0.58
7408	0.20	74154	1.15	74LS37	0.36	74LS279	0.73	93S00	2.00	4xxx		4519	0.62	MC1496L	0.69
7409	0.20	74155	0.69	74LS38	0.36	74LS283	0.99	93S05	2.30			4520	1.15	MC1709CP1	0.28
7410	0.20	74156	0.69	74LS40	0.34	74LS290	1.05	93S10	3.45	4000	$0.35	4527	1.67	MC1710CP	0.29
7411	0.25	74157	0.64	74LS42	0.82	74LS295	0.99	93S12	1.35	4001	0.35	4528	1.50	MC1711CP	0.39
7412	0.25	74158	0.64	74LS47	1.05	74LS365	0.66	93S13	1.95	4002	0.35	4539	1.35	MC1741CG	0.35
7413	0.39	74160	0.87	74LS48	1.05	74LS366	0.66	93S16	3.40	4006	1.19	4555	0.89	MC1748CP1	0.35
7414	0.70	74161	0.87	74LS49	1.05	74LS367	0.66	93S41	5.00	4007	0.35	4556	1.09	MC4741CP	1.25
7416	0.25	74162	0.87	74LS51	0.34	74LS368	0.66	93S42	1.50	4008	1.05	4582	1.09	MC7805CT	1.20
7417	0.25	74163	0.87	74LS54	0.34	74LS373	2.25	93S43	5.95	4009	0.49	4702	7.10	MC7806CT	1.20
7420	0.20	74164	0.87	74LS55	0.34	74LS374	2.25	93S46	1.55	4010	0.49	4703	8.25	MC7808CT	1.20
7423	0.25	74165	0.87	74LS73	0.45	74LS386	0.53	93S62	2.65	4011	0.35	4704	7.30	MC7812CT	1.20
7425	0.29	74166	1.22	74LS74	0.45	74LS390	1.89			4012	0.35	4705	9.25	MC7815CT	1.20
7426	0.29	74167	1.95	74LS76	0.52	74LS490	1.89	74Cxx		4013	0.49	4706	9.75	MC7824CT	1.20
7427	0.25	74170	1.58	74LS78	0.48	74LS670	2.45			4014	1.05	4720	6.95	MC78M12CT	0.77
7430	0.20	74173	1.74	74LS83	1.05			74C00	$0.34	4015	1.05	4723	1.50	MC75451P	0.50
7432	0.25	74174	0.89	74LS85	1.25	74Sxx		74C02	0.34	4016	0.53	4724	1.50	MC75492P	0.52
7437	0.25	74175	0.80	74LS86	0.49			74C04	0.35	4017	1.07	4725	3.95	MLM311P1	0.85
7438	0.40	74176	0.78	74LS90	0.71	74S00	$0.45	74C08	0.35	4018	1.07	40014	1.10	MLM324P	0.75
7439	0.29	74177	0.78	74LS92	0.71	74S01	0.45	74C10	0.34	4019	0.49	40085	1.69	MLM565CP	1.20
7440	0.20	74178	1.90	74LS93	0.71	74S02	0.45	74C14	0.90	4020	1.13	40098	0.69	N5558V	0.58
7441	0.88	74179	1.90	74LS95	0.99	74S03	0.45	74C20	0.34	4021	1.13	40106	0.90	N5596A	0.69
7442	0.59	74180	0.79	74LS107	0.44	74S04	0.46	74C30	0.34	4022	1.05	40160	1.17	N5733A	0.66
7443	0.75	74181	1.95	74LS109	0.44	74S05	0.46	74C32	0.34	4023	0.35	40161	1.17	NE501A	6.00
7444	0.75	74182	0.78	74LS112	0.49	74S08	0.48	74C42	1.00	4024	0.79	40162	1.17	NE526A	6.00
7445	0.75	74184	1.95	74LS113	0.49	74S09	0.48	74C48	1.27	4025	0.35	40163	1.17	NE531V	3.90
7446	0.69	74185	1.95	74LS114	0.49	74S10	0.45	74C73	0.71	4027	0.69	40174	1.15	NE550A	1.00
7447	0.69	74188	3.85	74LS123	0.98	74S11	0.48	74C74	0.71	4028	0.88	40175	1.15	NE555V	0.35
7448	0.79	74190	0.99	74LS125	0.62	74S15	0.48	74C76	0.71	4029	1.13	40192	1.37	NE556A	0.90
7450	0.20	74191	0.99	74LS126	0.62	74S20	0.45	74C83	1.45	4030	0.45	40193	1.37	NE560B	2.50
7451	0.20	74192	0.80	74LS132	0.91	74S21	0.48	74C85	1.45	4031	3.25	40194	1.17	NE565A	1.20
7453	0.20	74193	0.80	74LS136	0.48	74S22	0.46	74C86	0.49	4034	2.75	40195	1.17	NE566V	1.50
7454	0.20	74194	0.87	74LS138	0.93	74S30	0.45	74C89	3.95	4035	0.99			NE567V	0.98
7459	0.20	74195	0.87	74LS139	0.87	74S32	0.70	74C90	1.10	4040	1.20	LINEAR		SE540L	6.00
7460	0.20	74196	0.87	74LS151	0.75	74S40	0.45	74C93	1.10	4041	1.05			SN75451P	0.50
7470	0.29	74197	0.87	74LS152	0.75	74S50	0.45	74C95	1.30	4042	0.99	75451BTC	$0.50	SN75492N	0.52
7472	0.29	74198	1.45	74LS153	0.84	74S51	0.45	74C107	0.69	4043	0.89	75492PC	0.52	ULN2111A	1.55
7473	0.36	74199	1.45	74LS154	1.40	74S60	0.45	74C151	2.35	4044	0.89	DS75402N	0.52	uA311TC	0.85
7474	0.35	74251	1.09	74LS155	0.89	74S64	0.48	74C154	3.00	4046	1.79	LM311N	0.85	uA324PC	0.75
7475	0.49	74283	2.20	74LS156	0.89	74S65	0.48	74C157	2.05	4047	1.99	LM311V	0.85	uA555TC	0.35
7476	0.35	74290	0.99	74LS157	0.75	74S74	0.78	74C160	1.17	4048	0.95	LM324N	0.75	uA556PC	0.50
7480	0.40	74293	0.99	74LS158	0.75	74S76	0.78	74C161	1.17	4049	0.49	LM340T-5	1.20	uA709CV	0.28
7482	0.63	74298	0.92	74LS160	1.05	74S78	0.78	74C162	1.17	4050	0.55	LM340T-6	1.20	uA709TC	0.28
7483	0.69	74365	0.57	74LS161	1.05	74S86	0.78	74C163	1.17	4051	1.19	LM340T-8	1.20	uA710CA	0.29
7485	0.89	74366	0.67	74LS162	1.05	74S112	0.78	74C164	1.17	4052	1.19	LM340T-12	1.20	uA710PC	0.29
7486	0.40	74367	0.67	74LS163	1.05	74S113	0.78	74C165	1.17	4053	1.19	LM340T-15	1.20	uA711CA	0.39
7489	1.75	74368	0.67	74LS164	1.15	74S114	0.78	74C173	1.29	4060	1.49	LM340T-24	1.20	uA711PC	0.39
7490	0.43			74LS168	1.45	74S132	0.85	74C174	1.15	4066	0.78	LM342P-12	0.77	uA733PC	0.66
7491	0.59	74LSxx		74LS169	1.45	74S133	0.48	74C175	1.15	4068	0.39	LM348N	1.25	uA741CT	0.35
7492	0.43			74LS170	1.80	74S134	0.48	74C192	1.37	4069	0.35	LM380N	0.95	uA741HC	0.35
7493	0.43	74LS00	$0.34	74LS173	1.33	74S135	0.59	74C193	1.37	4070	0.49	LM382N	1.60	uA748CV	0.35
7494	0.65	74LS01	0.34	74LS174	1.20	74S138	0.97	74C195	1.17	4071	0.35	LM555CN	0.35	uA748TC	0.35
7495	0.65	74LS02	0.34	74LS175	0.89	74S139	1.90	74C200	7.50	4073	0.35	LM556CN	0.90	uA1458TC	0.58
7496	0.65	74LS03	0.34	74LS181	2.50	74S140	0.57	74C221	1.89	4075	0.35	LM565CN	1.20	uA2136PC	1.55
7497	2.90	74LS04	0.38	74LS190	1.25	74S151	1.55	74C901	0.48	4076	1.29	LM566CN	1.50	uA7805UC	1.20
74107	0.34	74LS05	0.38	74LS191	1.25	74S153	2.60	74C902	0.48	4077	0.69	LM567CN	0.98	uA7808UC	1.20
74109	0.45	74LS08	0.36	74LS192	1.15	74S157	0.95	74C903	0.79	4078	0.45	LM709CN-8	0.28	uA7808UC	1.20
74121	0.34	74LS09	0.36	74LS193	1.15	74S158	1.55	74C904	0.79	4081	0.35	LM710CN	0.29	uA7812UC	1.20
74122	0.39	74LS10	0.34	74LS194	1.35	74S174	1.90	74C905	6.00	4085	0.79	LM711CN	0.39	uA7815UC	1.20
74123	0.58	74LS11	0.36	74LS195	1.35	74S175	1.75	74C906	0.75	4086	0.79	LM733CN	0.66	uA7824UC	1.20

I.C.C. has in stock the complete line of AP Products, including the Poweraces, ACE Circuit Evaluators, Super-Strips, DIP Jumpers, PC Board Connectors, and even the NEW Hobby Blox. If AP makes it, we have it in stock for immediate delivery. And, best of all, our Volume Discount is applicable to all of them.

O.K. Machine & Tool has one of the widest line of products for wire wrapping, and the associated accessories. These high quality, yet low cost, components include: manual and battery-operated wrapping tools, wire dispensers, Just-Wrap® units, circuit boards, etc. The entire line is available from I.C.C.

Vector is The name in breadboarding, and I.C.C. has the widest range of Vectorbords, Experimenter's Boards, Vector Pins, Terminals and Wrap Posts, Wrapping Tools, and blank Microprocessor Boards for virtually every brand of Microcomputers.

The entire range of 5% and 10%, ¼ and ½ watt, type RCR Mil-Grade resistors manufactured by Allen-Bradley and Stackpole is available from I.C.C. The established reliability levels of 0.01% (Orange fifth band) – 0.001% (Yellow fifth band) failures per thousand hours of operation at 50% rated wattage is your assurance of trouble-free circuit performance.

wrapping wire

Pre-Cut and Pre-Stripped (1" from each end) No. AWG 30 wrapping wire in ten colors (Blk, Brn, Red, Org, Yel, Grn, Blue, Vio, Gry, and Wht) and in fifteen different lengths from 1" to 15" in four packages (50, 100, 500, and 1000) are available for low cost, yet fast and reliable circuit and back-panel wriring.

VOLUME DISCOUNT SCHEDULE		STANDARD SHIPPING CHARGES	
Merchandise Total	*DISCOUNT*	*If your Merchandise Total is between*	
$ 0.01-$ 9.99	NET	$ 0.01-$ 4.99	add $2.00
$ 10.00-$ 24.99	LESS 5%	$ 5.00-$24.99	add $1.00
$ 25.00-$ 99.99	LESS 10%	$ 25.00-$49.99	add $0.75
$ 100.00-$499.99	LESS 15%	$ 50.00-$99.99	add $0.50
$ 500.00-$999.99	LESS 20%	$100.00 and Up	NO CHARGE
$1000.00 and Up	LESS 25%	*The above charges include your choice of shipping in U. S. via First Class Mail or UPS.*	

INTERNATIONAL COMPONENTS CORPORATION

P. O. BOX 1837
COLUMBIA, MO 65205

PHONE: (314) 474-9485

CIRCLE 54 ON FREE INFORMATION CARD

POLY PAKS PENNY SALE

Buy 1 2.99er Get 2nd* for 1 Penny More!

25-SLIDE SWITCHES, various shapes, sizes, and types (#2726)	2.99	50 for $3	10-QUAD PHONO JACKS, 4 RCA jacks on 2 x 1½" Bakelite strip, (#6249)	2.99	20 for $3
50-TRANSISTOR ELECTROLYTICS, epoxy encapsulated, asst. values, (#2747)	2.99	100 for $3	25-RCA PHONO PLUGS, popular audio/speaker plugs, 100% material (#3293)	2.99	50 for $3
175-HALF WATTERS, 100% color-coded resistors, asst. values, (#3046)	2.99	350 for $3	15-MINI PLUG & CABLE SETS, 3.5mm plug, 6' insulated 2 cond. leads, (#6269)	2.99	30 for $3
20-SIDE VOLUME CONTROLS, various values & types, for Hi-Fi, etc. (#3057)	2.99	40 for $3	200-PRE-FORMED DISCS, caps w/leads for PC use, mixed values, (#2605)	2.99	400 for $3
50-UPRIGHT ELECTROS, 100% assorted values & voltages, marked, (#3226)	2.99	100 for $3	25-PLASTIC POWERS, 25 watt, npn & pnp, 50-200 bvcbo, TO-220, (#6237)	2.99	50 for $3
20-PANEL SWITCHES, assorted rotary, micro, slide, etc. (#6629)	2.99	40 for $3	100-2 WATT RESISTORS, assorted carbons, films etc. some 5%ers, (#6238)	2.99	200 for $3
20-PAIRS-RCA PLUGS & JACKS, popular for Hi-Fi, speakers, etc. (#6630)	2.99	40 for $3	24-LM-340T VOLTAGE REGULATORS, untested TO-220, may incl. 5-24V, (#2635)	2.99	48 for $3
60-IN914 SWITCHING DIODES, 4 nsec. axial, glass, untested, (#6632)	2.99	120 for $3	125-POLYSTYRENE CAPS, assorted types, styles & sizes, all good, (#2729)	2.99	250 for $3
4-2N3055 NPN TRANSISTORS, 115 watts, 15 amps, TO-3, 100% material, (#6633)	2.99	8 for $3	50-POWER TAB TRANSISTORS; plastic NPN, TO-220, asst. types, untested, (#2425)	2.99	100 for $3
50-THERMISTORS, various types & styles, neg. coefficient, 100% (#4089)	2.99	100 for $3	24-SKINNY TRIM POTS, multi & single turn, asst. values & types, (#6285)	2.99	48 for $3
30-INSTRUMENT KNOBS, for half round shafts, some w/pointers, (#6498)	2.99	60 for $3	75-LONG LEAD DISCS, prime, marked caps, assorted material, (#2598)	2.99	150 for $3
10-LINE CORDS, heavy-duty, 18 gauge, 6', molded plug, 2-cond. (#6499)	2.99	20 for $3	50-TTLs, 7400 series, incl. gates, flip-flops, etc. untested, (#6226)	2.99	100 for $3
10-2N3055 HOBBY TRANSISTORS, manuf. fallout, TO-3, U-test, (#6624)	2.99	20 for $3	5-BRASS LOCKS, with key, 1½" long, for doors, windows, etc. (#6253)	2.99	10 for $3
100-DTL IC's, mostly dual JK flip flops, marked, 100% prime, (#6444)	2.99	200 for $3	250-MOLEX SOCKETS, "on-a-strip", make your own pc sockets, (#6255)	2.99	500 for $3
35-STEREO INDICATORS, tiny red 1.5V bulbs, for Hi-Fi replacement, (#6244)	2.99	70 for $3	50-MINI POTS, pc style, single turn, assorted values, (#3345)	2.99	100 for $3
40-800V 1A RECTIFIERS, type IN4006, epoxy, axial leads, (#6245)	2.99	80 for $3	15-JUMBO RED LEDS, 3V 10 mA, 100% good material, red dome lens, (#3369)	2.99	30 for $3
9-DIGIT READOUTS, flat pak w/bubble mag. .120" high, 14 pin, (#5558)	2.99	18 for $3	2-SOUND TRIGGERS, sound activated amp, SCR triggered, on 3" board, (#3625)	2.99	4 for $3
100-PREFORMED ¼ WATTERS, assorted values, precut for PC appl. (#6622)	2.99	200 for $3	40-TRANSISTOR SOCKETS, assortment may include, TO-19,5,66,3,etc. (#3845)	2.99	80 for $3
20-NE-2 BULBS W/RESISTOR, neon, plugs right into 110 VAC, (#6620)	2.99	40 for $3	75-CABLE TIES, 4" non-slip white plastic, like Ty-wrap, (#5218)	2.99	150 for $3
15-RCA PHONO JACKS, popular Hi-Fi jack on a Bakelite strip, (#6230)	2.99	30 for $3	150-FEEDTHRU CAPS, assorted types & sizes, for RF, UHF, etc. (#5668A)	2.99	300 for $3
150-"4000" RECTIFIERS, IN4000 series, may include; 50 to 1000V. (#2417)	2.99	300 for $3	175-¼ WATT RESISTORS, asstd. carbons, carbo-films, some 5%ers, (#5797A)	2.99	350 for $3
50-AXIAL ELECTROS, asst. values, volts, sizes, What a buy! (#3227)	2.99	100 for $3	100-PLESSY CAPS, ceramic blocks in assorted sizes & values, (#6221)	2.99	200 for $3
3-SHIELDED AUDIO CABLES, 2 cond., with RCA plugs at each end, (#6412)	2.99	6 for $3	100-PC,-HEATSHRINK, slip-over type, shrinks 50%, like Thermo-fit, (#6239)	2.99	200 for $3
200-PC-SEMICON SPECIAL, assorted semis of all types, Untested material, (#3300)	2.99	400 for $3	25-NE-2 BULBS, neon, for 110 VAC, requires resistor, (not incl.) (#2613)	2.99	50 for $3
200-PRE-FORMED ½ WATTERS, popular values, some 5 & 10%ers, (#6246)	2.99	400 for $3	100-METALLIC RESISTORS, mostly ½ watters, asst. val. 1-5% tol. (#6280)	2.99	200 for $3
30-SCRs & TRIACS, assorted values, 10 Amp TO-220, untested, (#6337)	2.99	60 for $3	100-POWERS POWERS, 3 to 7 watt power resistors, (#6281)	2.99	200 for $3
25-TINY SLIDE SWITCH, only 3/7" cube, SPDT, PC leads, (#6385)	2.99	50 for $3	15-CRYSTALS, assorted types, some H6/U, some frequency marked, (#6256)	2.99	30 for $3
40-EDGE CONNECTORS, asst. 4 & 6 pin, 2-sided, pc leads, (#6364)	2.99	80 for $3	150-SUBMINI IF TRANSFORMERS, asst. may include; osc. antenna, etc. (#6259)	2.99	300 for $3
6-MINI-MOTORS, Type RE56, 1.5-6 VDC, color-coded wire leads, (#6718)	2.99	12 for $3	60-SQUARE OHM RESISTORS, prime resistors, asst. values, grab 'em! (#6261)	2.99	120 for $3
24-MINI-BULBS, asst. voltages & base styles, some colored, (#6757)	2.99	48 for $3	25-MICRO MINI REED SWITCHES, 1" long, for alarms, relay systems, etc. (#6263)	2.99	50 for $3
40-STRAIN RELIEFS, asst. types, styles, & sizes, (#6756)	2.99	80 for $3	150-PC,-CAPACITOR SPECIAL, asst. mylars, polys, micas, etc. 100% good, (#6264)	2.99	300 for $3
6-TIME DELAYS, solid state, asst. from 450 mSec to 8 Sec. (#6758)	2.99	12 for $3	10-PUSHBUTTON ALARM SWITCH, SPST, momentary, NC, w/hardware, (#6267)	2.99	20 for $3
3-HEAVY DUTY AUTO CHOKE, filters 12 VDC @ 5A, open frame, (#6750)	2.99	6 for $3	500-PC-HARDWARE SURPRISE, (approx.) 1 lb. asst. screws, washers, etc. (#6271)	2.99	1000 for $3
10-5K CONTROLS, thumbwheel type, single-turn, vert. mt. (#6705)	2.99	20 for $3	20-9V BATTERY CLIPS, snap connector, coded, insulated leads, (#6286)	2.99	40 for $3
4-CHROME PLATED ALARM SWITCH, spst, N.C. momentary, (#6742)	2.99	8 for $3	3-WATCH GUTS, 5-function, LED style, assorted sizes, untested, (#6287)	2.99	6 for $3
8-LED LAMPS, 2V red LED in chrome-colored assembly, w/hardware, (#5702)	2.99	16 for $3	5-HEAVY DUTY LINE CORDS, white, 2 cond. 6 ft. 16 gauge, (#6292)	2.99	10 for $3
8-BAR LIGHTS, GaAsP on LED chip, 1.5-3 volts, wire leads, (#6158)	2.99	16 for $3	20-SINGLE PIN LEDS, green, micro style, 3V 10mA, 100%, (#6293)	2.99	40 for $3
4-TAPE HEADS, record/play, stereo & mono, w/plugs, 11" leads, (#5973)	2.99	8 for $3	30-LED/TRANSISTOR SOCKETS, "snap-in", 3 pc leads, for TO-5,18,46,etc. (#6297)	2.99	60 for $3
10-RESISTOR LEDS, asst. red, green & yellow jumbos, 5V, (#6761)	2.99	20 for $3	200-PRECISION RESISTORS, ½W, 1%, axial (#2428)	2.99	400 for $3

Send For Our FREE Catalog Today!

Featuring the Largest Selection and the Lowest Prices on a wide variety of quality electronic products, including: Computer Peripherals, Solar Devices, Speakers, Audio Equipment, and much much more! Take advantage of our 25 years as America's foremost supplier of discount electronics.

For Faster Service Order By Phone 1-617-245-3828

ORDERING INSTRUCTIONS

- **Indicate QTY in front of 2.99ers desired**
- **Complete Coupon Section**
- **Cut Out Along Dotted Line and Mail Ad to**

Poly Paks
P.O. Box 942, RE1
SOUTH LYNNFIELD, MA. 01940

POLY PAKS *Same Cat. No.

Total Amount of Order $ _____
Please Add $3 for Postage & Handling

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

Enclosed is ☐ CHECK, ☐ MONEY ORDER
Charge my ☐ MASTERCARD ☐ VISA

ACCT. # _____ EXP. DATE ____

☐ *Send me your FREE catalog*

CIRCLE 51 ON FREE INFORMATION CARD

The Shack® is America's Parts Place™!

Low Prices and New Items Every Day!

Speed Up Your Wiring with This Cordless Power Wrapping Tool!

Reg. 21.95
Save 23%
16.88

So Easy! Why Solder Your Digital Projects?

Makes a perfect wrap every time! Unwraps, too. Built-in wire stripper/cutter. Positive indexing assures identical wraps on 0.025" square posts. Weight-balanced for comfort. Trigger-action on/off switch, carbon-steel tip. Jack for adapter/charger (below). Requires 2 nickel cadmium "C" cells. **276-1571** ..... **Sale 16.88**

AC Adapter/Charger. U.L. listed.
273-1454 ..... **5.95**

Subminiature LEDs

New!

1.59 Pkg. of 2

Highly-reflective chrome holders.
Red LED. 276-068 ..... **2/1.59**
Green LED. 276-069 ..... **2/1.59**

Cadmium Sulfide Photoresistor

1.19

Wide resistance range—5 megohms (darkness) to 100 ohms (bright light). Max. power dissipation: 200 mW @ 170V. **276-116** **1.19**

Sound Generator IC

Linear/I²L Device

Save 20% Reg. 4.49 **3.59**

SN76477. Build your own synthesizer and create almost any type of sound—including music, explosions, gunshots, steam whistles. Built-in preamplifier provides line-level output. 28-pin DIP. With applications and data.
276-1765 ..... **Sale 3.59**

Hall Effect Switching Detectors

1.98 Pkg. of 3

Electronically senses magnetic field. 750 gauss "on" threshold. 5-16VDC supply. Similar to type 3006ULN.
276-1646 ..... **3/1.98**

Infrared Opto-Coupler

New!

1.99

TIL-111. LED optically coupled to NPN phototransistor. 5 ms switching time. 6-pin DIP. **276-132** **1.99**

TIL-119/4N31. LED coupled to NPN Darlington phototransistor. DC transfer ratio 300% min. @ 10 mA. 6-pin DIP.
276-133 ..... **1.99**

New! Pushbutton Key-Pad Module

16.95

Produces 12 Touch-Tone™ Frequencies

1.5x2" face. Requires 3-5VDC @ 16 mA and 3.58 MHz crystal. With applications, specs.
277-1010 ..... **16.95**

TV Colorburst Crystal. 3.58 MHz.
272-1310 ..... **1.99**

Touch-Tone is a registered trademark of AT&T

PC Board and IC Breadboard Sockets

Non-Corrosive Contacts for Reliable Connections—Time After Time!

Low As **3.29**

[A] **Experimenter's PC Board.** Design circuits on a socket, then transfer to PC board. Holes match Archer* breadboard sockets. 0.3" center with 550 connecting points.
276-170 ..... **3.29**

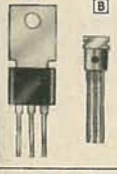
[B] **Modular Breadboard Socket.** Standard 0.3" center for use with up to 40-pin ICs. Boards snap together horizontally or vertically and accept #22-30 solid hookup wire. 2 bus strips with 40 tie-points each and 47 rows of 5 connected tie-points. 550 connections. 2⅛x6".
276-174 ..... **10.95**

[C] **Modular Breadboard Socket.** Smaller version of above. 270 connections in 2 bus strips of 20 tie-points each with 23 rows of 5 connected tie-points. 2⅛x3⅝". **276-175** **6.49**

[D] **Mini-Socket.** 22 rows of 5 tie-points each plus 2 bus strips with 10 connections each. Interlocks with above. 2⅛x1⅞". **276-176** **4.49**

VMOS Power FETs

New! [A] **2.49** [B] **1.59**



[A] [B] Gate-protected transistors for digital, analog, or RF circuits.

[A] **VN67AF.** 15W dissipation. TO-202 case.
276-2071 ..... **2.49**

[B] **VN10KM.** 1W dissipation. TO-92+ case.
276-2070 ..... **1.59**

12VDC DPST Encapsulated Reed Relay

New! 99¢

Encased in protective plastic. Designed to fit printed circuit boards. Contacts rated ½ amp at 125VAC.
275-229 ..... **99¢**

Miniature PC Mount DPDT Switches

Save $1

Low As **99¢** Each

[A] Designed for right angle PC board mounting. Center "off." Contacts rated 6A @ 125VAC.
275-665 ..... (Reg. 1.99) **Sale 99¢**

[B] Straight mount. Contacts rated 6A @ 125VAC.
275-668 ..... (Reg. 2.19) **Sale 1.19**

12V, 5A Power Transformer

10.95

For Projects Or Replacement

Quality, heavy-duty type with steel frame for chassis mounting. Solder lug terminals for easy connections. 120VAC, 5A, 60 Hz primary. 4x2x 2½".
273-1513 ..... **10.95**

4-Digit LCD Timer/Clock Module

New!

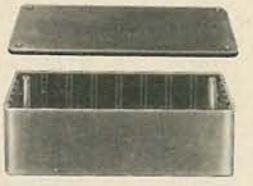
24.95

- ***Large Half-Inch LCD Display***
- ***12 or 24-Hour Format***

Just add a few parts and a battery, and you have a versatile nine-function, crystal-controlled timekeeper! Built-in backlight, dual time zones, 24-hour alarm, plus stopwatch, sleep, and control timer functions. 2⅝x1½". 1.5VDC operation. **277-1007** **24.95**

Hobby Project Cases

Low As **1.59**



Made of high-impact plastic, with internal slots to hold PC boards. Blue.

4x2x1¾" **270-220**	1.59
4x2⅞x1⅛" **270-221**	1.79
4¾x2½x1⅝" **270-222**	1.99
6x3⅜x1¾" **270-223**	2.59
7½x4⅛x2⅛" **270-224**	2.99

Coils and Chokes

1.98 Pkg. of 100

Ideal for audio and RF circuits. Assortment includes PC chokes, inductors, tuned RF coils.
273-1570 ..... **100/1.98**

Assorted Ferrites

1.98 Pkg. of 25

For chokes, RF coils, impedance matching transformers. Includes toroids, ferrite beads, cores, slugs.
273-1571 ..... **25/1.98**

WHY WAIT FOR MAIL ORDER DELIVERY? IN STOCK NOW AT OUR STORE NEAR YOU!

Retail prices may vary at individual stores and dealers.

Radio Shack®

A DIVISION OF TANDY CORPORATION · FORT WORTH, TEXAS 76102
OVER 7000 LOCATIONS IN 40 COUNTRIES

CIRCLE 39 ON FREE INFORMATION CARD

impedance change requires some simple conditioning before the UCT can "read" it. Additional conditioning may be required to get accurate measurements if the signals are plagued by such afflictions as contact bounce, noise, or glitches. Low-pass filters or monostables may be enough.

Even when the input signal is purely electronic (such as how many times a microprocessor interrupt-request flag goes up during a particular program run), a situation may demand some conditioning beyond that afforded by the UCT's own input circuitry.

All that is mentioned here in the interest of tracing those devilish problems down to their source—and saving your capable UCT from undeserved criticism when it counts things "funny." It just counts what it sees.

As you get more experience with your Universal Counter/Timer, you'll be able to pick up or invent a few tricks of your own. If you come up with something interesting, share it with us. It helps to keep life interesting. **R-E**

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

EQUIPMENT REPORTS

continued from page 35

our actual tests showed an overall improvement of about 5%. Different vehicles under different driving conditions will undoubtedly find different results.

Because of limitations on time, gas-economy tests were not checked. The *Tiger* has a reversible plug that allows the user to revert back to the car's original ignition at a twist of the wrist; thus, if failure of the CDI should ever occur, the vehicle will not become disabled. If it should ever be necessary to remove the CDI for service, two simple jumper-wire connections will provide normal operation of the vehicle without having to reconnect the original wiring harness.

Is the installation of the CDI system justified? If the extra few percent horsepower is important, and the additional mileage without replacing points and plugs a major consideration, then the answer may be yes.

The Tiger 500 CDI is available from Tri-Star Corp., PO Box 1727, Grand Junction, CO 81501. The assembled version sells for $69.95 and the kit version sells for $59.95. **R-E**

Brainchild

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

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

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

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

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

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

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

Heathkit®

SEND FOR *FREE* CATALOG

Write to Heath Co., Dept. 020-734, Benton Harbor, MI 49022.

VISIT YOUR HEATHKIT STORE

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

GX-379

CIRCLE 29 ON FREE INFORMATION CARD

In one year our K40™ antenna has become the largest selling CB antenna in the world!

1. It's more expensive...

$42.50 suggested retail

And when you pay more, you expect more!

MORE PERFORMANCE: The K40 is guaranteed to transmit further or receive clearer than any antenna it replaces. We know it will. We've tested it with 771 CB'ers just like you for one year.

MORE FLEXIBILITY: You can fit your K40 to any mounting surface. It will fit any vehicle you'll ever own! That includes choppers, dune buggies, gutters, mirror mounts, luggage racks, trunks, hatchbacks, through roofs, semis, pick ups and RV's.

MORE QUALITY: It's not imported. It's not made in Taiwan, Korea or Japan. It's American made in an American town. It's made with better materials that cost more and by professional people we pay more. And we designed it right here in the U.S.A.

*Including optional mounts at extra cost.

2. It's made better...

3. It's proven best!

...Here's what the leading CB publications said.

CB TIMES: "... it's not often that a product bursts onto the market scene, dominates and improves CB'ing for everyone. American Antenna and the K40 are doing it—repeated tests showed the K40 could out-perform the major competitive brands."

RADIO-ELECTRONICS: "The results of our tests showed that, in three different positions of the monitoring receiver, the *model K40* equaled or out-performed the competitive antenna. Apparently, American Antenna's advertising is not merely Madison Avenue showmanship."

PERSONAL COMMUNICATIONS: "... an impressive 95% of the trials, the K40 out-performed the existing mobile antennas. We had to try one for ourselves.
"... in every case, the K40 either equaled or out-performed its competitor.
"No ifs, ands, or buts! The K40 Antenna from American Antenna would have to be just about the best antenna around."

CB MAGAZINE: "Introduced in October, 1977, the K40 quickly became the top seller and in mid 1978, became the number one selling antenna in the nation."

...Here's what CB'ers all across the country said.

ANTENNA SPECIALISTS: "... truck driver and CB'er for 10 years ... 50% further than my M410 'Big Momma'."
—J.H. Collett, 207 McFee, Bastrop, LA

AVANTI: "I'm an electronic technician with a Second Class FCC license ... I was able to transmit 70% further and tune the SWR 75% lower than my Avanti."
—H.R. Castro, VRB, Monserrante D-67, Salinas, Puerto Rico

PAL: "... 20% better in transmission and reception than my 5/8 wave Pal Firestik."
—John A. Blum, Box 446, Zelienople, PA

SHAKESPEARE: "... I've been a CB'er for three years and the K40 is the best I've ever had. Better in reception and transmission than my Shakespeare."
—H. Bachert, Jr., 15 King Rd., Park Ridge, NJ

HUSTLER: "Compared to my Hustler XBLT-4, the K40 can consistently transmit 40% further and the reception was better. The K40 is the perfect way to complete a CB system."
—Jerome R. Brown, 7800 S. Linder, Burbank, IL

...This Antenna is so DYNAMITE you receive a ...

DOUBLE GUARANTEE

GUARANTEE I: The K-40 will transmit farther and receive more clearly than the antenna it replaces or the customer will receive a prompt and full refund from the Registered K-40 Dealer who installed and tuned it.

GUARANTEE II: Unconditionally guaranteed for 12 months. Guaranteed against cracking, chipping, or rusting. Guaranteed against mechanical failure. Guaranteed against electrical failure. Guaranteed against accidental breakage. No exclusions. No gimmicks. For a full 12 months.

(SPECIAL NOTE) IF YOU'RE A BEGINNER:

Our K40 Dealers will be happy to sell you any of the older style and less expensive antennas that are great bargains for any beginning CB'er.

AMERICAN ANTENNA
ELGIN, IL 60120

K40 POWER!

...Sold exclusively by 3500 American K40 Dealers throughout the U.S. & Canada.

CIRCLE 4 ON FREE INFORMATION CARD