MICROCONTROLLERS!

Build a RADON MONITOR and keep your home safe!

How to make VINTAGE RADIO an enjoyable hobby

Experiment with WAVE GENERATING transistor circuits

BUILD THIS PROGRAMMER

FOR MICROCHIP'S PIC 16C5X 8-BIT CMOS MICROCONTROLLER SERIES

PLUS:
- Hardware Hacker
- Audio Update
- Video News
- And Lots More!

FOR MOTOROLA'S 68705 MICROCONTROLLER

$3.50 U.S.
$3.95 CAN
Whether you're doing first-level troubleshooting or component-level diagnosis, Fluke meters offer you one of the widest choice of capabilities and price ranges in the industry. Choices ranging from the basic Fluke 12 with auto function V-Chek™ and Continuity Capture™ to the classic Fluke 77 with Auto Touch Hold® and current measurements.

To the advanced Fluke 83 with Min/Max/Average recording, Frequency, Duty Cycle and Input Alert™. Plus a full line of quality accessories to extend those capabilities even further. No matter which Fluke meter you choose, you can count on precise, reliable, consistent performance year in and year out. Plus, strong customer support and product warranties that measure up to any in the industry. Make the choice that gives you the most choices.

Look to Fluke for the tools you need to get the job done right.

See your Fluke distributor, or call 1-800-87-FLUKE for a catalog and the name of the distributor nearest you.
Mini-Spur™ turns your PC into a Spectrum Analyzer

Spot Spurious Signals Easily...
choose the best mixer for your design problems

$49.95

Free... 740 page RF/IF Designer's Handbook with purchase of Mini-Spur® program
place order as Designer's Special, DS-1

Introducing Mini-Spur™, the software simulation program for analysis of system spurious responses. Using actual data on Mini-Circuits mixers, spurious signal levels are calculated and then displayed.

Operation is simple. The user defines the input frequency and power level, the program then graphically displays the various outputs including all the spurs (up to 10xLO ± 10xRF) falling within the user-defined IF filter bandwidth. As the user tunes the frequency, the output spectrum scrolls across the screen just like that of a sophisticated spectrum analyzer.

Required hardware; IBM AT or compatible with 640k memory, and Free...740 page RFTIF EGA or VGA display. Optional, dot matrix, laser printer or plotter.

So maximize design efficiency... use Mini-Spur™ only from Mini-Circuits.
Electronic Paperbacks at Special Prices

- **BP225—A CONCISE USER GUIDE TO WINDOWS 3.1 . . .** $7.95. Come to grips with Windows 3.1 in the shortest and most effective way. Learn how to manipulate Windows screens and DOS by Windows graphics interface. Master its word processor, Paintbrush and data base along with Notepad, Macro Recorder, PIF Editor, and Calculator.

- **BP228—A CONCISE INTRODUCTION TO THE MACINTOSH SYSTEM AND FINDER. . .** $6.25. If you have one of the popular Macintosh range of computers, this book is designed to help you get the most from it. Although the Mac's WIMP user interface is designed to be easy to use, much of it only becomes clear when it is explained in simple terms. All Macintosh computers are covered including the new "Classic" range.

- **BP247—TEST EQUIPMENT CONSTRUCTION** . . . . $5.95. Details construction of simple, inexpensive, but extremely useful test equipment. AGF, Test Bench Ampl, Audio Multimeter, Translator Test and six more.

- **BP248—TEST EQUIPMENT CONSTRUCTION** . . . . $5.95. Practical circuits to build and experiment with. Includes AGF converter, input amplifier, digital delay line, compander, echo effect and more.

- **BP265—MORE ADVANCED USES OF THE MULTI-METER** . . . . $5.95. Use these techniques to test and analyze the performance of a variety of components. Also see how build add-ons to extend multi-meter capabilities.

- **BP265—MORE ADVANCED USES OF THE MULTI-METER** . . . . $5.95. Includes more advanced test equipment construction projects. They include digital voltmeter, capacitance meter, current tracer, etc.

- **BP267—HOW TO USE OSCILLOSCOPES AND OTHER TEST EQUIPMENT** . . . . $6.95. Mastering the oscilloscope is not really too difficult. This book explains all the standard controls and functions. Other equipment is also described.

- **BP269—PRACTICAL ELECTRONIC FILTERS** . . . . $6.95. Presents a dozen filter-based practical projects with applications in and around the home or in the constructor's workshop. Complete construction details are included.

- **BP275—INTRO TO AMATEUR RADIO** . . . . $6.95. Amateur Radio is a unique and fascinating hobby. This book gives the newcomer a comprehensive and easy-to-understand guide to the subject.

- **BP278—PRACTICAL ELECTRONIC FILTERS** . . . . $6.95. Presents a dozen filter-based practical projects with applications in and around the home or in the constructor's workshop. Complete construction details are included.

- **BP279—MORE ADVANCED TEST EQUIPMENT CONSTRUCTION** . . . . $6.95. Includes more advanced test equipment construction projects. They include digital voltmeter, capacitance meter, current tracer, etc.

- **BP289—PRACTICAL ELECTRONIC FILTERS** . . . . $6.95. Presents a dozen filter-based practical projects with applications in and around the home or in the constructor's workshop. Complete construction details are included.

- **BP290—ADVANCED SECURITY PROJECTS** . . . . $5.95. Includes a passive infra-red detector, a fiber-optic loop alarm, computer-based alarms and an unusual form of ultrasonic intruder detector.

- **BP292—POWER SELECTOR GUIDE** . . . . $10.00. Complete guide to semiconductor power devices. More than 1000 power handling devices are included. They are tabulated in alphabetical order, by technical specs includes power diodes, Thyristors, Tracs, Power Transistors and FETS.

- **BP294—TRANSISTOR SELECTOR GUIDE** . . . . $10.00. Companion volume to BP292. Book covers more than 1400 JEDEC, RS, and brand-specific devices. Also contains listing by type, and electronic parameters. Includes Darlington transistors, high-voltage devices, high-power FETS.

- **BP295—PRACTICAL ELECTRONIC BUILDING BLOCKS—Book 1** . . . . $5.75. Oscillators, Timers, Noise Generators, Rectifiers, Comparators, Triggers and more.

- **BP296—INTRODUCTION TO SATELLITE TV** . . . . $8.95. A definitive introduction to the subject written for the professional engineer, electronics enthusiast, or others who want to know more before they buy 8 x 10 in.

- **BP297—ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS . . . . $7.50. Data and circuits for interfacing the computer to the robot's motors and sensors.

- **BP298—ELECTRONIC FILTERS** . . . . $6.95. A refresher volume designed to help the reader get the most from their construction. It is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

- **BP299—GETTING THE MOST FROM YOUR MULTIMETER** . . . . $5.95. Covers basics of analog and digital meters. Methods of component testing includes transistors, thyristors, resistors, capacitors and other active and passive devices.

- **BP300—MULTI-METER AND ENCLOSURE** . . . . $5.95. Provides circuits and background info for a range of pre-amplifiers, plus tone controls, filters, mixers and more. All high-performance circuits that can be built at a reasonable cost.

- **BP301—AN INTRODUCTION TO SCANNERS AND SCANNING** . . . . $7.95. Radio scanners have opened a completely new realm of exciting radio listening. Understand radio wave propagation, types of transmissions, antennas, and security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

- **BP302—MORE ADVANCED USES OF THE MULTI-METER** . . . . $5.95. Includes more advanced test equipment construction projects. They include digital voltmeter, capacitance meter, current tracer, etc.

- **BP303—UNDERSTANDING PC SOFTWARE** . . . . $6.95. This book will help you understand the basics of various types of business software. Includes word processors, spelling checkers, graphic programs, desktop publishing, databases, spreadsheets and utilities.

- **BP305—COMPUTER HOBBISTS HANDBOOK** . . . . $5.95. A wrap-up of everything the computer hobbyist needs to know to easily use a computer. Provides a range of useful reference material in a single source.

- **BP306—MORE ADVANCED MEDI PROJECTS** . . . . $5.95. Circuits included are a MIDI indicator, THRU box, menu unit, code generator, pedal, programmer, channelizer, and analyzer.

- **BP307—ELECTRONIC SECURITY PROJECTS** . . . . $5.95. Radio scanners have opened a completely new realm of exciting radio listening. Understand radio wave propagation, types of transmissions, antennas, and security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

- **BP310—ADVANCED SECURITY PROJECTS** . . . . $5.95. Includes a passive infra-red detector, a fiber-optic loop alarm, computer-based alarms and an unusual form of ultrasonic intruder detector.

- **BP311—AN INTRODUCTION TO SCANNERS AND SCANNING** . . . . $7.95. Radio scanners have opened a realm of exciting radio listening. Understand radio wave propagation, types of transmissions, antennas, and security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

- **BP311—AN INTRODUCTION TO SCANNERS AND SCANNING** . . . . $7.95. Radio scanners have opened a realm of exciting radio listening. Understand radio wave propagation, types of transmissions, antennas, and security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

- **BP314—MORE ADVANCED USES OF THE MULTI-METER** . . . . $5.95. Use these techniques to test and analyze the performance of a variety of components. Also see how build add-ons to extend multi-meter capabilities.

- **BP315—ELECTRONIC PROJECTS FOR HOME SECURITY . . . . $10.00. 25 projects ranging from a single-door protection circuit that can be completed in an hour or two, to a sophisticated multi-channel security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

- **BP322—ELECTRONIC SECURITY PROJECTS** . . . . $6.95. This book explains the basics of electronic security. The book goes a step further in getting down to fundamentals. A reference volume that can be read casually by a reader seeking knowledge.

- **BP326—INTRO TO LOUDSPEAKERS AND ENCLOSURE DESIGN** . . . . $5.95. We explore the variety of enclosures and speaker designs in use today so the reader can understand the principles involved.

- **BP327—REFERENCE GUIDE TO PRACTICAL ELECTRONICS TERMS** . . . . $8.95. More than just a dictionary of practical electronics terms, the book goes a step further in getting down to fundamentals. A reference volume that can be read casually by a reader seeking knowledge.

- **BP330—ELECTRONIC SECURITY PROJECTS** . . . . $5.95. Radio scanners have opened a completely new realm of exciting radio listening. Understand radio wave propagation, types of transmissions, antennas, and security system. Each project is described in detail with circuit diagrams, explanations of how it works, instructions for building and testing, and how to adapt circuits to meet special requirements.

CHECK OFF THE BOOKS YOU WANT

**ELECTRONIC TECHNOLOGY TODAY INC.**
P.O. Box 240, Massapequa Park, NY 11762-0240

**SHIPPING CHARGES IN USA AND CANADA**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.01 to $5.00</td>
<td>$1.50</td>
</tr>
<tr>
<td>$5.01 to $10.00</td>
<td>$2.50</td>
</tr>
<tr>
<td>$10.01 to $20.00</td>
<td>$3.50</td>
</tr>
<tr>
<td>$20.01 to $30.00</td>
<td>$4.50</td>
</tr>
<tr>
<td>$30.01 to $40.00</td>
<td>$5.50</td>
</tr>
<tr>
<td>$40.01 to $50.00</td>
<td>$6.50</td>
</tr>
<tr>
<td>$50.01 and above</td>
<td>$8.00</td>
</tr>
</tbody>
</table>

**SORRY No orders accepted outside of USA & Canada**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total price of merchandise</td>
<td>$</td>
</tr>
<tr>
<td>Shipping (see chart at left)</td>
<td>$</td>
</tr>
<tr>
<td>Subtotal</td>
<td>$</td>
</tr>
<tr>
<td>Sales Tax (NY State only)</td>
<td>$</td>
</tr>
<tr>
<td>Total Enclosed</td>
<td>$</td>
</tr>
</tbody>
</table>

All payments must be in U.S. funds

**Number of books ordered**

- **BP295—INTERNATIONAL RADIO STATION GUIDE** . . . . $7.95. Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed to guide him or her around the more than ever complex radio bands.
# BUILD THIS

<table>
<thead>
<tr>
<th>Page</th>
<th>Project Description</th>
</tr>
</thead>
</table>
| 35   | PIC MICROCONTROLLER PROGRAMMER  
      | Build a full-function PIC16C5X microcontroller programmer.  
      | Fred Eady |
| 43   | 68705 MICROCONTROLLER PROGRAMMER  
      | Program your own 6805 microcontrollers.  
      | Brian Beard |
| 56   | RADON MONITOR  
      | Learn about radioactivity while you build this radon detector.  
      | Paul Neher |

# TECHNOLOGY

<table>
<thead>
<tr>
<th>Page</th>
<th>Topic Description</th>
</tr>
</thead>
</table>
| 70   | WAVE SHAPING  
      | All about waveform generation with bipolar transistor circuits.  
      | Ray Marston |

# FEATURES

<table>
<thead>
<tr>
<th>Page</th>
<th>Topic Description</th>
</tr>
</thead>
</table>
| 63   | VINTAGE RADIO  
      | Practical pointers for restoring antique radios.  
      | Marty Knight |
| 77   | ELECTRONICS NOW 1993 ANNUAL INDEX  
      | A complete guide to last year's articles. |

# DEPARTMENTS

<table>
<thead>
<tr>
<th>Page</th>
<th>Department Description</th>
</tr>
</thead>
</table>
| 8    | VIDEO NEWS  
      | What's new in this fast-changing field.  
      | David Lachenbruch |
| 18   | EQUIPMENT REPORTS  
      | Howard Electronics SC-7000 desoldering tool. |
| 28   | DRAWING BOARD  
      | Adding old-fashioned gauges to modern automobiles.  
      | Robert Grossblatt |
| 80   | HARDWARE HACKER  
      | Multimedia resources, and more.  
      | Don Lancaster |
| 87   | AUDIO UPDATE  
      | A question of power.  
      | Larry Klein |
| 89   | COMPUTER CONNECTIONS  
      | Falling prices are not necessarily a good thing.  
      | Jeff Holtzman |
| 96   | Advertising Sales Offices |
| 96   | Advertising Index |
| 92   | Buyer's Mart |
| 16   | Letters |
| 24   | New Lit |
| 20   | New Products |
| 10   | Q&A |
| 6    | What's News |
Virtually any appliance you can buy today—from the refrigerator and microwave oven in your kitchen, to the VCR in your den, to the car in your garage—contains embedded microcontrollers. Even those engineers or technicians who do not encounter microcontrollers on a daily basis must understand the basics of microcontrollers to be successful. This month, we look at how to program two such devices. First, on page 35, we take an in-depth look at Microchip Technology’s PIC 16C5X, a new breed of low-power 8-bit microcontrollers, and how to program it. Next, on page 35, we delve into Motorola’s MC68705, one of the industry’s most widely used microcontrollers, and show you how to build an inexpensive programmer for it.

COMING NEXT MONTH

THE FEBRUARY ISSUE GOES ON SALE JANUARY 4.

CALLER ID
Display the number of the calling party on an LCD.

68705 CONSTRUCTION PROJECT
Put a microcontroller—and a 68705 programmer—to work.
Introducing a New Era In Technical Training.
World College, an affiliate of the Cleveland Institute of Electronics, was created to provide a four year, independent study, technical degree program to individuals seeking a higher education. The Bachelor of Electronics Engineering Technology Degree, offered by World College, prepares students for high-paying careers in electronics, telecommunications, electrical power, computer and control systems. World College’s curriculum is taught in an effective, time-proven, independent study environment. With World College’s flexible study schedule, students have the opportunity to work or spend time with their family without having to worry about rigid scheduling residential colleges offer.

A Quality Education with a Flexible Schedule.
In a world heavily dependent on electronic equipment, people who understand electronics will have no problem putting their knowledge to work... in high-paying careers. The staff and faculty of World College have invested over ten years developing, what we believe to be, the finest independent-study, baccalaureate degree program available. World College’s mission is to instill in each student the knowledge, education, and training that employers are seeking for the many technical positions available today. It’s a program created to provide the best education and training possible with a flexible schedule to match your busy lifestyle.

World College is currently seeking approval to confer the Bachelor Degree from the Virginia Council of Higher Education.

Complete the Entire Degree Program Under One Roof. Yours!
Only World College offers an independent study, four year technical degree which can be completed through one school. All lab equipment*, parts, and software are included in your tuition and the program’s 300-plus laboratory experiments can be completed in your own home.

You Pay Only For Time Actually Used.
World College not only provides a means to earn a Bachelor Degree while fulfilling current obligations, but there are no restrictions on how fast you can complete the program. At World College, you pay tuition only for the actual upper-level semesters it takes to graduate. The quicker you complete the program, the less you pay in tuition. It’s an effective way to keep you motivated in order to complete the course and move on to a better paying position as quickly as possible.

Currently not available in Ohio.
* Student must have access to a personal computer system.

Lake Shores Plaza
5193 Shore Drive, Suite 113
Virginia Beach, VA 23455-2500

Send For Your Free Course Catalog.
Take the first step towards a new start in life. Send for World College’s Free Independent Course Catalog today and discover how easy and affordable it is to get started on your Bachelor Degree.

World College is affiliated with

World College’s Free Course Catalog detailing the full curriculum.

Name: ____________________________
Address: __________________________
Apt: ______________________________
City: __________________ Zip: ______
State: _______ Phone: (_______)
Age: ______________________________
Return to: _________________________
World College
Lake Shores Plaza
5193 Shore Drive, Suite 113
Virginia Beach, VA 23455-2500

YES! Please send me

WAE05
**Semiconductor laser advance**

The first vertical-cavity, surface-emitting laser (VCSEL) to produce visible light was demonstrated by researchers at Sandia National Laboratories (Albuquerque, NM). According to the researchers, the VCSEL is an important leap forward in laser technology because this device promises many new commercial applications for semiconductor lasers. One example given was the possible use of the VCSEL in plastic fiber-optic communications and its use in printing with optical technology.

The VCSEL emits light perpendicular to the top surface of the semiconductor die. This contrasts with the more typical emission for semiconductor lasers: from the cleaved edge of the die parallel to its plane. A VCSEL output beam has a narrow angle and a circular beam cross section. Visible light emission from a point close to the surface of the die makes it easier to assemble closely packed arrays of VCSELs whose output will form multiple parallel beams.

The electrical injection process permits the laser to be operated directly from the AC line rather than requiring that it be pumped by another laser, making the power supply more complex. This line operation feature opens more potential commercial applications for injected lasers than their laser-pumped counterparts, which are generally confined to laboratory research.

Sandia reports that the new lasers emit light in the bright red 639- to 661-nanometer wavelength region of the visible light spectrum (the shortest wavelength previously reported for a VCSEL diode was 699 nanometers, at the extreme limit of visibility).

Bright red light-emitting VCSELs could find a place in the improved laser "pointers" used for lectures and slide presentations. Models now available include conventional edge-emitting semiconductor lasers whose beam is more fan than round shaped. Other applications are seen in communications based on plastic fibers, arrays for displays, holographic memories, and telemetry systems.

It is pointed out that the 639-nanometer VCSEL wavelength closely matches 633-nanometer wavelength of helium-neon gas lasers now found in supermarket checkout bar-code scanners. This might make possible a lower cost substitute for those lasers.

The VCSEL is intended for pulsed operation at room temperature. Peak emitted power, which occurs at 650 nanometers, can exceed 3.3 milliwatts. At that wavelength, the threshold current is 2.7 volts and the output beam has a 20-micrometer diameter. The devices can be from 10 to 30 micrometers in diameter, less than half the thickness of a human hair.

Sandia National Laboratories has filed an invention disclosure, and it reports that optoelectronic device manufacturers have expressed interest in the device. Many are seeking to do cooperative research or sign development agreements with the laboratory.

**Semiconductor slowdown**

The slowdown in the semiconductor market will continue through mid-1994, according to the October 1993 report from Advanced Forecasting Inc. (Cupertino, CA).

Dr. Moshe Handelsman, a spokesman for Advanced Forecasting, reports that the semiconductor industry is now buying a lot of new manufacturing equipment to meet its present demand. However, he added that because orders are flat—and his company's forecasting continued on page 83
Take this GIANT CIRCUIT LIBRARY for only $9.95 when you join the Electronics Engineers’ Book Club®

THE ENCYCLOPEDIA OF ELECTRONIC CIRCUITS —Vols. 1, 2 & 3 by Rudolf F. Graf

Hundreds of circuit ideas alphabetically arranged — from Alarm circuits to Zero crossing detector circuits!

"...includes schematics for the latest electronics circuits from industry leaders..."
—Popular Electronics

Turn to this comprehensive circuit library for hundreds of project ideas . . . valuable troubleshooting and repair tips . . . and concise pinout diagrams and schematics. In each volume you'll find more than 700 electronic and integrated circuits and 100+ circuit categories right at your fingertips to give you ideas you can use on the job or at your workbench.

2,344 total pages 3,490 total illustrations

Book No. 5489C Hardcover

As a member of the Electronics Engineers' Book Club . . .

... you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. And you'll be eligible for FREE BOOKS through the Bonus Book Plan. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time.

Publisher's price shown. ©1993 EEBC

Electronics Engineers' Book Club
Blue Ridge Summit, PA 17294-0860

YES! Please send me The Encyclopedia of Electronic Circuits—Vols. 1, 2 & 3 (5489C), billing me $9.95 plus shipping/handling & tax. Enroll me as a member of the Electronics Engineers' Book Club according to the terms outlined in this ad. If not satisfied, I may return the book within 10 days and have my membership cancelled.

Name
Address
City
State
Zip
Phone

Valid for new members only, subject to acceptance by EEBC. Canada must remit in U.S. funds drawn on U.S. banks. Applicants outside the U.S. and Canada will receive special ordering instructions. A shipping/handling charge & sales tax will be added to all orders.

RPF194
VIDEO NEWS

What's new in the fast-changing video industry.

DAVID LACKENBRUCK

- **Cable compatibility.** When Congress passed the Cable TV Act of 1992 it required the FCC to issue rules to assure the compatibility of cable TV with such consumer-electronic products as TV sets and VCR’s. Congress also required the FCC to report on its proposals in advance of putting them on the books. The FCC has now made its report, which was based largely on compromise recommendations by a committee composed of representatives of cable and electronics industries—but in some respects, its proposals went beyond that agreement.

The proposals are designed to let consumers enjoy the benefits of such TV and VCR features as picture-in-picture, on-screen menus, and the ability to tape one program while watching another. As an “intermediate” starter, the FCC served notice that it will prohibit scrambling of basic-tier channels, a practice adopted recently by some big-city cable systems.

The Commission said that its long-term goal was to eliminate set-top boxes and to end delivery of scrambled signals to consumers’ tuners. It endorsed the development of a “decoder interface” system that would allow either current analog or future digital signals to enter the VCR or TV tuner for channel selection and then exit into a plug-in decoder.

Among other rules proposed by the Commission: For the short term, before the interface is developed, give consumers the option of having all unscrambled signals delivered directly to their TV sets or VCR’s, bypassing set-top boxes. In addition, it would require cable systems to offer subscribers boxes with multiple descramblers, timers, and other features to let them use the special features of their equipment. Cable systems would be required to let consumers use commercially available remote controls with their set-top boxes.

And as new cable systems are built or older ones rebuilt, the rules would require cable companies to adhere to standard channel number and frequency designations (IS-16), originally developed in 1983, covering 153 channels, and now being expanded. That would eliminate the problem of non-standard channel designations.

The rules would set up standards that TV sets and VCR’s must meet in order to be advertised as “cable ready” or “cable compatible.” Those would include a built-in decoder interface connector, the ability to tune all channels specified in the IS-16 standard, and improved tuner performance and shielding.

- **Video CD progress.** The new “Video CD” standard for compressed full-motion video on a five-inch compact disc is beginning to bear fruit in terms of proposed products. Hungry for a new, appealing product in a severe recession, most major Japanese consumer-electronics manufacturers demonstrated prototypes or mockups of Video CD products at the Japan Electronics Show. JVC, co-developer of Video CD (with Philips), showed three prototypes—standard and mini component Video CD decks and a unit combined with a video-game console. Matsushita (Panasonic) demonstrated a three-disc changer that provides more than 3½ hours playing time. Sony showed a mini component version, while Hitachi displayed a Video CD player built into a TV set, and Sharp showed a mini deck.

Philips, which is pushing its CD-I interactive multimedia system, said that it will not offer a dedicated video CD player, but that its digital-video cartridge add-on would enable CD-I machines to play Video CD’s as well as new interactive, full-motion discs. Matsushita said that its 3DO Multiplayer, now on the market, would be able to play Video CD’s when a full-motion video adapter is available this spring.

- **Video-game alliance.** Videogame manufacturers are lining up with semiconductor makers to develop new and more sophisticated interactive systems. Nintendo and Silicon Graphics announced that they are developing a 64-bit system scheduled for launch at the end of 1995 at less than $300. That was followed by an announcement from Sega that it is working with Hitachi on a new-generation game system built around Hitachi’s 32-bit RISC chip.

Pioneer has entered the increasingly crowded video-game field with LaserActive, combining the analog video of laserdisc with encoded digital operation. Pioneer says that the system combines laserdisc’s full hour of high-resolution full-motion video and FM audio with the same 540-megabytes of storage used by existing CD-ROM game systems. LaserActive doesn’t come cheap, however. It’s expected to be priced at $800 for the basic player, with $500 extra for adaptor modules that will let it play Sega or TurboGrafx software, and $300 for a karaoke module.

- **Landmark.** Despite the recession, and amid all the talk of HDTV and the marvelous products of the future, the American public seems pretty satisfied with the “old-fashioned” TV set. Last September became the first month in which the industry sold more than three million color TV sets, according to EIA figures. Although EIA charts only sales to dealers, it’s obvious that the public is buying by the way dealers are opening their checkbooks. In the final week of September, more than one million color sets were sold. That’s the same number sold in the full year of 1964, the tenth year after the introduction of color TV.
Never before has so much professional information on the art of detecting and eliminating electronic snooping devices—and how to defend against experienced information thieves—been placed in one VHS video. If you are a Fortune 500 CEO, an executive in any hi-tech industry, or a novice seeking entry into an honorable, rewarding field of work in countersurveillance, you must view this video presentation again and again.

**Wake up!** You may be the victim of stolen words—precious ideas that would have made you very wealthy! Yes, professionals, even rank amateurs, may be listening to your most private conversations.

**Wake up!** If you are not the victim, then you are surrounded by countless victims who need your help if you know how to discover telephone taps, locate bugs, or “sweep” a room clean.

There is a thriving professional service steeped in high-tech techniques that you can become a part of. But first, you must know and understand Countersurveillance Technology. Your very first insight into this highly rewarding field is made possible by a video VHS presentation that you cannot view on broadcast television, satellite, or cable. It presents an informative program prepared by professionals in the field who know their industry, its techniques, kinks and loopholes. Men who can tell you more in 45 minutes in a straightforward, exclusive talk than was ever attempted before.

### Foiling Information Thieves

Discover the targets professional snoopers seek out! The prey are stock brokers, arbitrage firms, manufacturers, high-tech companies, any competitive industry, or even small businesses in the same community. The valuable information they filch may be marketing strategies, customer lists, product formulas, manufacturing techniques, even advertising plans. Information thieves eavesdrop on court decisions, bidding information, financial data. The list is unlimited in the mind of man—especially if he is a thief!

You know that the Russians secretly installed countless microphones in the concrete work of the American Embassy building in Moscow. They converted

The professional discussions seen on the TV screen in your home reveals how to detect and disable wiretaps, midget radio-frequency transmitters, and other bugs, plus when to use disinformation to confuse the unwanted listener, and the technique of voice scrambling telephone communications. In fact, do you know how to look for a bug, where to look for a bug, and what to do when you find it?

Bugs of a very small size are easy to build and they can be placed quickly in a matter of seconds, in any object or room. Today you may have used a telephone handset that was bugged. It probably contained three bugs. One was a phony bug to fool you into believing you found a bug and secured the telephone. The second bug places the investigator when he finds the real thing! And the third bug is found only by the professional, who continued to search just in case there were more bugs.

The professional is not without his tools. Special equipment has been designed so that the professional can sweep a room so that he can detect voice-activated (VOX) and remote-activated bugs. Some of this equipment can be operated by novices, others require a trained countersurveillance professional.

The professionals viewed on your television screen reveal information on the latest technological advances like laser-beam snoopers that are installed hundreds of feet away from the room they snoop on. The professionals disclose that computers yield information too easily.

This advertisement was not written by a countersurveillance professional, but by a beginner whose only experience came from viewing the video tape in the privacy of his home. After you review the video carefully and understand its contents, you have taken the first important step in either acquiring professional help with your surveillance problems, or you may well consider a career as a countersurveillance professional.

**The Dollars You Save**

To obtain the information contained in the video VHS cassette, you would attend a professional seminar costing $350-750 and possibly pay hundreds of dollars more if you had to travel to a distant city to attend. Now, for only $49.95 (plus $4.00 P&H) you can view Countersurveillance Techniques at home and take refresher views often. To obtain your copy, complete the coupon or call.
DISK DILEMMA

Could you give me a clear explanation of what happens when a hard disk is formatted and how that differs from the formatting of a floppy disk?—B. Feoger, Sharon, IN

Disk drives, both floppy and hard, are very important parts of any computer system because that's where data eventually winds up. A failure in any other component could cost you money to repair, but perhaps some of the data you have on your disks can't be replaced at any price. So always remember that routine backups can turn a major disaster into a minor inconvenience.

The physical layout of a hard disk is similar to that of a floppy disk. Basically it is a spinning magnetic platter, or disk, with a record/playback head mounted on an arm so that it can move across the platter. While a floppy disk has a single magnetic surface, a hard disk can have several, and each platter has its own pair of heads mounted on a pair of arms—one for each side of the plate.

The platters of a hard disk spin at 3600 rpm and the heads "fly" some 10 microns above the platter's surface. This close tolerance is required so that the heads can read and write magnetic patterns on the disk without actually touching the surface. At 3600 rpm, physical contact between the head and the plate could destroy both. But, because the strength of the magnetic patterns decrease with the square of the distance, too great a distance would make read/write operations impossible.

The format of a hard disk is almost identical to that of a floppy disk. As you can see from Fig. 1, each platter is separated into a series of tracks and sectors by a series of magnetic patterns on each surface. The tracks are the concentric circles on the disk, and the sectors divide the tracks into pie-shaped pieces. Since hard disks usually have more than one platter, the term "cylinder" was coined to refer to all the related tracks on all the platters. Cylinder 3, for example, refers to track 3 on the platters.

FIG. 1—THE LAYOUT OF A HARD DISK is almost identical to that of a floppy disk. The tracks are the concentric circles on the disk and the sectors divide the tracks into pie-shaped pieces.

Hard disks require two formatting operations: a low-level and a high-level format. A DOS format can perform both functions on a floppy disk but it can do only a high-level format on a hard disk. During a low-level format, the sector address (track and sector number) and a few other bytes are written at the start of each sector. That separates the track into sectors. Along with the sector addresses are sync bytes and gap bytes which let the computer know that a sector address is about to be read. This preliminary format, also referred to as a "physical format," can be performed only by the hardware on the controller card on older drives. Newer drives are low-level formatted at the factory.

Once the sector addresses are written on the disk, DOS is able to do a high-level format. This involves dividing the disk into five different sections: the boot record, the partition table, the file allocation table, the root directory, and the data area.

The boot record contains a small program that DOS must have to load the operating system from the disk. The partition table is created by the DOS FDISK program, and it stores the size of the disk. If you want to use the whole disk as a single drive, only one partition is created, but it's also possible to break the disk into multiple partitions. The size and location of each partition is stored in the partition table and that table is located in the boot record.

The file-allocation table, or FAT, is a list of all the sectors on the disk. DOS keeps the status of each sector here; whether it's in use or available. The FAT is such an important part of DOS that two identical copies of the FAT are maintained, and DOS is always comparing the two to verify the accuracy of the data.

The root directory contains a list of all the files on the hard disk. It also stores the date, time, size, and location of the file's first sector in the FAT. When DOS wants a file, it goes to the root directory for the name and then to the FAT for the location of the data. The data area occupies the majority of the disk, and this is where the file data is stored.

There's a lot more to the innards of a hard disk but these are the basics. If you're interested in learning more about how they work, I would suggest a trip to your local library or bookstore. That's the best way to unravel the mysteries of disk storage, find out exactly what a "cluster" is, and understand what a "CRC error" really means to you.

PULSE COUNTER

I'm building a circuit that must count the number of pulses produced by a sensor. I'm using half of a 4518 binary counter, but the pulses are negative-going
and the clock input of the 4518 must see positive pulses. Other than inverting the pulses by adding even more hardware to the board, is there some simple change I can use to get around this problem?—R. Olive, New York, NY

I don't really understand why a hardware inversion of the pulses is such a big deal because, as shown in Fig. 2-a, all you need to do the job is a single transistor. If you're dead set on being a hardware minimalist, you're lucky that you're using a 4518 because that IC can easily be set to trigger on a negative-going pulse.

The 4518 has both a clock and an enable input. Normally the clock input is used to increment the count, but the enable input can be used for the same purpose. Since the clock input is active-high and the enable input is active-low, a slight rearrangement of signal lines will let the 4518 respond to negative-going pulses.

The circuit setup to do this is shown in Fig. 2-b. In normal operation, the enable input is made high and the chip will then respond to positive-going pulses at the clock input. But by keeping the clock input grounded, the chip's count will advance with each negative-going pulse at the enable input. No matter how you set up the chip, however, a high on the reset pin will always set the count back to zero.

**SWIMMING LIGHTS**

I have a swimming pool and I'm about to put some lights around it so the pool can be used at night. I'm a bit nervous about how to do this because the lights I'm planning to use run on 120-volt household current and the bulbs are rated 25 watts each. Are there any special precautions I should take?—C. Berger, Torrence, CA

The only precaution I can think of is that you should return all the stuff you bought to the store and get your money back. What you have in mind is known in the technical journals as a "bad idea."

Lighting up a swimming pool is a terrific idea both from the point of aesthetics and safety, but having 120 volts anywhere near the water even with a GFCI is asking for trouble—to say nothing of the fact that it might be a violation of local laws.

There are low-voltage (usually around 12 volts) quartz halogen lights available. They throw just as much light and won't turn your pool into a gigantic bug zapper.
Train With The Leader—NRI

Train with NRI and prepare for a high-paying position as a computer service technician, even a computer service business of your own! Regardless of your previous electronics background, you can succeed with NRI, the leader in career-building at-home electronics training for over 78 years. You begin with the basics, rapidly building on the fundamentals of electronics to master today’s advanced microcomputer concepts.

Learn By Doing

NRI’s highly acclaimed learn-by-doing approach gives you a complete understanding of the intricate electronics behind the 1 meg RAM, 32-bit CPU computer system included in your course. You perform hands-on electronics experiments with your NRI Discovery Lab and digital multimeter, then build and test the powerful 486sx/25 MHz computer you train with and keep. You install the 1.2 meg, 5-1/4” floppy disk drive, learning disk drive operation and adjustment. Later, you dramatically improve your computer’s data storage capacity by installing a powerful 80 meg IDE hard drive. You even learn to diagnose and service virtually any computer

Study At Your Own Pace

With NRI, you study in the privacy and convenience of your own home — with your personal instructor and NRI’s team of technical professionals behind you every step of the way. You learn at your own pace — no classroom pressures, no night school, no need to quit your present job until you’re ready to make your move. Step by step you’re guided through the assembly of a powerful 486sx based computer system — the centerpiece of your coursework — complete with monitor, floppy drive, 80 meg hard drive, operating and applications software. You get the hands-on experience you need to work with, troubleshoot, and service any IBM PC/AT-compatible computer, plus the confidence to tackle any service job you take on.
Say They Offer Service Training... Let Our The Talking.

What's more, you work with today's most popular integrated software package, Microsoft Works, learning to use its word, processing, spreadsheet, database, and communications utilities for your own personal and professional applications.

Master Your Future

The Department of Labor forecasts over 220,000 jobs for computer service technicians by the year 2005 — a 38 percent increase over today's level. With the right training and skills, you can cash in on this service business of your own — you'll be well prepared, continuously drawing on the real-world experience of your NRI training. Master electronics and computers the NRI way and master your future!

Learn More About NRI Today

Let NRI hear from you next. Send today for NRI's free, full-color catalog which describes every aspect of NRI's innovative microcomputer training, as well as hands-on training in other growing high-tech fields. If the coupon is missing, write to NRI Schools, McGraw-Hill Continuing Education Center, 4401 Connecticut Avenue, NW, Washington, DC 20008.

IBM is a registered trademark of International Business Machines Corp. R.A.C.E.R. and QuickTech are registered trademarks of Ultra-X, Inc.

Check one FREE catalog only □ Computer-Aided Drafting □ Computer Programming □ Desktop Publishing & Design □ PC Applications Specialist □ Programming in C++ with Windows

NRI Schools
McGraw-Hill Continuing Education Center
4401 Connecticut Avenue, NW, Washington, DC 20008

□ Microcomputer Servicing □ TV/Video/Audio Servicing □ Industrial Electronics & Robotics □ Basic Electronics

Name (please print) Age

Address

City/State/Zip Accredited Member: National Home Study Council

3-0194
PARTS LIST CORRECTION
In my article, "Triple-Output DC Power Supply" (Electronics Now, October 1993), the part number for transformer T2 was inadvertently omitted. It defines T2's voltage and current rating. It is Jameco Electronics AC1210 (12 VAC Sec. at 1 Amp).

JOHN F. KEIDEL

KEEPING JOBS IN THE U.S.
I'm guessing that there are many (legions?) of us in the same boat as Michael Kiley, whose letter appeared in the October issue of Electronics Now. Mini-cellular and fiber-optic manufacturing will be going up and military electronics contracts are declining.

Isn't this coincidence a made-to-order call for military equipment manufacturers to enter commercial (non-defense) electronics? Of course, American workers might find work installing the cable and repeaters, but what country (or countries) will manufacture the cable and the electronics at the ends of the cable? How about the transceivers for the new mini-cellular systems or the mini-cellular repeaters?

Will the U.S. Congress act to protect U.S. workers? Or have so many members of Congress received enough contributions for their re-election campaigns that they are now indifferent to the transfer of work to off-shore corporations?

E. JONES JR, WB2DVL
Somerset, NJ

IN THE SAME BOAT
Thank you for publishing Mike Kiley's letter in the October issue of Electronics Now. It summed up very well my gut-wrenching fears about my future in electronics; I have been seeing the same things happening.

I am employed by a manufacturer of industrial electronic instruments. Our new products, all based on surface-mount assembly, are made by an outside board-stuffing job shop. I am almost 40 years old and don't have the resources (time and money) to drop everything and return to college for five years. But I see no alternative if I am to provide for my family's future.

Frankly, I'm scared to death and I am not sure what I can do. Moreover, I believe that the North American Free Trade Agreement (NAFTA) will only hasten the process Mike discussed.

I felt so strongly about that issue that I copied Kiley's letter and enclosed it with a letter from me to my congressman! I'm sure that there are others out there who have experienced similar frustrations and feelings. Perhaps some of them will write in to tell us about the actions they took.

Again, thanks for publishing the letter. It made me feel better to know that I am not alone.

M.A. GERMAINE
Mt. Gilead, OH

THE POSITIVE APPROACH
I have never before written to a magazine or newspaper in response to a letter from a reader. However, after reading the letter from Michael Kiley (Electronics Now, October 1993), I felt I had to express another viewpoint.

Jeff Holtzman was correct in his original assessment. Jobs will be eliminated as technology advances. The invention of the automobile eliminated the blacksmith's job. A secretary who knows shorthand but has no computer skills will certainly have a difficult time finding a job.

I have worked in the electronics field since I was in my teens back in the early 1960s. When I first went to work in the electronics field, transistors had not replaced electron tubes. Because some equipment included transistors, I had to learn about them. However, about the time I had mastered transistors, integrated circuits came along. I resisted the study of them for some time, but it soon became obvious that they were not going to go away. So, I gave in and studied ICs and digital electronics.

Then, computers began to appear everywhere. Although by that time I could design and build microcontroller-based equipment, I stayed away from computers with keyboards. I thought that I would always be able to hold a good job with good pay. After all, I had a strong hardware background.

In 1990, it finally sank in that I would need programming skills if I were to continue to earn the kind of money I had been earning. So I went to a local college and took two semesters of C programming. Because I did not take the courses for credit, no prerequisites were required; I simply audited the classes to gain the knowledge that I would need in the future. I now work in a job whose content is about 50% electronics hardware and 50% software. I would still prefer to concentrate on hardware, but that does not seem to be enough in today's job marketplace.

I think that Mr. Kiley's attitude is quite prevalent in our society today. In the first place, I think that a lot of our country's problems are due to a government that is too large and too inefficient. We cannot continue to depend on the government to provide lifetime jobs.

Most government employees are overpaid for the work they do, and their benefits seem to be out of proportion for those jobs. Their pay scales and workloads should be more in line with the private sector. Too many people think that this country owes them something simply because they were fortunate enough to have been born here.

They make no effort to advance their job skills to adapt to a changing
global economy. It seems to me that most job-specific technical training that was taught in 1974 is of no real value today.

I also disagree with Mr. Kiley’s statement that you need a college education to get a good job. Sure, it helps a lot, but there are other ways to prepare yourself for a good job. I do not have a college education, yet I have always been able to get and hold what is considered to be a good job. I have always pushed myself to keep my job skills current with job market demands.

Even in the relatively small Phoenix, Arizona, job market, there are some 20 to 30 jobs offered in each Sunday newspaper for people with current technical or computer skills.

But one has to start somewhere. Sometimes that somewhere means you have to start over and head in another direction. I suggest that Mr. Kiley try to shed his negative views, take some classes in computer programming, and plan for an entry-level position in that field. An investment of that kind in his future should pay off. Neither this country nor the rest of the world is going to slow down and wait on him.

R. C. BUCK, III
Fountain Hills, AZ

MONEY MATTERS
I would like to thank you for saving me a lot of money. I planned to spend $90 on an audio mixer until I saw the schematic in Q&A (Electronics Now, October 1993). I checked my parts bin and found that I only had to buy the IC and an enclosure. Those items cost me only $10—a far cry from the $90 I was going to spend!

Thank you again, and keep up the good work.
D. KISER
Elmira, NY

PARTS UPDATE
HESC has sold hundreds of the kits offered in the article “Build the Audio Expander” (Electronics Now, March 1993). However, HESC reports that sourcing and cost considerations no longer permit them to offer those kits.

However, we have recently discovered a source for the Philips TDA3810 IC specified for that project. It can be ordered from Consolidated Electronics, 705 Waterway Avenue, Dayton, OH 45420-2599 (1-800-543-3568). This new source will now allow even more readers to build the Audio Expander.

We want to thank everyone who purchased the kit. We hope they are now enjoying the benefits of the Audio Expander and basking in the satisfaction of having built it all by themselves.

PHILL HAUSMAN
Fort Wayne, IN

NEW USE FOR PHONE-LINE SIMULATOR
While most issues of Electronics Now contain at least several articles that interest me, the August 1993 issue contained the “Phone-Line Simulator;” by itself, it was worth much more to me than the price of a year’s subscription. It solved a problem that has been annoying me for two years.

I wanted to transfer several megabytes from the files of my 1983 model Timex/Sinclair TS2068 computer to an IBM-compatible 286 PC with modem. The TS2068 has 64 kilobytes of memory, a cassette tape drive, and a 2400-baud modem. The TS2068 uses a non-ASCII code and cannot be directly connected to a PC.

However, the hardware and software associated with the modem allow the transmission of ASCII files. Therefore, the two computers can be connected by phone line. However, that is not always a satisfactory arrangement because it ties up another person’s line or machine, and it takes a lot of his time.

I had transferred some sensitive financial files by printing them out from the TS2068 computer and reading them with an optical character reader into the PC. While that process was time consuming compared to the speed that one can transfer data with modems, it certainly is faster than keying the data into the PC.

The Phone-Line Simulator allows me to connect the modems from the two incompatible computers and transfer the files without human assistance—quickly and privately.

K.G. Pratt
Newport News, VA

Earn Your B.S. Degree in ELECTRONICS or COMPUTERS

By Studying at Home

Grantham College of Engineering, now in our 43rd year, is highly experienced in “distance education”—teaching by correspondence—through printed materials, computer materials, fax, and phone.

No commuting to class. Study at your own pace, while continuing on your present job. Learn from easy-to-understand but complete and thorough lesson materials, with additional help from our instructors.

Our Computer B.S. Degree Program includes courses in BASIC, PASCAL and C Languages — as well as Assembly Language, MS DOS, CADD, Robotics, and much more.

Our Electronics B.S. Degree Program includes courses in Solid-State Circuit Analysis and Design, Control Systems, Analog/Digital Communications, Microwave Engr, and much more.

An important part of being prepared to move up is holding the right college degree, and the absolutely necessary part is knowing your field. Grantham can help you both ways—to learn more and to earn your degree in the process.

Write or phone for our free catalog. Toll free, 1-800-955-2527, or see mailing address below.

An Accredited by
the Accrediting Commission of the National Home Study Council

GRANTHAM College of Engineering
Grantham College Road
Slidell, LA 70460
EQUIPMENT REPORTS

DIC SC-7000 Desoldering Tool

Desoldering components is a snap even for field technicians with this unique desoldering tool.

CIRCLE 10 ON FREE INFORMATION CARD

It would be surprising to find a reader of this magazine who was not well versed in the fine art of soldering. But desoldering is another matter entirely. It seems as if every technician has his own favorite method. The DIC SC-7000 desoldering tool seems to provide the right mix of features for everything from removing through-hole components from 12-layer boards to removing surface-mounted devices. It is available from, among other distributors, Howard Electronic Instruments (6222 North Oliver, Wichita, KS 67220; phone 316-744-1984).

Technicians who need to desolder components only occasionally often find that the fastest and easiest way to go is a simple hand-operated spring-loaded vacuum tool. Desoldering braid is another favorite for low-volume desoldering. Higher-volume applications—where many circuit boards need to be reworked in an efficient, cost-effective manner—often require a full service/rework center with multiple soldering irons and desoldering tools.

The SC-7000 desoldering tool is unique in that it plugs directly into an AC outlet and is self-contained. No bench-top vacuum pump and connection hoses are required because the diaphragm pump is integrated into the handheld unit. The direct in-line connection between the pump and the tip provides such efficiency that 8-layer boards can be worked. That increases to 12 layers if the bottom side is pre-heated. The rated vacuum is 600 mm Hg, and the rated air flow rate is 15 liters per minute with an open tip. The maximum vacuum can be reached in 0.2 seconds.

The SC-7000 is a gun-shaped device, measuring at its widest dimensions about $7 \times 7\frac{1}{2} \times 1\frac{3}{4}$ inches. It weighs less than one pound. The black plastic housing contains carbon, which helps to prevent damage to sensitive components form electrostatic discharge or ESD.

A rotary temperature control is located on the rear end of the gun. It can be adjusted from 300°C to 400°C (525°F to 842°F). Above the temperature control is an indicator lamp that remains steady as the tool comes up to operating temperature, and that blinks when the desired operating temperature is reached. If the temperature setting is reduced, the indicator remains until the tip reduces to the new reduced temperature. The tool heats up quickly, reaching its midpoint temperature (375°C) in about 2 minutes, and it also has a quick recovery time.

A power switch for the unit is located at the butt end of the gun, and a trigger for the vacuum pump is at the customary trigger location for a gun.

There are two other sets of controls on the SC-7000. First is a mechanical toggle that switches the desoldering tool between its suction and its hot-air blow functions. Another set of mechanical controls are used to change the two-piece filter cartridge which mounts behind the tip, above the trigger.

The filter cartridge design is effective in maximizing the life of the filter. Most of the solder and flux removed accumulates on a hard plastic base that is in front of the fibrous filter. When the cartridge is full, it is simply thrown away. Replacement filter cartridges cost about $3 each.

To remove surface-mounted components, a hot-air tip and hot-air filter cartridge are required. Tips can be changed easily with the small open-ended wrench supplied with the desoldering tool. An SMD accessory kit is recommended. It includes not only the hot-air blower nozzle and filter, but also stainless-steel wire and blades, and holders for the wire and blades, all of which make SMD removal possible.

Surface-mounted devices can be removed in several ways with the hot-air blower. One method is to slip some stainless-steel wire under the legs of an IC, forming a loop. The wire is then used to lift the legs as the blower melts the solder that holds them to the circuit board.

Another method is to insert a short length of stainless steel wire into the wire holder. As each lead is heated, the wire can be slipped under the lead, lifting it from the board. With a little practice, it is possible to desolder individual leads of a flat pack or small-outline package.

Continued on page 85
Enter A World Of Excitement with a Subscription to

Popular Electronics®

Get the latest electronic technology and information monthly!

Now you can subscribe to the magazine that plugs you into the exciting world of electronics. With every issue of Popular Electronics you'll find a wide variety of electronics projects you can build and enjoy.

Popular Electronics brings you informative new product and literature listings, feature articles on test equipment and tools—all designed to keep you tuned in to the latest developments in electronics. So if you love to build fascinating electronics, just fill out the subscription form below to subscribe to Popular Electronics...It's a power-house of fun for the electronics enthusiast.

EXCITING MONTHLY FEATURES LIKE:

口 CONSTRUCTION—Building projects from crystal sets to electronic roulette

口 FEATURES—Educational training on digital electronics, Ohm's Law, Antennas, Communications, Antique Radio, Simplified Theory

口 HANDS-ON-REPORTS—User test comments on new and unusual consumer products

口 SPECIAL COLUMNS—Think Tank, Circuit Circus, Computer Bits, DX Listening, Antique Radio, Amateur, Scanner Scene

PLUS: ALL OUR GREAT DEPARTMENTS!

You'll get 12 exciting and informative issues of Popular Electronics for only $18.95. That's a savings of $23.05 off the regular single copy price. Subscribe to Popular Electronics today! Just fill out the subscription order form below.

FOR FASTER SERVICE CALL TODAY
1-800-827-0383
(7:30AM-8:30PM)
EASTERN STANDARD TIME

Popular Electronics® SUBSCRIPTION ORDER FORM

YES! I want to subscribe to Popular Electronics for 1 Full year (12 Issues) for only $18.95. That's a savings of $23.05 off the newsstand price.

(Basic Subscription Rate—1 yr/$21.95)

口 Payment Enclosed  □ Bill me later

Please charge my:  □ Visa  □ Mastercard

Acct. #

Signature

Exp. Date

P.O. Box 338, Mt. Morris IL, 61054

PLEASE PRINT BELOW:

NAME

ADDRESS

CITY  STATE  ZIP

Allow 6 to 8 weeks for delivery of first issue. U.S. Funds only.

In Canada add $4.00 postage. Includes U.S. Mail. All Other Foreign add $7.50 postage.
500-MHZ BENCHTOP OSCILLOSCOPE. The new Hewlett-Packard HP 54600A delayed-sweep oscilloscope is intended for those who need digital oscilloscope performance but don't want to sacrifice the real-time display and user friendliness of analog scopes.

The two-channel HP 54610A oscilloscope has a vertical bandwidth of 500 MHz. It can make accurate measurements of high-speed, ECL-based digital circuits and analog circuits with operating frequencies greater than 150 MHz because of its 1 nanosecond per division sweep speed.

HP 54610A has a rated accuracy of 0.01% of full scale. It includes such digital features as pretrigger viewing, waveform storage, and measurement automation. Nevertheless, it has the familiar controls and interactive display of an analog scope. The instrument has a viewable external trigger that allows users to make such common digital-circuit measurements as propagation delay and setup and hold times.

Hewlett-Packard reports that the oscilloscope can be upgraded with add-on modules and software links. Optional accessories include interface modules for remote control and output to RS-232C, HP-IB, and parallel-interface for printers and plotters. Test automation modules for mask template testing and automatic sequencing with pass/fail testing and conditional branching are also offered. Measurement and storage modules are also available.

LEATHER DISKETTE HOLDER. A pocket-sized, leather diskette case from Browning & Drum's adds class to your software presentations. It is also a distinctive sales tool when imprinted with your company's logo and given away to customers.

The case protects disks that you might carry between home and office or take along on business trips. Available in burgundy or black smooth-grained leather, the case holds two 3.5-inch diskettes and your business card.

The diskette holder is priced at $15.95 or six for $89.

Browning & Drum
P.O. Box 468
Brookline Village, MA 02147
Phone: 617-566-4300
Fax: 617-566-4208

HANDHELD TRANSMISSION-LINE TEST SET. The 186T handheld analog and digital transmission-line test set from American Reliance performs four test functions. The test set is packaged in a case about the size of a handheld portable DMM. In addition to its role as a transmission line test set, it is a transmission line impairment measuring set (TIMS), and an autoranging DMM. It also has telephone handset functions.

The 186T field tests voice and data (two- or four-wire) telecommunications circuits from 20 to 50 kHz. It includes a 20 to 50 Hz synthesized sinewave generator. It has a telephone handset with dial, talk, and listen capabilities. The instrument complies with IEEE 743-1984 (Bell Standard 41009).

HP ScopeLink and BenchLink software packages permit the transfer of screen images, waveforms, instrument setups, and test-automation sequences to MS-DOS-based or Windows operating system applications.

The HP 54610A oscilloscope, complete with power cord and two probes, is priced at $4995.

Hewlett-Packard Company
Direct Marketing Org.
P.O. Box 58059
MS51L-SJ
Santa Clara, CA 95051-8059
Phone: 1-800-452-4844

CIRCLE 16 ON FREE INFORMATION CARD

CIRCLE 17 ON FREE INFORMATION CARD

CIRCLE 18 ON FREE INFORMATION CARD

An optional RS-232C interface permits communication between the 186T and a host computer. Built-in dialing permits a user to dial with dial pulse, tone
(DTMF), or MF signals. Handset functions combined with an internal DC hold circuit permit one tester to communicate with another over the line under test.

As a transmission line test set, it measures frequency, dBm level, signal-to-noise ratio, return loss, noise, noise-to-ground, noise-with-tone, and impulse noise. The DMM functions include the measurement of DC voltage and current, true-rms AC voltage, resistance, and capacitance.

The 186T has a two line, 16-character LCD display. Its speaker volume is adjustable. It can be powered from eight AA cells or the AC line.

The 186T handheld transmission-line test set has a list price of $1975.

American Reliance, Inc.
11801 Goldring Road
Arcadia, CA 91006
Phone: 800-654-9838
Fax: 818-358-3838

CONTEST CARD. A new PC plug-in interface board with a voice recorder/keyer and continuous-wave interface allows amateur radio operators to record useful information. The Contest Card from Unified Microsystems permits amateur operators to record their CQs, call signs, contest exchanges, or other voice messages for transmission under PC control. The Contest Card can also be used with PC-based repeater controllers for ID and special voice messages. It can also directly drive an external speaker for non-radio applications. Voice messages are stored on the card in non-volatile memory, saving computer memory or disk space. The built-in CW interface allows your computer to send CW on both negatively and positively keyed amateur-radio transmitters.

The card is compatible with IBM XT, 286, 386, and 486-based PCs. The Contest Card is compatible with contest-logging software. The included disk contains a voice keyer-control program and programming information for writing your own software for controlling the Contest Card.

The Contest Card sells in kit form for $119.95; assembled and tested it is $179.95. Cables are not included. Add $5 for shipping to the U.S. and Canada.

Unified Microsystems
P. O. Box 133
Slinger, WI 53086
Phone: 414-644-9036

CIRCLE 19 ON FREE INFORMATION CARD

THE MOST

AN IMPORTANT PART
OF YOUR PHOTOCOPIER
ISN'T PART OF
YOUR PHOTOCOPIER

Having a machine may not permit you to photocopy books, journals, newsletters and magazines.

The Copyright Clearance Center CAN.

Contact us to find out how you too can COPY RIGHT!

COPYRIGHT CLEARANCE CENTER
222 Rosewood Drive, Danvers, MA 01923 • Tel. (508) 744-3350 • Fax (508) 741-2338

CIRCLE 19 ON FREE INFORMATION CARD

QUALITY TV & VCR PARTS

REPLACEMENT SEMICONDUCTORS

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>BU208A</td>
<td>10/10</td>
<td>1.99 ea</td>
<td></td>
</tr>
<tr>
<td>2SD899</td>
<td>10/10</td>
<td>1.99 ea</td>
<td></td>
</tr>
<tr>
<td>2SK2461</td>
<td>10/10</td>
<td>1.99 ea</td>
<td></td>
</tr>
<tr>
<td>2SD1427</td>
<td>10/10</td>
<td>1.99 ea</td>
<td></td>
</tr>
<tr>
<td>STR9012</td>
<td>10/10</td>
<td>4.95 ea</td>
<td></td>
</tr>
</tbody>
</table>

REPLACEMENT FLYBACKS

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>184-040</td>
<td>10/10</td>
<td>$10.95 ea</td>
<td></td>
</tr>
<tr>
<td>184-074E</td>
<td>10/10</td>
<td>$10.95 ea</td>
<td></td>
</tr>
<tr>
<td>221-7524-4</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>221-356-11</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>3214003</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>2434391</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>T01430F</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>TLC14630F</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>PANASONIC</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>SAMSUNG</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
</tbody>
</table>

VCR IDEAS

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>164113</td>
<td>10/10</td>
<td>$13.75 ea</td>
<td></td>
</tr>
<tr>
<td>164121</td>
<td>10/10</td>
<td>$13.75 ea</td>
<td></td>
</tr>
<tr>
<td>164129</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
<tr>
<td>164135</td>
<td>10/10</td>
<td>$29.95 ea</td>
<td></td>
</tr>
</tbody>
</table>

POPULAR CAPACITORS

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>100V/63V</td>
<td>20/10</td>
<td>$1.50 ea</td>
</tr>
<tr>
<td>100V/100V</td>
<td>10/10</td>
<td>$1.00 ea</td>
</tr>
<tr>
<td>100V/150V</td>
<td>10/10</td>
<td>$1.00 ea</td>
</tr>
<tr>
<td>100V/200V</td>
<td>10/10</td>
<td>$1.00 ea</td>
</tr>
<tr>
<td>75V/125V</td>
<td>10/10</td>
<td>$1.50 ea</td>
</tr>
<tr>
<td>75V/250V</td>
<td>10/10</td>
<td>$1.50 ea</td>
</tr>
</tbody>
</table>

FREE 68 PAGE CATALOG!

CALL TOLL-FREE
1-800-628-1118

CIRCLE 89 ON FREE INFORMATION CARD
BASIC language dialects with added commands for data-acquisition.

The Tattletele 5F-LCD sells for $495. A starter kit of accessories for application development is priced at $95. The price of its case is $35, and a 3-button keypad is priced at $25.

Onset Computer Corporation
536 MacArthur Blvd.
P. O. Box 3450
Pocasset, MA 02559
Phone: 508-563-9000
Fax: 508-563-9477

TECHNICIAN’S POCKET TOOL. The SOG ToolClip from Jensen Tools, combines 13 functions in one pocket tool. It includes pliers, a gripper, a wire cutter, a spear-point blade, a serrated edge blade, a utility blade, two screwdrivers, two wire strippers, a file, a pry bar, and a bottle opener. The wire cutter can easily cut chain-link fencing.

The tool is equipped with a bail for attaching it to a chain or belt. The pliers, wire cutters, and grippers can all be worked with one hand, a useful feature when the other hand is occupied.

It is made of stain-resistant steel and can be cleaned with water or non-corrosive solvents.

The SOG ToolClip is priced at $59.95.

Jensen Tools Inc.
7815 South 46th Street
Phoenix, AZ 85044
Phone: 602-968-6231

MOTOR-TABLE CALCULATOR. MotorCalc from Extech is said to be the first and only calculator with built-in 1993 National Electrical Code (NEC) tables. The calculator works directly in units of volts, amperes, volt-amperes, watts, power factor, kilowatts, and kilovolt amperes (kVA).

Extech Instruments Corp.
335 Bear Hill Road
Waltham, MA 02154
Phone: 617-890-7440
Fax: 617-890-7864

STEREO DIGITAL VOLUME CONTROL. Crystal Semiconductor’s CS3310 is a single-chip integrated circuit for high-fidelity stereo volume control. It offers a wide dynamic range of 110 dB, and total harmonic distortion less than 0.001.

The device’s low-noise active output stage can drive a 600-ohm load. It is expected to find applications in digital-audio workstations, multi-track recorders, and home surround-sound processors.

The CS3310 overcomes clicking, popping, and “zipper noise” during volume changes—audible artifacts that degrade system performance and sound quality. It performs volume changes at zero crossings to give noise-free level transitions.

MotorCalc can calculate the performance of single- or three-phase induction or synchronous motors. It will also permit the user to calculate wire sizes in accordance with NEC tables 310 and 310-17. Problems related to parallel or derated wires sizes can quickly and easily be solved with a button push.

The calculator is organized so that it automatically finds mixed wire conduit sizes and determines loads for single- or three-phase motors in amperes per NEC Tables 430-148 and 430-150. It can determine overload protection per NEC 430-32, and compute fuse and breaker sizes per NEC 40-152. It can also find NEMA starter sizes.

The MotorCalc sells for $129.

Extech Instruments Corp.
335 Bear Hill Road
Waltham, MA 02154
Phone: 617-890-7440
Fax: 617-890-7864

Stereo digital volume control in 16-pin plastic DIP or SOIC packages is priced at $6.60 each in lots of 1000.

Crystal Semiconductor Corporation
P. O. Box 17847, 78760
4210 South Industrial Drive
Austin, TX 78744
Phone: 512-445-7222
Fax: 512-445-7581

AUDI0 LEVEL CONTROLLER. The Model ALC235P automatic audio-level controller module from C&S Electronics provides user adjustable audio output. Small signals are amplified and large levels are attenuated without introducing noise or distortion. The module is intended for radio, television and recording studios. It can be used with scanners, receivers, and PA amplifiers.

The controller’s output level is held constant by a light-dependent resistor (LDR). As the input signal amplitude changes, the LDR changes its resistance. It varies circuit gain to produce a nearly constant output. Three controls permit the user to match specific audio units. The module includes a 2-watt onboard amplifier in addition to its 100-millivolt low-level output. It also has an onboard volume control.

The ALC235P automatic audio-level controller is priced at $49.95.

C&S Electronics
P. O. Box 2142
Norwalk, CT 06852-2142
Phone/Fax: 203-866-3208
TRUE-RMS DIGITAL MULTIMETER. All functions and ranges of Protek’s Model D-937 3½-digit, 4000-count, true-rms digital multimeter can be entered by switch. It has an LED port with optically-coupled serial output for data-logging or recording.

The unit’s liquid-crystal display includes annunciators and a 42-segment bargraph. The D-937 offers full autoranging for all functions except current. It provides logic and data hold, relative set, and min/max with 100-millisecond capture time. It also has data storage and recall.

An adaptor mode can expand the functions for custom applications such as sensor or current measurements. The DMM includes a holster, built-in tilt stand, safety probes, two “AA” alkaline cells, and an instruction manual.

The D-937 DMM is priced at $139.

Protek
P. O. Box 59
Norwood, NJ 07648
Phone: 201-767-7242
Fax: 201-767-7343

ESD-SAFE SOLDER DISPENSER. The ESD-safe FD-1001 solder dispenser from OK Industries has manual and automatic dispensing controls that regulate solder paste deposition. It has a timing range of 0.1 to 1.0 seconds for precise dispensing control.

The system includes a foot pedal for activating the dispensing process, a syringe stand, and a quick-connect hose assembly with a locking syringe adaptor. The dispenser also includes a 30-piece set of syringe needles and a static-dissipative plastic base.

The price for the FD-1001 solder-dispensing system is $765.

OK Industries
4 Executive Plaza
Yonkers, NY 10701
Phone: 914-969-6800

DSP/DATA-ACQUISITION BOARD. The Model 310A PC add-in board from Dalanco Spry is built around a digital signal processor IC for digital signal processing and data acquisition. It offers floating-point math DSP, and its throughput capabilities are intended for data-logging and data-output.

Based upon Texas Instrument’s TMS320C31 floating-point DSP IC, the IBM PC/AT-compatible board operates at 33 MHz for up to 33 MFLOP performance. Data acquisition for four differential channels at 14-bit resolution with programmable gain is offered. It has a maximum sampling rate of 150 kHz. One 12-bit, 300-kHz analog output is available. The board can accommodate 0 to 1 wait-state static RAMs with capacities of 32 K to 512K words.

The Model 310A is sold Continued on page 30
Excel for Science and Technology; by Peter Gaeng. Abacus, 5370 52nd Street SE, Grand Rapids, MI 49512; Phone: 1-800-451-4319; $34.95 including diskette.

This book explores the capabilities of Excel for the professional scientist and technologist. After a brief overview of Excel 4 worksheets, databases, and graphics, the book discusses Excel Solver and the Scenario Manager. The book also covers mathematics functions such as graphs, curves, numerical integration drawing, and tables.

In the physics section, Gaeng's book has a collection of formulas for such subjects as oscillation and waves, and animated diagrams. Of interest to those working in chemistry, is the section that discusses stoichiometry and the role of alligation technology; it includes information on conversion, logical construction sets, and illumination.

Under the heading of statistics and social sciences, the book explains how to gather empirical data and perform deductive and database statistics, correlation, and linear regression. Ecologists, will be pleased to find how Excel can be applied to chart growth, decay and population dynamics. The chapter also explores the significance of different ecological models.

The companion diskette will help readers to apply the concepts presented in the book. The macros and worksheets included on the disk are based on the special Excel powers described in this book.

1993 Short Form Designers' Guide and New Product Update. Analog Devices, Inc., 181 Ballardvale Street, Wilmington, MA 01887; Phone: 617-937-1428; Fax: 617-821-4273; free.

This is the latest in Analog Devices' series of combined designer's guides and product catalogs. It is intended to help designers find an Analog Devices product that will meet their application needs.

Surprisingly, many audio purists and designers still prefer the performance of electron tubes over transistors. This book fills the information vacuum created by the decline of the electron tube market. Said to be a reliable reference source on tubes, it catalogs 14 of the most popular low-power triode tubes that have been in audio equipment for the past 30 years. They are still available from suppliers.

Rather than being a reprint of old data dredged up from dusty, yellowed catalogs, the data in this book has been recently researched, compiled, and verified in the author's own laboratory.

You will find 11 graphs and 7 data tables for each of the 14 tube types. Also included are specifications data including maximum ratings, physical dimensions, and brief comments that will be meaningful for designers who intend to include tubes in their circuits.

High-Performance D/A Converters. Burr-Brown Corporation, P. O. Box 11400; Tucson, AZ 85734; Attn: Mary Douglas, Inquiry Handling Manager; Phone: 1-800-548-6132 or 602-746-1111; Fax: 602-889-1510; free.

Burr-Brown is offering its latest eight-page, full color catalog that highlights more than 30 industry-standard and recently introduced digital-to-analog converter products. The booklet contains product descriptions and specifications, selection guides, and applications notes.

Two new sections feature digital audio and ultrahigh-speed digital-to-analog converters. A selection guide is organized by ap-
Practical Troubleshooting

with the Advanced Video Analyzer; by Robert L. Goodman. Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Phone: 1-800-233-1128; $24.95.

This book tells you how to troubleshoot with a proprietary video analyzer. It explains in detail just about everything you would want to know about Sencore's VA62A Video Analyzer and its accessories. With this instrument you can troubleshoot various video equipment including TVs, VCRs, camcorders, and computer monitors.

After describing each of the video analyzer's operating features and explaining how to hook them up for the tests, Goodman covers TV and VCR servicing. Among the topics he takes on are troubleshooting video amplifiers and the aligning of TV chroma, video IF, and video detector circuits. He also provides guidance on how to troubleshoot TV sync and AGC systems.

With this book you can learn to analyze vertical sweep and "sandcastle" circuits, and how to troubleshoot horizontal-sweep systems. Included is an ex-

CABLE TV 50dB NOTCH FILTERS for interference removal or channel censoring. Filters are user-adjustable to desired channel # or frequency. Eight Models available, each for certain channels: 2 & 3; 4 to 6; 7 to 13; 14 to 17; 18 to 22; 23 to 29; 30 to 36; 95 to 99 plus 0 & 1. Just $30 each or 3 for $75, includes shipping. ONE MONTH MONEY BACK, fast delivery. Visa, MC, check or M.O. (C.O.D. is $5 extra). Huge discounts for higher quantities. STAR CIRCUITS, P.O. Box 94917, Las Vegas, NV 89193. Call 24 hours 1-800-535-7827.

NiCd / NiMH MINI-CHARGER MODULE CHARGES WITH COMPLETE PROTECTION IN 1 HOUR. Quality device charges any number of batteries safely. Ambient / cell temperature sensor, peak voltage sense, deadman timer, charge enable logic, & PWM control extend battery life. Charger is only 1.25" dia. x .020" thick! $24.95 + 1.50 s&h. Ask about our Dboards' "(D" size dia,) mini controls product line. J.DV SOLUTIONS, 773 Brookstone Rd., Ste. 104, Chula Vista, CA 91913. 619-338-1701. Call for more info!

CIRCLE 181 ON FREE INFORMATION CARD

ULTRA LOW COST LINEAR PROGRAMMABLE POWER SUPPLIES. User-Friendly with LCD Readouts at Analog Prices. Output Voltage / Current Programming and Readback via LCD Panel • Data Entry with Front-Panel Keypad • Power-off Memory • Voltage and Current Step-up-Step-down Function • Microprocessor Controlled • Superior Line Load Regulation • Output Enable-Disable • Optional RS-232 Interface for Remote Operation (standard on LPS-305) • Intelligent Forced-Air Fan Operation. AMERICAN RELIANCE, INC., 11801 Goldring Road, Arcadia, CA 91006. Tel: (818) 303-6688 • Fax: (818) 358-3838

CIRCLE 178 ON FREE INFORMATION CARD

CRystal-CONTROLLED! 5 MINUTE ASSEMBLY! MONEYBACK GUARANTEE! Attach 3 wires and hear every whisper up to 2 miles away on any programmable scanner or VHF surveillance receiver. Pre-tested surface mount module uses standard 9V battery for 100mW output! Includes battery box and crystal for 140MHz. Custom frequencies available for Law Enforcement. Model VX-100 only $79.95 + 2.00 S&H. VISA, MC, MQ. COD add $5.00. DECO INDUSTRIES, BOX 607, BEDFORD HILLS, NY 10507. 914-232-3879.

CIRCLE 127 ON FREE INFORMATION CARD

CALL NOW AND RESERVE YOUR SPACE

• 6 x rate $940.00 per each insertion.
• Fast reader service cycle.
• Short lead time for the placement of ads.
• We typeset and layout the ad at no additional charge.

Call 516-293-3000 to reserve space.
Ask for Arline Fishman. Limited number of pages available. Mail materials to: mini-ADS, ELECTRONICS NOW, 500-B Bi-County Blvd., Farmingdale, NY 11735.

FAX: 516-293-3115

January 1994, Electronics Now
The catalog also includes descriptions of flat-panel display systems that feature "DisplayPacs," products. These combine a variety of flat-panel displays (liquid crystal and electroluminescent, for example), and touchscreens with single-board computers to form operator interface systems.

Other flat-panel products being promoted include the VAMP, a combination color LCD panel and touchscreen that can plug into any standard VGA analog output. A similar FP-Kit has a PC bus flat-panel driver card. The brochure also contains information on the company's software development tools. Some can program ROMs and touchscreens; others are for system development. Products include expansion boards, PCMCIA interface boards, and a line of accessories.

Muscle Wires Project Book, Third Edition; by Roger G. Gilbertson. Mondo-ronics, Inc., 524 San Anselmo Avenue #107-20, San Anselmo, CA 94960; Phone: 800-374-5764 or 415-455-9330; $17.95. This 106-page brochure from Calex describes the company's many modular load-cell and strain-gage signal conditioners, DC isolated transmitters, constant-current sources, alarms, and operational amplifiers.

The catalog describes DC-to-DC converters and linear power supplies for powering instrumentation modules. It also contains detailed design specifications, circuit diagrams and descriptions, a selection guide, block diagrams, performance curves, and prices. Tutorial articles on operational amplifiers, constant-current theory, instrumentation amplifiers, and grounding and shielding should prove useful to readers.

Voodoo NetWare: Tips & Tricks with an Attitude for Version 4.0; by Emmett Dunaney. Ventana Press, P.O. Box 2468, Chapel Hill, NC 27515; Phone: 919-942-0220; Fax: 919-942-1140; $27.95.

This book presents the key points of the NetWare 4.0 operating system in a lively format packed with tips and traps. It explains how to put the network's power in the hands of the network administrator. It also offers guidance on how to choose the right server cards and cables to get a system up and running smoothly.

Dulaney tells you how to use NetWare 4.0's new utilities to add, delete, and monitor stations on the network. It explains how to get things done quickly and efficiently with command-line shortcuts, and how to streamline system management. This can be done with log-in scripts, improved backup and security, and sensible directory trees.
Need data in a hurry?

Don't worry!

Just clip this form carefully along the dotted lines, fill it out (PLEASE PRINT) and fax it to the company of your choice today!

For fastest response, please send directly to manufacturers.

FAX numbers are on page 42.

If you need more than one form, please make copies of this original.

Electronics Now provides this fax form as a service to its readers. A quick response from you indicates your company's willingness to do business with the sender.

**Electronics FAX RESPONSE**

**TO:**

Company Name

Fax Number

I urgently need more information about your ____________________________ products.

I saw your products on Page _______ in the ________________________ issue of EN;

(Month/Year)

**ADDITIONAL NOTE:**


**FROM:**

Sender's Name

Title

Company Name:

Street

City

Country

Phone

Fax

We are a(n) □ manufacturer □ service center □ engineering company

□ R&D center/laboratory □ other (________)
Nothing in life comes without a price of some kind. As we get closer to the twenty-first century, there are fewer and fewer global truths around, but this is definitely one of them.

Once upon a time, given a certain amount of really basic automotive understanding and a screwdriver, you could fix your own car. If you were out driving and your car conked out in the middle of nowhere, you could pop the hood and get yourself going again. As cars became more and more dependent on electronics, your chances of making a successful quick fix, temporary or not, got worse and worse.

There's no arguing the fact that cars are technically better than they used to be. Not too many years ago, the only place you would go with a car that had more than fifty thousand miles on it was to the garage. Now, a car with more than one hundred thousand miles on the odometer is considered to be just about broken in. This is true because of advances in metallurgy, design, engineering, and electronics. But remember that there's no such thing as a free lunch. And that's just as true in 1993 as it was in 1893.

A significant part of the increased efficiency of modern cars is due to the increased amount of electronics in the car. Now many of the mechanical systems in your car are controlled by electronics of one kind or another. Little by little, PC boards are being put between the driver and the car.

For the most part, this is a good thing, but it's something you should be aware of when you're driving. Anti-lock braking is a terrific step forward, but it means that when you step on the brake pedal, braking control is shared with electronics rather than being exclusively a function of pressure of your foot. The ABS system checks each wheel sequentially and applies braking pressure only to the wheels that are turning. In essence, the brakes are pumped individually, which is a great help in avoiding skids and other braking nightmares.

An ABS system is only one example of how electronics has been used to increase automotive efficiency. Such things as fuel injection, all-wheel drive, and even engine performance have benefited from the introduction of electronics. This is a good thing, but it's moved the driver further from the control of the vehicle. Don't get me wrong, all of this stuff is great—as long as it works.

Electronics that are designed to assist in the control of what we can refer to as “life safety” systems (such as braking) are designed to be fail-safe. If anything goes wrong with them, they're supposed to drop out of the line. All other electronic controls in a car are made to handle automotive “operational” systems. These include such things as fuel injection and engine operation. Failure in any one of these systems is not life threatening and won't cause the car to go out of control—all that happens is that the car will stop running.

Anybody who has had an electronic problem with his car and has had to replace the “computer” knows that it's an expensive replacement. If you get the broken part and open it up, you'll be amazed at what you find because the component density there is minimal indeed—certainly nothing like that on a computer motherboard, power supply, or other component that you can buy for a tenth the price. But, because there aren’t any automotive electronic standards for a car’s computer, and there’s no alternative to replacing it, there's not a lot you can do about it.

The engine- and fuel-control systems in your car, among others, are constantly being monitored by the car's computer and, if it detects a problem, either a warning light will come on (“Service Engine Soon” in a GM car), or some other indicator will be activated. The problem with all this stuff is that it has no meaning for the owner of the car. Sure, there are things you can do to make the light flash a code number that you can then look up in a book to determine the problem sensed by the computer. But chances are you won't have the book with you at three o'clock in the morning when you get stuck on a road exactly seventeen miles from nowhere.

If any reader has a code list and knows what to do to make the warning light flash the code numbers, drop me a line with the information and the year and make of the car referred to. I'll publish the code lists here because it's good stuff for everybody to have and, as we all know, we motorists have to stick together.

The only defense a driver has these days is to install his own electronics in the car. That will let him know, in unambiguous terms, exactly what's going on under the hood. That won't tell them what the warning lights mean, but hopefully it will point out potential problems before the computer sees them and causes the car to die. This is what gauges were for, but since most modern cars are really short on helpful dashboard instruments, we'll just have to build them ourselves.

As with any other design problem, the first consideration when you set out to add electronics to a car is to think about how you're go-
ing to power them. You can count on a car to provide a solid source of 12 volts, but that's just the beginning. A car battery's voltage will drop below 12 volts when it's under load (even down to a low of 9 volts when the starter is cranking). So depending on a constant 12-volt supply isn't always a good idea.

Because, in the grand scheme of things, the frequencies that you'll find running around a car are fairly low, anything we design can be run from a 5-volt supply. Our first design job, then, is to come up with a reliable, regulated 5-volt supply that can provide a clean source of power in an automobile. This isn't as straightforward as you might think because a running engine creates just about the worst environment you can imagine for electronics. The ignition and spark system generate an unbelievable amount of noise and voltage spikes, the mechanical systems create vibration, and the engine produces heat, oil mist, and other things that can play havoc with the reliable operation of any sensitive electronics.

To ensure a clean 5-volt supply no matter what's happening with the car (short of a completely dead battery), we'll have to take an unusual approach to the design and layout of the supply. This will have the goal of reducing the effects of the car's electrically noisy environment. The overall approach is shown in Fig. 1. The main supply is going to generate the following voltages:

1—A pass-along voltage that's equal to the operating voltage of the automobile. This is just a buffered version of the voltage at the positive terminal of the battery, and it can be used for monitoring the state of the charging system, as a power source for recharging batteries, and other loads.

2—A regulated 12 volts that's available just in case we need it. A lot of sensors you might add to the car must operate from 12 volts and, since we're in the design stage of the supply, we have to include it in the circuit.

3—A regulated 9-volts. This is the preregulated supply for the most of the electronics. Even a seriously discharged battery can be counted upon to supply 9 volts, especially because the electronics load we're going to add to this regulator is really light.

4—The alternator voltage. Whether or not you have to add this one depends on your car's charging system. If you have a separate alternator (or generator) and regulator, the voltage at the positive terminal of the alternator is an important value to have when you're monitoring the health of the car's charging system. If the voltage regulator is built into the back of the alternator, this information will be slightly less useful but should still be made available.

5—Electrical ground. This is the voltage at the negative terminal of the battery.

6—Chassis ground. In the best of all possible worlds, this is supposed to be the same as the electrical ground, but the older your car, the less likely this is to be true.

When we get together next time, we'll go through the details of the power supply and the power considerations for each module we want to add. Then we'll begin designing the circuitry needed to add real monitoring to the car.
Heathkit Heathkit Heathkit Heathkit Heathkit

PC Servicing

Now, a Quality, Affordable, and Value-Packed Course

A Heathkit Exclusive. We deliver a true multi-media learning adventure. Not only do you get a better computer, but you get the only Computer-Aided Instruction software available as part of a self-study course.

What You'll Learn:
- PC Upgrading and Maintenance
- Preventive Maintenance Procedures
- How to Identify and Repair Problems
- Installing Memory, Drives, Expansion Boards, Microprocessor Upgrades
- How to Configure for Performance
- MS/DOS* & Windows*

And Learn About Computers at the Electronics Level:
- DC Electronics
- AC Electronics
- Semiconductor Devices
- Electronic Circuits
- Digital Techniques
- Microprocessor Programming

NEW PRODUCTS continued from page 23

Dalanco Spry
89 Westland Avenue
Rochester, NY 14616
Phone: 716-473-3610
Fax: 716-271-8380

DIGITAL-STORAGE/ANALOG OSCILLOSCOPE. The model 2522A from B+K Precision combines the flexibility of a digital storage oscilloscope (DSO) with the versatility of an analog scope. Like other DSOs, it can freeze and greatly magnify waveforms for closer inspection. Digital display modes include roll, refresh, hold, save CH2, and pretrigger storage. The 2522A offers 20 mega-sample/second real-time sampling on each channel, so that waveforms can be stored with resolution to 10µs/division. The instrument has an equivalent time-sampling bandwidth of 20 MHz for repetitive waveforms.

The 2522A also provides full 20-MHz dual-trace analog scope operation at the touch of a button. Analog features include up to 1-mV per division vertical sensitivity and V-mode for viewing two signals unrelated in frequency. The user can choose from 19 calibrated sweep time ranges with full adjustment between ranges.

DIGITAL-MODE OPERATION includes ×100 time/division ranges to extend sampling time to as much as 50 seconds per division. That allows the viewing of slow events that wouldn't be possible on an analog scope. Stored waveforms may be further expanded ten times for closer examinations. A plotter output is also provided.

Additional features include front-panel x-y operation, channel 1 analog output, channel 1 and channel 2 digital outputs on the rear panel for driving an analog plotter, and an 8×10-cm CRT.

The 2522A DSO/analog scope, complete with two 10:1 probes and instruction manual, has a suggested price of $1099.

B+K Precision
6470 West Cortland Street
Chicago, IL 60635
Phone: 312-889-1448
Fax: 312-794-9740
Graduate with an Associate Degree from CIE!

CIE is the best educational value you can receive if you want to learn about electronics, and earn a good income with that knowledge. CIE’s reputation as the world leader in home study electronics is based solely on the success of our graduates. And we’ve earned our reputation with an unconditional commitment to provide our students with the very best electronics training.

Just ask any of the 150,000-plus graduates of the Cleveland Institute of Electronics who are working in high-paying positions with aerospace, computer, medical, automotive and communications firms throughout the world. They’ll tell you success didn’t come easy...but it did come...thanks to their CIE training. And today a career in electronics offers more rewards than ever before.

CIE’S COMMITTED TO BEING THE BEST...IN ONE AREA...ELECTRONICS.

CIE isn’t another be-everything-to-everyone school. CIE teaches only one subject and we believe we’re the best at what we do. Also, CIE is accredited by the National Home Study Council. And with more than 1,000 graduates each year, we’re the largest home study school specializing exclusively in electronics. CIE has been training career-minded students for nearly sixty years and we’re the best at our subject...ELECTRONICS...IT’S THE ONLY SUBJECT WE TEACH!

CIE PROVIDES A LEARNING METHOD SO GOOD IT’S PATENTED.

CIE’s AUTO-PROGRAMMED® lessons are a proven learning method for building valuable electronics career skills. Each lesson is designed to take you step-by-step and principle-by-principle. And while all of CIE’s lessons are designed for independent study, CIE’s instructors are personally available to assist you with just a toll free call. The result is practical training...the kind of experience you can put to work in today’s marketplace.

LEARN BY DOING...WITH STATE-OF-THE-ART EQUIPMENT AND TRAINING.

CIE pioneered the first Electronics Laboratory Course and the first Microprocessor Course. Today, no other home study school can match CIE’s state-of-the-art equipment and training. And all your laboratory equipment, books and lessons are included in your tuition. It’s all yours to use while you study and for on-the-job after you graduate.

PERSONALIZED TRAINING...TO MATCH YOUR BACKGROUND.

While some of our students have a working knowledge of electronics others are just starting out. That’s why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So...even if you’re not sure which electronics career is best for you, CIE can get you started with core lessons applicable to all areas in electronics. And every CIE Course earns credit towards the completion of your Associate in Applied Science Degree. So you can work toward your degree in stages or as fast as you wish. In fact, CIE is the only school that actually rewards you for fast study, which can save you money.

Send for CIE’s FREE Course Catalog and See How We Can Help Your Career Too!

YES! I want to get started. Send me my CIE course catalog including details about the Associate Degree Program. (For your convenience, CIE will have a representative contact you - there is no obligation.)

Please Print Clearly

AE58

Name __________________________
Address ________________________
City ____________________________
State _____ Zip _______ Age ______
Phone No. _______________________
Check box for G.I. Bill Benefits.
☐ Veteran
☐ Active Duty

Cleveland Institute of Electronics, Inc.
1775 East 17th Street
Cleveland, OH 44114

A School of Thousands.
A Class of One. Since 1934.
What Do These Prestigious Companies Have In Common?

They sell through distributors.
They belong to the E.I.A.
They belong on your vendor list.

Leadership in electronics is not just a matter of designing products better and manufacturing them better, but also of marketing them better. And the sponsors of this message understand that better service to customers requires effectively involving distributors as part of their marketing teams.

Distributor involvement means lower prices, quicker deliveries, better service overall. The Buyer wins...the Seller wins.

Distributors help achieve marketing leadership. So does the manufacturer's involvement in the Components Group of the Electronic Industries Association. EIA fosters better industry relations, coherent industry standards, and the sharing of ideas, which helps one another and serves customers better.

In choosing your component supplier, look for the marks of leadership — availability through distribution membership in the E.I.A.
FRED EADY

This article will introduce you to a new and very popular RISC (reduced instruction set computer) -like microcontroller called PIC from Microchip Technology.

It will also show how to build a full-function PIC16C5X microcontroller programmer. The PIC16C5X hardware and software examples—and a PIC16C5X cross assembler—will allow you to develop your own PIC applications. Everything you need to get started costs only about $80.

What's a PIC?
The PIC16C5X series of 8-bit microcontrollers are low-cost, low-power, high-speed, CMOS devices that contain EPROM, RAM, I/O, and a CPU in an 18- or 28-pin DIP package. The PIC16C5X microcontrollers clock from DC to 20 MHz, have 8 to 20 I/O lines, and incorporate sleep, timer, and watchdog functions.

PIC OTP (one-time programmable) devices are also available. They are not erasable either electrically or with ultraviolet light. PIC OTP parts are typically plastic-cased and less expensive parts than their corresponding devices that contain EPROM. They are usually used only in thoroughly tested and stable designs where no future code changes are likely to occur. This project is a perfect example of that. The programmer is based on an OTP device to make it affordable.

The PIC EPROM-based devices are normally cased in ceramic packages with a transparent window that allows the memory to be erased and reused just as in the popular 27XXX series of EPROMs. These devices are ideal for the testing and prototype phase of a design because they can be reused. However, they are much more expensive than OTP devices.

This programmer can program devices from the PIC16C5X family—both OTP and EPROM variants. A PIC17C42, in OTP form, acts as the PIC16C5X programmer controller. (In the next installment of this article, a PIC17C42 programmer will be described.)

The PIC16C5X family
The PIC16C5X microcontroller programmer is capable of reading, verifying, blank-checking, and programming the PIC16C54, PIC16C55, PIC16C56 and PIC16C57 in both the plastic OTP and ceramic EPROM packages. For security-sensitive applications, each PIC device includes a security EPROM fuse that can be programmed to prevent others from reading the EPROM code. The differences in the four PIC16C5X parts are the oscillator type, the number of available I/O (input/output) pins, and the size of the internal EPROM and RAM. Table I provides an overview of the erasable PIC16C5X devices.

Not only is the PIC physically compact, its built-in high-efficiency microcode allows compact programming. A 33-element, single-cycle, single-word instruction set permits the creation of programs that would normally require microcontrollers that use 100-element (or greater) multi-cycle, multi-byte instruction sets. In comparison, the 8749H has almost 50 mov-oriented instructions which actually make up less than a small part of the complete 8749H instruction set. Each PIC16C5X instruction word is 12 bits in length with the mnemonic (the opcode) and operand (the register, memory location or direct data to be manipulated) fully defined within the 12-bit word. All 33 PIC16C5X instructions are shown in Table 2, which is reprinted from a PIC data sheet.

PIC's high microcode execution speed is attained because a Harvard architecture, or the Harvard dual-bus concept, is...
used instead of the classic Von Neumann, or single-bus, implementation. The devices have separate bus and memory space allocated for instructions and data. All program-controlled objects—such as I/O ports, memory locations and timers—are physically implemented as hardware registers. For instance, most microcontrollers require different instructions for writing to an I/O port directly and for writing to an internal register. (The 8749H, for example, uses OUT to write to an I/O port while MOV is used to access internal registers.) With PIC devices, however, the instruction is the same: only the register destination is changed. The MOVW instruction is used to write to either an I/O port or a general-purpose register. The reduced number of PIC mnemonics can reduce a novice PIC programmer's learning curve dramatically.

The shorter the instruction cycle time and the fewer instruction cycles per instruction, the faster your code will execute. To clear (set to hex 00) I/O port 1 on the 8749H requires the OUTL.PLA instruction which consumes a total of 2 instruction cycles. An additional cycle is required for the CLR A instruction that should be executed prior to the OUT instruction unless the 8749H's accumulator contains hex 00. The PIC part performs the same function against register 6 (register 6 is the 8-bit B I/O port on the PIC) with a simple CLR 6 which it executes in a single instruction cycle. Also consider that the 8749H's maximum clock rate is 11 MHz (for a 1.36-microsecond instruction cycle) versus 20 MHz for the PIC (for a 200-nanosecond instruction cycle). PIC devices with 25-MHz clock rates should be available in early 1994.

The PIC16C5X data memory (RAM) bus is 8 bits wide while the program memory (EPROM) bus is 12 bits wide. The Harvard dual-bus configuration allows the PIC to perform high-speed bit, byte, and register operations. Harvard architecture also inherently allows the overlapping of instruction execution cycles, or pipelining. Pipelining is the simultaneous execution of the current instruction as the next instruction is being read from program memory. Traditional Von Neumann architecture requires that information be fetched over a single shared, or multiplexed, bus.

Figure 1 is a block diagram of the dual-bus PIC16C5X. The internal logical and physical components that make up the PIC16C5X family are similar to those of any other microcontroller you might encounter. However, the way these common components are interconnected via the dual-bus Harvard architecture is the key to the reduced instruction set and the high execution speed of the PIC16C5X family.

### TABLE 1—OVERVIEW OF UV-ERASABLE DEVICES

<table>
<thead>
<tr>
<th>Part #</th>
<th>EPROM</th>
<th>RAM</th>
<th>I/O</th>
<th>Supply Voltage</th>
<th>Osc. Freq. Range</th>
<th>Package Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIC16C54</td>
<td>512 x 12</td>
<td>32 x 8</td>
<td>13</td>
<td>4.0 - 5.5 V</td>
<td>DC - 20 MHz</td>
<td>18-pin Windowed CERDIP</td>
</tr>
<tr>
<td>PIC16C55</td>
<td>512 x 12</td>
<td>32 x 8</td>
<td>21</td>
<td>4.0 - 5.5 V</td>
<td>DC - 20 MHz</td>
<td>28-pin Windowed CERDIP</td>
</tr>
<tr>
<td>PIC16C56</td>
<td>1K x 12</td>
<td>32 x 8</td>
<td>13</td>
<td>4.0 - 5.5 V</td>
<td>DC - 20 MHz</td>
<td>18-pin Windowed CERDIP</td>
</tr>
<tr>
<td>PIC16C57</td>
<td>2K x 8</td>
<td>80 x 2</td>
<td>21</td>
<td>4.0 - 5.5 V</td>
<td>DC - 20 MHz</td>
<td>28-pin Windowed CERDIP</td>
</tr>
</tbody>
</table>

### TABLE 2—INSTRUCTION SET SUMMARY

#### BYTE-ORIENTED FILE REGISTER OPERATIONS

<table>
<thead>
<tr>
<th>Instruction-Binary (Hex)</th>
<th>Name</th>
<th>Mnemonic, Operands</th>
<th>Operation</th>
<th>Status Affected</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0001 11df 00ff 1Cf</td>
<td></td>
<td>Acid W and f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0001 01df 00ff 1A</td>
<td></td>
<td>AND W and f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 11ff 0000 0A</td>
<td></td>
<td>Clear W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 0000</td>
<td></td>
<td>Clear W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 10df 00ff 2Ah</td>
<td></td>
<td>Bit Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 10df 00ff 2Ff</td>
<td></td>
<td>Bit Clear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 10ff 00ff 00</td>
<td></td>
<td>Clear W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 10ff 00ff 01</td>
<td></td>
<td>Exclusive OR W and f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 10ff 00ff 10</td>
<td></td>
<td>Move f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 00ff 00ff 11</td>
<td></td>
<td>Move W to f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 0000</td>
<td></td>
<td>No Operation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 01df 00ff 3E</td>
<td></td>
<td>Rotate left f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 02df 00ff 00</td>
<td></td>
<td>Rotate right f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 00ff 0000 0000</td>
<td></td>
<td>Subtract W from f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 01df 00ff 3F</td>
<td></td>
<td>Swap halves f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 00ff 00ff 10</td>
<td></td>
<td>Exclusive OR W and f</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### BIT-ORIENTED FILE REGISTER OPERATIONS

<table>
<thead>
<tr>
<th>Instruction-Binary (Hex)</th>
<th>Name</th>
<th>Mnemonic, Operands</th>
<th>Operation</th>
<th>Status Affected</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0010 00ff 00ff 6f</td>
<td></td>
<td>Bit Clear f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0010 00ff 00ff 5f</td>
<td></td>
<td>Bit Set f</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 00ff 00ff 6b</td>
<td></td>
<td>Bit Test f, Skip if Clear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0011 00ff 00ff 06</td>
<td></td>
<td>Bit Test f, Skip if Clear</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### LITERAL AND CONTROL OPERATIONS

<table>
<thead>
<tr>
<th>Instruction-Binary (Hex)</th>
<th>Name</th>
<th>Mnemonic, Operands</th>
<th>Operation</th>
<th>Status Affected</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1110 0001 0001 00</td>
<td></td>
<td>AND Literal and W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 0000 0010 0000</td>
<td></td>
<td>Clear Watchdog timer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0101 0000 0000 0000</td>
<td></td>
<td>Incr. OR Literal and W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100 0000 0000 0000</td>
<td></td>
<td>Move Literal to W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 0000</td>
<td></td>
<td>Load OPTION register</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0100 0000 0000 0000</td>
<td></td>
<td>Return, place Literal in W</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 0000</td>
<td></td>
<td>Sleep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0000 0000 0000 0000</td>
<td></td>
<td>TRIS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1111 0000 0000 0000</td>
<td></td>
<td>Exclusive OR Literal and W</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For more detailed information, refer to the PIC16C5X datasheets.
Register file concept

All PIC program objects are implemented as physical registers within the PIC IC. To understand how the PIC hardware works, you should understand the PIC register-file concept. Refer to Fig. 2 as the registers common to all PIC16C5X devices are described.

The Operational Register File provides a means for indirect data addressing, a real-time clock/counter, a program counter, a status word register, a file select register, and also includes the I/O registers.

Indirect Data Addressing Register (f00)—This register is not physically implemented. It uses the contents of the File Select Register (FSR), or f04, to indirectly address any one of the 32 available file registers for use as a data register or pointer register depending upon the intent of the instruction that called f00.

Real Time Clock/Counter (f01)—The Real Time Clock/Counter, or RTCC, can be read and written to just like any other register. The RTCC can also be incremented by an external signal applied to the RTCC pin or by the internal instruction clock. Applications that would involve the RTCC are event counting and time measurement. The RTCC can also be prescaled using the PIC’s internal programmable prescaler.

Program Counter (f02)—The Program Counter, or PC, generates addresses for EPROM cells containing the 12-bit user-written program instruction words. The PC is 9 to 11 bits wide depending upon the type of PIC. The 10th and 11th bits of the PC come into play when using the paging capabilities of the EPROM-rich PIC16C56 and PIC16C57 devices, thus allowing for PIC programs up to 2048 words long. A 2-word stack area is provided for call and return operations.
Status Word Register (f03)—The Arithmetic Logic Unit (ALU) status, reset status, and page-preselect bits for the larger program memories of the PIC16C56/57 are contained within f03. It is comparable to the PSW (Program Status Word) found in most other microprocessors. Power-down and Time-out bits used by the Watchdog Timer (WDT) and sleep instructions are also held within f03.

File Select Register (f04)—As previously noted, the File Select Register (FSR or f04) is used in conjunction with f00 to indirectly select 1 of 32 available file registers. Because only bits 0–4 are needed to select the general-purpose register file (addressed 00 through 1F hexadecimal), bits 5–7 of the FSR are read-only and are always set to binary 111. If no indirect calls are used in the program, the FSR can serve as a 5-bit wide general-purpose register.

I/O Registers (f05–f07)—Ports A, B, and C (f05, f06, and f07 respectively) comprise the I/O registers for the PIC16C55 and PIC16C57 processors. Port C (f07) is a general-purpose register on the PIC16C54 and PIC16C56 as there are not enough pins on these devices to accommodate another physical I/O port. Port A is a 4-bit I/O register with bits 4–7 defined as binary 0000. Ports B and C are full 8-bit implementations. These I/O registers can be read and written to just like any other registers in the register file and are capable of having related I/O pins placed in high-impedance states for isolation or read operations. Any I/O pin can be independently programmed for input, output, or bi-directional operation.

General Purpose Registers (f08–f1F)—This second set of registers is addressed 08–1F hexadecimal for the PIC16C54, PIC16C55 and PIC16C56. Take another look at Fig. 2 and you will see that the PIC16C57 extends the General Purpose Register presence to 7F (addressed 7F hexadecimal) via bank switching. These registers are most commonly programmed to act as internal user RAM.

Special Purpose Registers—The PIC16C5X register file also includes Special Purpose Registers. One is the W, or Working Register, which is essentially an accumulator. W is used heavily for internal data-transfer operations. Three other write-only I/O-control Special Purpose Registers, TRISA, TRISB, and TRISC, determine if the bits in the corresponding Port registers (Ports A, B, and C), and thus their respective I/O pins, are input or output. A binary 1 corresponds to high-impedance or input mode, while a binary 0 allows output of that bit position to the related I/O pin. For example, if W is loaded with binary 00001111 and TRISB is executed, Port B, or f06, would hold bits 0–3 at a high-impedance, or input state, and it will output the contents of register f06 bits 4–7 to the I/O pins.

The last of the Special Purpose Registers is the Option Register. The Option Register defines prescaler assignment to the RTCC or Watch Dog Timer (WDT). The prescaler is shared by RTCC and WDT and this assignment is mutually exclusive; only one resource can be pre-

FIG. 2—SHOWN HERE are the registers common to all PIC16C5X devices.
sensed at a time. Other bits within the register determine which signal edge RTCC will clock on, and if the RTCC input signal is internally or externally generated.

**Watchdog Timer (WDT)**—The watchdog timer must be reset under software control or it will time out and generate a processor reset. If a program is operating normally, the built-in commands to reset the watchdog timer are executed within specified time limits eliminating a processor reset. On the other hand, if the microprocessor leaks beyond the existing program or begins to loop within the program, the watchdog timer reset commands will likely not be executed in a timely manner, and a watchdog timeout will occur. A full-blown processor reset would be issued to clear the error condition.

The PIC16C5X watchdog timer does not require any external components; it operates on its own internal RC oscillator. The PIC16C5X WDT operates even if the main processor clock is not operational. The typical WDT time-out period is 18 milliseconds. The prescaler can be assigned to the WDT and extend the time-out period to over 2 seconds.

Another function of the WDT is to aid wake-up operations during the PIC16C5X sleep mode. The sleep mode can also be exited at a WDT timeout or on the occurrence of an external input.

**PIC16C5X oscillator options**

Four oscillator options can be used with the PIC16C5X series of microcontrollers: a crystal oscillator (XT), a high-speed crystal oscillator (HS), a low-power crystal oscillator (LP), and an RC-network oscillator (RC). One-time programmable (OTP) devices can be purchased with any one of those oscillator configurations pre-programmed. EPROM devices can be programmed to use any of the four oscillator configurations. The XT, HS, and LP devices need a ceramic resonator, crystal, or buffered external clock source to establish oscillation, while the RC configuration requires only a resistor and capacitor. Naturally, the ceramic-resonator and crystal-oscillator configurations are more accurate time-keeping devices, but if high timing accuracy is not required, the RC oscillator approach can be used to cut costs and complexity.
Reset circuitry

The PIC16C5X devices use an internal Power-On Reset (POR) circuit in conjunction with the Oscillator Start-Up Timer, OST, to alleviate the need for the traditional reset capacitor and resistor in most situations. To use the POR circuitry you need only tie the MEMORY CLEAR pin (MC1R) to +5 volts. If the power ramps up slowly or you have a very slow clock speed, the typical RC reset circuit can be used.

The PIC17C42

The intelligence for the PIC16C5X microcontroller program is provided by a 40-pin, 16-bit, Harvard-Architecture PIC17C42. The programmer code is housed within the PIC17C42’s 2K x 16 on-chip EPROM. The PIC17C42 contains 256 bytes of RAM and can address a total of 64K x 16 of program memory. The on-chip 2K x 16 is sufficient for the PIC programmer.

Just like the PIC16C5X, the PIC17C42 uses instruction pipelining, dual-business architecture, a watchdog timer, a register file system, and a sleep mode, the functions of which are similar but more robust on the PIC17C42. In addition, the PIC17C42 contains an on-board USART (universal synchronous/asynchronous receiver/transmitter), five multipurpose I/O ports, and two 8-bit timer/counters.

PIC16C5X programmer

The PIC17C42 is very versatile in that the I/O pins can, under program control, assume many identities. It is the PIC17C42’s unique I/O capability that allows the PIC16C5X microcontroller programmer to be implemented with only 3 ICs (in addition to the regulators) and a handful of common components (see Fig. 3). Rather than attempt to cover all of the PIC17C42 I/O configurations, we will describe in detail the I/O functions that pertain to the operation of the PIC16C5X microcontroller programmer. Reference the schematic diagram as we “PIC” apart the programmer’s inner workings.

All DC voltages for the PIC programmer are derived from the output of 18-volt AC transformer T1, which feeds the full-wave bridge rectifier arrangement comprised of diodes D1–D4 and capacitor C6. The unregulated DC from the output of the bridge is fed simultaneously to three voltage regulators (IC4, IC5, and IC6). Bypass capacitors C7 and C11 are placed at the inputs of the LM317/LZ adjustable voltage regulators (IC4 and IC5) to ensure stability and to reduce transient noise. Capacitor C10 does the same on the output of IC6.

The output voltage of IC4 is determined by the formula

$$V_{OUT} = 1.25V \times \left(\frac{1 + R2/R1}{R2}\right)$$

A regulator supplies +13.5 volts DC to inputs VIA, VIB, VEC, and VEC of IC3, a CD4053B triple 2-channel analog multiplexer/demultiplexer. Inputs VEC and VEC along with associated output ZC are not used and are tied to VPP to prevent any possible interference with the other input and outputs. Inputs VOA and VOB of IC3 are grounded. That allows either +13.5 volts DC or 0 volts DC to be routed to IC3’s output pins ZA and ZB. Note that the A and B input and output channels of IC3 are wired in parallel. That is done to provide a 50- to 100-ohm source impedance for the target PIC’s MCLR inputs. Any impedance outside those limits may allow the target PIC to latchup during programming. Capacitor C12 acts as a filter to suppress any VPP transient voltages.

The voltage VPP (+13.50 volts DC) is also directed to the IC3’s select inputs, SA and SB, through resistor R7, with input SC tied to ground. Transistor Q2, with resistors R7 and R8, comprise a means of selecting either of IC3’s VPP, voltage input pairs, VOA/VOB or VIB/VIEB, to be routed to the paralleled output pair ZA/ZB. VPP selection is performed under program control. The logic state of pin 28 of IC2 (RE2) determines if Q2 is on or off. Transistor Q2 provides a path to ground for inputs SA and SB when it is turned on, and

| PARTS LIST |
|-----------------|-----------------|-----------------|-----------------|
| All resistors are 1/4-watt, 5%, unless otherwise noted | R1, R3 = 237 ohms, 1% |
|                  | R2 = 2320 ohms, 1% | R4 = 866 ohms, 1% |
|                  | R5 = 3090 ohms, 1% | R6–R8 = 10,000 ohms |
|                  | R9 = 430 ohms | |
| Capacitors       | C1–C5, C7, C10–C12 = 0.1 µF, 25 volts, monolithic | C6 = 330 µF, 35 volts, electrolytic |
|                  | C8, C9 = 27 pF, 5 volts, NPO |
| Semiconductors   | IC1 = MAX233 RS-232 transceiver | IC2 = Pre-programmed PIC17C42  |
|                  | IC3 = CD4053B CMOS multiplexer | IC4, IC5 = LM317LZ adjustable voltage regulator |
|                  | IC6 = 7805 5-volt regulator | IC7 = 7805 5-volt regulator |
|                  | Q1 = 2N2222A NPN transistor | Q2 = 2N2222A NPN transistor |
| Other components | ZIF1 = 18-pin zero-insertion-force socket for PIC16C54/56 target microcontroller | ZIF2 = 28-pin zero-insertion-force socket for PIC16C55/57 target microcontroller |
|                  | IC1 = 10 µF ceramic capacitor | XTAL1 = 10 MHz crystal |
|                  | T1 = 18 VAC transformer, 500 mA | J1 = PC-mount female DB-25 connector |
| Miscellaneous    | PC board, IC sockets, 25-conductor ribbon cable, solder. |
|                  | Note: The following items are available from E D Technical Publications, P.O. Box 541222, Merritt Island, FL 32954, Phone/Fax 24 hours 407-454-9905: |
|                  | Complete PIC16C5X kit including IC board, transformer, female DB-25 connector, and all electronic parts (no ZIF sockets or cables) $69.95 |
|                  | PC board only $30 |
|                  | Programmed PIC17C42 = $30 |
|                  | Software on diskette = $10 |
|                  | Please add $7.50 shipping for the full kit and $3.00 shipping for parts and software. Check, money order, or COD only. |
blocks the path to ground, letting $V_{PP}$ be applied to those inputs through R7 when it is turned off. With Q2 turned off, inputs SA and SB of IC3 are logic 1s and SC is logic 0 (pin 9 of IC3 is permanently grounded), so the ZA and ZB outputs are at +13.5 volts DC. With Q2 turned on, all three inputs (SA, SB, and SC) are logic 0, and the ZA and ZB outputs are at 0 volts DC. The selected $V_{PP}$ voltage at the output pair of IC3 is then applied directly to the MCLR pins of the target PICs. zero-insertion-force sockets ZIF1 and ZIF2.

The PIC16C5X programmer must include circuitry to provide +4.5- to +5.5-volts DC to the target PIC sockets to verify PIC programming margins. In other words, the PIC programmer must be able to correctly read a freshly programmed PIC at minimum and maximum rated $V_{CC}$ voltages to ensure that the PIC will perform its duty over its entire specified voltage range. An LM317 (IC5) generates these voltages. However, the circuit must not only be able to switch the target PIC socket's $V_{CC}$ between +4.5- and +5.5-volts DC, it must also provide a means to supply and remove the switched $V_{CC}$ power to the target PIC socket. To do this, the versatility of the PIC17C42's I/O subsystem is put to work. A controlled $V_{CC}$ network for the target PICs is implemented using only three components and minimal program overhead.

Pins 23 and 24 of IC2 (RA3 and RA2, respectively), are I/O pins with Schmitt trigger inputs and open-drain outputs. The associated source for these pins is internally grounded within the PIC17C42. By simply adding a pullup resistor, RA3 and RA2 can be used to switch between ground and voltages up to +12 volts DC.

With IC5 in a standard configuration, the value of R4 is normally used to determine the output voltage. By changing R4's value, IC5's output voltage changes proportionately. That is accomplished by switching R5 in parallel with R4 using the open-drain capability of RA2.

The combined resistance of R4 and R5 in parallel is less than the lower value of the two resistors (676 ohms in this case). The closer pin 1 of IC5 (the adjust pin) is taken to ground, the less its output voltage will be. So, by simply writing a 1 or 0 to I/O pin 24, we can switch between +4.5- and +5.5-volts DC.

Grounding the adjust pin of IC5 would result in an output voltage of +1.25 volts, which would not completely turn off $V_{CC}$ to the target PIC sockets. A negative voltage must be applied to the LM317's adjust pin to bring the output voltage to 0 volts DC. To avoid adding a negative supply voltage, the PIC programmer uses a simple transistor switch controlled by open-drain I/O pin 23 (RA3). To compensate for the voltage drop across the transistor, the output voltages of IC5 are set for +4.9- and +5.9-volts DC. When RA3 is at logic 0, the base of Q1 is grounded and $V_{CC}$ does not flow across Q1's junctions. When RA3 is a logic 1, resistor R6 pulls the base of Q1 up to $V_{CC}$, turning Q1 on, allowing $V_{CC}$ (+4.5 or +5.5 volts) to reach target sockets ZIF1 and ZIF2.

Naturally, IC1 and IC2 need +5 volts DC to operate. That voltage is supplied by IC6, a 7805+5-volt regulator.

The PIC16C5X programmer hardware communicates at 9600 bits per second (BPS) with the PICPROG terminal program. The 9600 BPS connection is provided by the PIC17C42 internal USART with the aid of the MAX232 RS-232 transmitter/receiver IC1. The PICPROG program is interactive and provides a pathway for data and commands to be passed to and from the PIC programmer hardware. Once valid commands are recognized by the PIC17C42 controller, firmware residing within the PIC17C42 takes over and performs the requested operation.

Continued on page 55
<table>
<thead>
<tr>
<th>COMPANY</th>
<th>FAX NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfa Electronics, Inc.</td>
<td>(609) 275-9536</td>
</tr>
<tr>
<td>All Electronics Corporation</td>
<td>(818) 781-2653</td>
</tr>
<tr>
<td>A.M.C. Sales, Inc.</td>
<td>(303) 494-4924</td>
</tr>
<tr>
<td>B.G. Micro</td>
<td>(214) 271-2462</td>
</tr>
<tr>
<td>Caig Laboratories, Inc.</td>
<td>(619) 451-2799</td>
</tr>
<tr>
<td>Chemtronics, Inc.</td>
<td>(404) 717-2111</td>
</tr>
<tr>
<td>Communications Specialists, Inc.</td>
<td>U.S. – (800) 424-3420 Int’l – (714) 974-3420</td>
</tr>
<tr>
<td>C&amp;S Sales, Inc.</td>
<td>(708) 520-0085</td>
</tr>
<tr>
<td>Danbar Sales Company</td>
<td>(909) 592-2940</td>
</tr>
<tr>
<td>Electronic Rainbow, Inc.</td>
<td>(317) 291-7269</td>
</tr>
<tr>
<td>Fair Radio Sales Co., Inc.</td>
<td>(419) 227-1313</td>
</tr>
<tr>
<td>Fusion Electronics, Inc.</td>
<td>(516) 599-6495</td>
</tr>
<tr>
<td>Gateway Products Corp.</td>
<td>(305) 974-6818</td>
</tr>
<tr>
<td>Gateway Electronics</td>
<td>(314) 427-3147</td>
</tr>
<tr>
<td>Global Specialties</td>
<td>(203) 468-0060</td>
</tr>
<tr>
<td>Goldstar Precision Co. Ltd.</td>
<td>(310) 921-6227</td>
</tr>
<tr>
<td>Hameg Instruments</td>
<td>(619) 630-6507</td>
</tr>
<tr>
<td>Interactive Image Technologies Ltd.</td>
<td>(416) 368-5799</td>
</tr>
<tr>
<td>Jameco Electronic Components</td>
<td>(800) 237-6948</td>
</tr>
<tr>
<td>&amp; Computer Products</td>
<td>(213) 888-6868</td>
</tr>
<tr>
<td>Mark V Electronics, Inc.</td>
<td>(513) 434-6959</td>
</tr>
<tr>
<td>MCM Electronics</td>
<td>(415) 455-9333</td>
</tr>
<tr>
<td>Mondo-Tronics, Inc.</td>
<td>(401) 885-4565</td>
</tr>
<tr>
<td>Moody Tools, Inc.</td>
<td>(817) 483-0931</td>
</tr>
<tr>
<td>Mouser Electronics</td>
<td>(909) 278-4887</td>
</tr>
<tr>
<td>MWK Industries</td>
<td>(508) 695-9694</td>
</tr>
<tr>
<td>Northeast Electronics</td>
<td>(317) 298-5604</td>
</tr>
<tr>
<td>Number One Systems Ltd.</td>
<td>(605) 339-0317</td>
</tr>
<tr>
<td>Pc Boards</td>
<td>(813) 726-4434</td>
</tr>
<tr>
<td>People’s College of Independent Studies</td>
<td>(305) 537-5577</td>
</tr>
<tr>
<td>Print Products International</td>
<td>(904) 596-7599</td>
</tr>
<tr>
<td>Howard W. Sams &amp; Company</td>
<td>(802) 525-3451</td>
</tr>
<tr>
<td>Sencore, Inc.</td>
<td>(410) 860-0302</td>
</tr>
<tr>
<td>Sibex, Inc.</td>
<td>(619) 565-9558</td>
</tr>
<tr>
<td>Startek International, Inc.</td>
<td>See page 27 for FAX response order form</td>
</tr>
<tr>
<td>Suncoast Technologies</td>
<td>A public service of this publication and the Consumer Information Center of the U. S. General Services Administration</td>
</tr>
<tr>
<td>The Engineers Collaborative, Inc.</td>
<td>&quot;YOUR FREE CATALOG KNOCKED MY SOCKS OFF&quot;</td>
</tr>
<tr>
<td>(TECI)</td>
<td>We get that sort of comment all the time. People are impressed that our free Consumer Information Catalog lists so many free and low-cost government booklets. There are more than 200 in all, containing a wealth of valuable information.</td>
</tr>
<tr>
<td>Toroid Corp. of Maryland</td>
<td>They tell you how to make money, how to save money and how to invest it wisely. They tell you about federal benefits, housing and learning activities for children. They fill you in on nutrition, jobs, health and much, much, much more.</td>
</tr>
<tr>
<td>Wavetek Corp.</td>
<td>Our free Catalog will very likely impress you, too. But first you have to get it. Just send your name and address to:</td>
</tr>
<tr>
<td>(formerly Beckman Industrial)</td>
<td>Consumer Information Center Department KO</td>
</tr>
<tr>
<td></td>
<td>Pueblo, Colorado 81009</td>
</tr>
</tbody>
</table>

A public service of this publication and the Consumer Information Center of the U. S. General Services Administration
Now you can program your own 
6805 microcontrollers with this inexpensive programmer.

BRIAN BEARD

the same 8-bit CPU core, so if you can program one device you can program any member of the family.

The 68705 is ideal for small control projects because it is easy to program and because it is available to hobbyists for less than $17. The EP705N can program the P3, P5, R3, R5, U3, and U5 versions of the 68705. The “5” parts are identical to the “3” parts except for the addition of an EPROM security feature that prevents the viewing of code in a programmed device. Table I compares the features of the various versions.

The EP705N is flexible, quick, and easy to use. It operates from a single 5-volt supply thanks to its own DC-to-DC converter which provides the 21 volts required for programming. LED indicators show the status of the programming process. A parallel printer port and a serial port allow it to be connected to most personal computers. Figure 1 shows the functional blocks that make up the EP705N and how they are interconnected.

Theory of operation

Because the HMOS (high-density NMOS) 68705 processors have no external address or data bus, they cannot access external programs. They can be programmed, however, because of a bootstrap program in a small section of ROM in each 68705. Normally, when the
RESET pin goes high, the program counter is loaded with the reset vector from the on-chip EPROM. However, if the TIM pin is at +12 volts when RESET goes high, the program counter is loaded with the starting address of the bootstrap program instead.

The bootstrap program is designed to work with the hardware shown in Motorola Application Note 857 (AN857) consisting primarily of a 2764 EPROM and a 4040, 12-bit ripple counter. The 2764 is preprogrammed with the object code destined for the 68705. The 4040 supplies the address to the 2764 which in turn supplies the data to port A of the 68705. The 4040 is cleared and incremented by control lines from port B of the 68705. The bootstrap program starts the 4040 at address $8000 and increments up to the 68705's maximum address; $87FF for the P3/P5 and $FFFF for the R3/R5/U3/U5. At each address corresponding to EPROM in the 68705, the bootstrap program takes the data from port A and programs it into the EPROM.

After reaching the maximum address, the bootstrap program clears the 4040 and makes one more pass through the address space to compare the data at port A with the contents of its on-chip EPROM. The +21 volts required to program the 68705's EPROM ($V_{PP}$) is switched by R10. Additional lines from port B are used to signal that the EPROM is programmed and the program is verified.

The 68705 being programmed expects to interact with the hardware specified in AN857. The circuitry of the EP705N emulates the functions of that hardware. The programming data comes from the RAM buffer via a latched port (IC14 in Fig. 2) instead of from a 2764 EPROM. A 6803 monitors the count (PB3) and clear (PB4) lines from the 68705 and modifies its pointer into the RAM buffer, which replaces the 4040 counter. The control line from the 68705 that switches $V_{PP}$ to the chip is still controlled directly by the 68705.

FIG. 1—THE FUNCTIONAL BLOCKS that make up the EP705N and how they are interconnected.

---

**TABLE 1—CHIP FEATURES**

<table>
<thead>
<tr>
<th>Feature</th>
<th>68705P</th>
<th>68705R</th>
<th>68705U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of pins</td>
<td>28</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>On-chip RAM (bytes)</td>
<td>112</td>
<td>112</td>
<td>112</td>
</tr>
<tr>
<td>On-chip ROM (bytes)</td>
<td>115</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>On-chip EPROM (bytes)</td>
<td>1804</td>
<td>3776</td>
<td>3776</td>
</tr>
<tr>
<td>Bidirectional I/O lines</td>
<td>20</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Input only I/O lines</td>
<td>0</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>A/D</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Timer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>External Interrupts</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**TABLE 2—MEMORY MAP FOR THE EP705N**

<table>
<thead>
<tr>
<th>Address Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0000-$001F</td>
<td>MPU REGISTERS, 6803, IC9</td>
</tr>
<tr>
<td>$0020-$03FF</td>
<td>UNUSED</td>
</tr>
<tr>
<td>$0400-$05FF</td>
<td>DATA OUTPUT TO 68705</td>
</tr>
<tr>
<td>$0600-$07FF</td>
<td>PRINTER PORT INPUT</td>
</tr>
<tr>
<td>$0800-$09FF</td>
<td>LED OUTPUT PORT</td>
</tr>
<tr>
<td>$A000-$BFFF</td>
<td>ADDRESS 000 LATCH SET</td>
</tr>
<tr>
<td>$C000-$DFFF</td>
<td>RAM, 6264, IC11</td>
</tr>
<tr>
<td>$EC00-$FFFF</td>
<td>EPROM, 2764, IC12</td>
</tr>
</tbody>
</table>
Figure 2 shows the sockets for the 68705 chips. There are two 68705 sockets because of the different pinouts on the chips. The 28-pin 68705s are programmed in the IC16 socket and the 40-pin chips in IC15. Only one 68705 can be programmed at a time even though there are two sockets. Note that the reset and int lines to the 68705 are controlled by the 6803 processor. The 6803 uses the reset line to keep the 68705 inactive until programming begins. The int line serves as a "data ready" handshake line to the 68705.

The EP705N requires a supply of 5-volts DC at 500 milliamperes. The 21 volts (Vpp) needed to program the microcontroller is supplied by the DC-to-DC converter circuit shown in Fig. 3. Trimmer R4 adjusts the 21-volt supply, which is applied to the Vpp pin of the 68705 by the
The status of the programming process is indicated by the seven LEDs on the board. Figure 6 shows how LEDs 1–7 are wired and what they indicate. Green LEDs indicate the successful completion of a step and red ones indicate a failure.

The serial port on the 6805 programmer is RS-232 compatible. Figure 7 shows the serial port circuitry. The MAX232 (IC6) contains two RS-232 drivers, two RS-232 receivers, and an on-chip charge-pump. The charge-pump generates the bipolar voltages needed by the RS-232 drivers from the 5-volt supply.

Table 3 shows the pinout of the EP705N's serial connector. None of the handshake lines are actively controlled by the EP705N. The DTR (DATA TERMINAL READY) line is not connected. Lines DSR (DATA SET READY) and DCD (DATA CARRIER DETECT) are wired to a logic-high condition at all times. The RTS line is received, buffered, and looped back to the host as CTS, so that CTS (CLEAR TO SEND) tracks RTS (REQUEST TO SEND). The baud rate is selected with jumper block JP2 (Fig. 7). All of the standard baud rates from 600 to 9600 baud are available.

The parallel printer port circuitry is shown in Fig. 8. Each byte sent to the port from a perforated card reader (punch card reader) is divided into 8 bits, and each bit is transmitted as a tristate voltage level. The printer port is configured as an interface and performs signal and clock timing functions.
The status of the programming process is indicated by seven LEDs. Green LEDs indicate success, and red ones indicate failure.

The EP705N can operate in two different modes. If jumper block JP1 in Fig. 4 is open, the EP705N acts like a printer. It monitors the parallel and serial ports and accepts data from whichever one is active. The S19 output of an assembler can

Personal computer is signaled by D7 (DATA STROBE) strobing low. D7 sets flip-flop IC4-a, which sets the BUSY line and latches the new byte into IC3. The 6803 monitors the BUSY line (P17), and when it detects activity it reads the new byte from IC3. After processing the new byte, the 6803 strobes ACK (ACKNOWLEDGE) (P16) low. The rising edge of ACK clears the flip-flop which clears the BUSY line allowing the host computer to send the next byte.
Select any 5 books for only $4.95

when you join the ELECTRONICS BOOK CLUB®
(values up to $151.75)

As a member of the Electronics Book Club...

...you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. And you'll be eligible for FREE BOOKS through our Bonus Book Program. Your only obligation is to purchase 3 more books during the next 12 months, after which you may cancel your membership at any time.

A shipping/handling charge and sales tax will be added to all orders. All books are shipped hardcover unless otherwise noted.

If you select a book that counts as 2 choices, write the book number in one box and XX in the next. If you select a book that counts as 3 choices, write the book number in one box and XXX in the next 2 boxes. (Publishers' Prices Shown) ©1994 EBC

YES! Send the 5 volumes listed below, billing me just $4.95 plus shipping/handling & tax. Enroll me as a member of the Electronics Book Club according to the terms outlined in this ad. If not satisfied, I may return the books within ten days and have my membership cancelled. A shipping/handling charge and sales tax will be added to all orders.

Name _____________________________
Address ___________________________
City __________________ State _______
Zip __________ Phone ___________

Valid for new members only, subject to acceptance by EBC. Canada must remit in U.S. funds drawn on U.S. banks. Applicants outside the U.S. and Canada will receive special ordering instructions.

Your most complete and comprehensive source for the finest electronics books
be sent from a computer to the EP705N just as if it were a printer. For example, on an MS-DOS system, you would simply connect the EP705N in place of your printer and type in the normal print command “PRINT (FILENAME).S19.”

In the printer mode the EP705N performs all operations automatically. The result of each step in the programming process is marked by the appropriate LED. If any step fails, a red LED will light up and the process will cease. When programming is complete and successful, there will be four green LEDs glowing.

When power is first applied to the EP705N, all LEDs come on for one second to verify that they are operational. The EP705N then checks the 68705’s internal EPROM to determine if it is completely erased. If it is erased, the chip is ready to be programmed and the green ERASE LED comes on. The EP705N will now wait for you to send it an object file via either the parallel or serial port.

The object file must be in the Motorola standard S19 format. Any 6805 assembler will generate this type of output. As the object file is sent to the EP705N, it is converted to binary code and stored in the RAM buffer. If there is an error in the conversion, such as a non-hex character or a bad checksum, the red LOAD LED lights.

If the entire S19 file is received successfully, the green LOAD LED comes on. After an object file is loaded, programming of the 68705 begins. Completion of the programming step is marked by the program LED. The last step is to verify the pro-

![Diagram of serial-port circuitry](image)

**FIG. 7—SERIAL-PORT CIRCUITRY.** The MAX232 contains two RS-232c drivers, two RS-232c receivers, and an on-chip charge-pump that uses the 5-volt supply to generate the bipolar voltages needed by the RS-232c drivers.
PARTS LIST

All resistors are 1/4-watt, 5%, unless otherwise noted.
R1—130 ohms
R2—0.25 ohm or less
R3—51,000 ohms
R4—1000 ohms, 7/8-inch upright trimmer
R5—2700 ohms
R6, R7—1100 ohms
R8—100,000 ohms
R9, R10—6800 ohms
R11, R12—1500 ohms
R13, R14—220 ohms
R15—4.7K, 7, 8-pin SIP (pin 1 common)
R16—R17—4700 ohms × 7, 8-pin SIP (pin 1 common)

Capacitors
C1—22 µF, 50 volts, electrolytic
C2—560 pF, Mylar
C3—C5, C11, C13, C16—0.1 µF, ceramic disc
C6—C10—10 µF, 16 volts, radial electrolytic
C12, C14, C15—15 pF, ceramic disc

Semiconductors
IC1—78S40 switching regulator
IC2—78L12 12-volt regulator (TO-92 case)
IC3, IC13, IC14—74HCT574 octal D-type flip-flop
IC4—74LS74 dual D-type flip-flop
IC5—74HC14 hex inverter
IC6—MAX232 RS-232 interface
IC7—MC145411 bit rate generator
IC8—74LS138 3-to-8 decoder
IC9—MC6803 microcomputer
IC10—74HCT573 octal latch
IC11—6254 8K × 8 CMOS RAM
IC12—2764 8K × 8 EPROM (pre-programmed)
D1, D2—1N5819 Schottky diode
Q1—2N3904 NPN transistor
Q2—2N3906 PNP transistor
LED1—LED4—Green light-emitting diode
LED5—LED7—Red light-emitting diode

Other components
J1—2-contact terminal block
J2—25-pin female right-angle Centronics connector

Miscellaneous:
PC board, two 14-pin IC sockets, four 16-pin IC sockets, four 20-pin IC sockets, two 28-pin IC sockets, one 40-pin IC socket, one 40-pin ZIF socket, and one 28-pin ZIF socket.
Note: The following items are available from Lucid Technologies, 7439 Highway 70 South, Unit 297, Nashville, TN 37221:
- Partial EP705N kit (includes PC board, programmed 2764 EPROM (IC12), MC145411 bit-rate generator (IC7), documentation disk (5.25", 360K IBM format), and schematics)—$45
- Same kit as above but without PC board—$25

FIG. 8—PARALLEL PRINTER PORT CIRCUITRY. Each byte sent to the EP705N is signaled by scdst strobing low.
### TABLE 5—IC POWER PINS

<table>
<thead>
<tr>
<th>Reference</th>
<th>Type</th>
<th>Gnd</th>
<th>VCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC1</td>
<td>78S40</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>IC3, IC13, IC14</td>
<td>74HCT574</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>IC4</td>
<td>74LS74</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>IC5</td>
<td>75HC14</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>IC6</td>
<td>MAX232</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>IC7</td>
<td>MC145411</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>IC8</td>
<td>74LS138</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>IC9</td>
<td>6803</td>
<td>1</td>
<td>7, 21</td>
</tr>
<tr>
<td>IC10</td>
<td>74HCT573</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>IC11</td>
<td>6264</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>IC12</td>
<td>2764</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>IC15</td>
<td>68705R/U</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>IC16</td>
<td>68705P</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

If jumper block JP1 is short-circuited, the EP705N acts like a modem and uses only the serial port. To use this option your computer must have a communications program capable of ASCII file transfer. This mode allows you to interact with the EP705N via the menu shown in Table 4. The modem mode is not a completely automatic mode; the erase check is still done when power is applied, but after that you must tell the EP705N to perform each step of the programming process. In the printer mode, if something goes wrong, the only indication is a red LED. However, in the modem mode, a problem will generate a specific error message. The modem mode also allows the contents of the RAM buffer to be examined, modified, and downloaded.

### Construction

The design of the EP705N is complex enough to make point-
to-point wiring difficult. An etched and drilled PC board is available from the source mentioned in the parts list. Foil patterns are provided here for readers who wish to make their own boards. The rest of the parts are readily available. A parts-placement diagram is shown in Fig. 9. Begin by installing all parts on the board, but do not insert the ICs in their sockets at this time.

With no ICs installed in the sockets, attach a 5-volt DC supply to J1 and check the $V_{cc}$ pins for all the IC sockets. Table 5 shows the power and ground pins for all the ICs making it easy to check.

Install the DC-to-DC converter chip, IC1, in its socket. Turn on the power and measure the voltage at pin 1 of IC1. Adjust trimmer R4 to get a reading of 21 volts. Now measure the voltage on pin 7 of the IC15 target socket; it should be about 4.9 volts. If it is close to 21 volts there is a problem in the circuitry around Q1 and Q2. Measure the voltage on pin 8 of the IC15 target socket; it should be 12 volts.

Turn off the power supply and allow the charges to bleed from the electrolytic capacitors. Plug the ICs in their respective sockets, taking care to orient them properly. Figure 10 shows the completed prototype.

A parallel connection to the EP705N can be made with any standard parallel printer cable. If you are using a parallel printer now, disconnect the cable at the printer end and connect it to the EP705N. Serial connection to the EP705N might be more difficult. The EP705N is designed as a DCE (data communications equipment) device. It uses a 9-pin program/verify operation involving pulsing the TTL pin is performed up to 25 times per location. When verification is successful, a 3x overprogramming pulse train is applied to assure the location is programmed solidly. A final verify is performed by keeping the RTCC pin at TTL high and raising the OSC1 pin to TTL high. Again, the newly programmed contents at this memory location are presented to the port pins to be verified by the PIC17C42. If the memory location fails to verify properly, the PICPROG program is notified and the program operation is halted. Otherwise, the falling edge of OSC1 increments the target PIC's internal PC.

Once the configuration bits have been programmed and verified, the target PIC PC now contains 000 hex decimal, which is the beginning of PIC program memory. The program/verify operation is performed for the rest of the memory locations and a final read/verify is performed to assure everything went OK.

In summary, there are 3 basic steps to programming a PIC:
1. Write and assemble your source code.
2. Blank-check the device you wish to program.
3. Program and verify your device.

Rather than to explore the in-depth details of the firmware here, use the programming method flow chart to follow along in the supplied PIC17C42 source code for a detailed explanation of just how the bits and bytes get transferred and programmed.

**Next month**
Next month we'll finish up this project. We'll start by building the programmer, and because the programmer itself requires a pre-programmed PIC17C42 microcontroller, we'll show you how to build a programmer for that as well. In the meantime, gather together all of the parts you'll need.

---

**PIC PROGRAMMER**

continued from page 41
Build this radon monitor to detect a possible health threat in your home and, while doing it, learn more about radioactivity.

This two-part article discusses the design, construction, and use of a simple, inexpensive environmental radon gas detector that you can build. It is called the beverage can environmental radon monitor or BERM because its ionization chamber sensor is made from a readily available aluminum beverage can. You will be given a choice of methods for measuring and recording events or rates that can be translated into units of radon density.

Most people are exposed to environmental radon in excess of the natural rate because of the time they spend indoors. This first article explains what radon is, why it is a health hazard, and the importance of knowing the level of radon in the rooms of your house where you spend most of your time while indoors. It also includes the information needed to build the ionization chamber, its amplifier circuitry, and alternative circuits for charging the chamber’s internal high-voltage capacitor to 500 volts.

The second part of this article covers pulse-rate measurement, instrument calibration, and the conversion of pulse rates to radon density units. The article also offers alternative methods and circuits for performing these functions.

Even if the BERM is only crudely calibrated, it can warn you of unsafe radon levels in your home. However, when properly calibrated, it can give readings that compare favorably with those obtained from professional radon monitoring instru-
Direct exposure to radon, unlike direct exposure to beta particles, gamma rays, X-rays, or even ultraviolet light, poses little risk for humans.

The health threat from radon is indirect. Energetic alpha particles can cause chromosomal damage to the thin layers of lung tissue when humans breathe air contaminated by radon and its progeny. That damage is a potential cause of lung cancer, especially when coupled with the effects of cigarette smoke in the lungs.

There are several different forms of radon, but radon 222 is the most prevalent form, and is of the most concern to health researchers. The number 222 refers to its isotope number. The alpha particles emitted by radon and its progeny are helium nuclei.

Most of the radon 222 that is inhaled is either exhaled directly or it diffuses into the bloodstream where its alpha emission does little detectable damage. However, radon's short-lived progeny such as polonium 214 and polonium 218 are more likely to emit alpha particles that are capable of damaging sensitive human tissue.

The alpha particles from the decay process of polonium 218 have 6.0 MeV of energy while those from polonium have 7.7 MeV, both higher than the 5.5 MeV of radon 222. For this reason, researchers believe that they are the agents primarily responsible for inducing lung cancer in situations where radon 222 is present in amounts considered to be above the safe level.

Radon has been a constituent of the air for millions of years. We became aware of its existence only when instruments were developed that could detect and measure it. Its presence is of concern because of the alarming statistics on death due to lung cancer. Its presence has long been considered a contributing factor to those deaths. However, it is difficult to separate cancer attributable to radon alone from that attributable only to smoking or to smoking in the presence of radon.

The harmless concentration of radon in the outdoor air is about one-thousandth of its concentration in the ground. This can be demonstrated by placing an inverted bucket on bare ground over a suitable radon monitor. The radon emanating from the soil collects inside the bucket until an equilibrium condition is reached. The monitor will probably indicate a radon concentration that is several orders of magnitude higher than that in the surrounding air, but less than the soil concentration in the soil.

A house with a foundation, walls, floors, and a roof can be

![Diagram of radon monitor](https://example.com/diagram.png)

**FIG. 1—THEORY OF RADON MONITOR IONIZATION CHAMBER.** Positively charged anode wire attracts electrons and negatively charged cathode attracts positively charged ions. The recombination of electrons and ions causes a current that produces a voltage pulse.

What is radon?

Radon is a natural, inert, radioactive gas emitted from the earth. Odorless, colorless, and invisible, it is a byproduct of the radioactive decay of uranium. Because it is inert and does not chemically bond to elements, it is released from the soil into the atmosphere. Radon is emitted almost everywhere on earth, but some geographical regions have higher concentrations than others, depending on the local geology and soil porosity.

Radon becomes a health problem when it decays and produces other short-lived isotopes called daughter products or progeny. These chemically active isotopes are usually formed as charged particles (ions). They bond readily to other substances such as dust and smoke particulates. Table 1 lists a portion of the decay chain of radon 222 and its short-lived progeny.

When radon decays, it releases alpha particles with an energy of 5.5 million electron volts (5.5 MeV). That would seem to be a large amount, but alpha particles travel only 4 to 7 centimeters (1.5 to 2.5 inches) in air before dissipating their energy in the ionization of air molecules. A piece of paper or even human skin is thick enough to stop alpha particles.
considered analogous to a bucket. It will also trap radon that leaks into the indoor airspace, especially if all the doors and windows of the house are closed. Under these conditions, the indoor radon might be 10 to 100 times more concentrated than outdoor radon. People in developed countries typically spend most of their time indoors at work, at school, or at home, so they could be exposed to radon concentrations that are considered to be high enough to endanger health.

**Units**

The amount of radon in the air, termed specific activity, is measured in units of picoCuries per liter (pCi/l). This can be interpreted as 2.22 disintegrations per minute per liter of air. Typical radon concentration in the outside air is about 0.1 to 0.2 pCi/l. Radon gas in the soil, at a depth of about 15 inches, is typically 100 pCi/l.

The Environmental Protection Agency (EPA) has stated that a radon level within a home of 4 pCi/l or less will present little or no health threat. It has published recommendations for specific actions to be taken where higher concentration levels are found. These include follow-up testing in other rooms in the home. Nevertheless, it is ultimately up to the homeowner to decide what radon level is acceptable for his home in the absence of a scientifically established absolute safe threshold level for radon exposure.

Published risk comparisons indicate that a radon concentration of 30 pCi/l carries about the same cumulative risk as smoking two packs of cigarettes per day.

**Detectors**

There are many commercial instruments and techniques available for measuring radon indoors. Most detectors for evaluating indoor radon levels are passive in that they do not require external power. Examples include activated charcoal canisters or nuclear-track etch detectors. These detectors are exposed to indoor air under specified test conditions. After exposure, they are sent off to a laboratory for analysis.

The principal drawback to passive detectors is that they measure radon concentration at only one specific location for a specified period of time. Many variables influence radon concentration levels; therefore, a single estimate of radon concentration is likely to have a significant error.

Obviously, radon concentration surveys based on two or more passive measurements will provide a more accurate assessment than a single measurement, but they are expensive because the price of a "one-time-only" passive detector can range from $25 to $100. If you conduct only one test, the EPA recommends that it be run under worst-case conditions.

By worst-case conditions, the EPA means that the test should be made in any living space in the home or building that is closest to the ground (just above the floor slab, crawl space or basement) at a time of the year when ventilation is at a minimum—typically during the winter.

The air exchange rate and type of heating and cooling system in a house or building can cause wide variations in the amount of radon present due to differences in the way air is introduced, circulated and exhausted. There can also be daily variations in radon concentration. Because radon readings might exceed limits considered to be safe, it is recommended that radon concentration levels be measured over a one-year period in different locations in the home to obtain the best estimate of long-term risk.

Only an active radon monitor such as the BERM is capable of monitoring radon continuously. Commercial instruments capable of doing that typically cost several thousand dollars. The BERM radon monitor has many of the features of the expensive instruments at a far lower price.

BERM readings will not be very accurate unless they are
compared against those of a properly calibrated test instrument. Nevertheless, even if it is not calibrated, the BERM will yield relative data that is accurate enough to indicate if a radon hazard exists in your home. You can use a BERM to locate the "worst case" room in your house where a follow-up test with a precisely calibrated monitor should be performed if you suspect excessive levels.

**Ionization chamber theory**

The easiest way to measure the presence of radon is to detect the high-energy alpha particles that it emits as a result of radioactive decay. As can be seen in Table 1, the alpha particle has a kinetic energy of about 5.49 MeV which ionizes the air passing through it. On average, about 34 eV is required to ionize air.

Therefore, assuming that an alpha particle dissipates all of its energy ionizing air, about 100,000 \(10^5\) electron-ion pairs are generated over a path length of about 4 centimeters (1.5 inches). As a result, a charge of \(10^{-14}\) coulombs can be collected by the electric field inside the ionization chamber.

The BERM ionization chamber, shown schematically in Fig. 1, has a cylindrical form factor because it is constructed from an aluminum beverage can. It has an axial, positively charged wire anode that extends the length of the can.

Negatively charged electrons (e) are attracted to the positively charged anode and arrive a few microseconds after an ionizing event while positively charged ions (+) are attracted to the negative cathode cylinder liner. A few milliseconds later the ions recombine with electrons from the high-voltage, DC-power supply.

The resulting current flow produces a small voltage pulse across the resistor in series with the power supply. That pulse is then amplified, detected, and counted. The number of counts per minute can then be multiplied by a constant that includes the effective volume of the chamber to determine specific radon activity in units of pCi/l. The presence of radon "daughters" produced in the chamber increases the count rate.

The BERM ionization chamber design is based on the assumption that the air inside the chamber is a representative sample of the air in the room that is being monitored. The air in the BERM is slowly exchanged by diffusion through openings in the chamber.

**Chamber size**

A 12-ounce aluminum beverage can was selected for making the ionization chamber.

---

FIG. 3—CUTAWAY OF RADON MONITOR IONIZATION CHAMBER. A beverage can forms the chamber, an aluminum can forms the cathode, and half cans form protective end covers. Amplifier circuit board is shown left of center.
because, in addition to its ready availability, its size is standard-
ized. This size uniformity permits BERM calibration based
on chamber size. The can's dimen-
sions are large enough for alpha particles to dissipate
most of their energy ionizing air. As stated earlier, the
amount of charge generated de-
termines the amplitude of the
current pulse collected on the
anode.
Ionization caused by beta par-
ticles and other naturally occur-
ing radiation, primarily gamma rays, causes lower ampli-
tude pulses in a chamber of this
size. This means that it is easier
to discriminate the larger alpha
ionization pulses from those
cased by beta particles and
gamma rays as well as by ampli-
ifier noise.

High-voltage supply
A nominal but stable 500-volt
differential is required to set up
an electric field between the
anode and cathode. The ion col-
collection efficiency of this cham-
ber remains fairly constant over
a voltage range of 200 to more
than 1000 volts.
Unfortunately, any noise gen-
erated by the 500-volt supply
would be coupled directly into
the amplifier input. This estab-
lishes the additional require-
ment that the combined noise,
ripple, and short-term drift be
less than 100 millivolts.
The high voltage is obtained from
a charged, 0.1 microfarad
metallized-polypropylene-film
 capacitor. A suitable capacitor
will hold its charge long enough
to power the ionization cham-
ber for several weeks. It must be
recharged whenever the 9-volt
battery is replaced.
Before using the BERM, its
high-voltage capacitor must be
charged from a suitable source.
(Alternative methods for obtain-
ing the required voltage will be
explained later.) The high-volt-
age supply was designed to be
stable and not be an electrical
noise source.

Circuit description
Figure 2 is the schematic for
the amplifier. To maximize the
amplifier input signal, its ca-
pacitance must be minimized.
This is done by connecting the
chamber's anode wire directly to
the gate of JFET Q1. The effects
of excess capacitance and leakage
current that would be present
if a printed circuit had been
used for the connection are
eliminated. This approach
holds total input capacitance to
around 7 picofarads. An input
pulse charges the gate of Q1
about 1 millivolt.
The charge must be kept on
the gate long enough for the am-
plifier to respond. An input re-

distance large enough to main-
tain a long pulse width would
introduce too much thermal
noise for a good signal-to-noise
ratio.
This problem was avoided by
letting the gate float or self-bias.
The result is that input imped-
ance is maximized and noise is
minimized.
A JFET can be self-biased be-
cause its gate leakage pulls the
gate towards the drain-to-
source voltage. By operating the
JFET with only 1 to 2 volts from
drain-to-source, the gate oper-
ating voltage is restored by a
current of about 1 picampere.
Both of these techniques rule
out the possible use of a circuit
board as the gate-to-anode con-
nection. With this design, an
alpha ionization produces a large
100-millisecond pulse that is 20
to 40 dB greater than the ampli-
ifier's noise.

The principal drawback of
this arrangement is that the
drain resistor and the feedback
resistor must be selected to
match the specific JFET used.
Moreover, it can take several
minutes for the amplifier to sta-

bilize after power is applied. The
specified values of some compo-

nents can be changed to im-
prove BERM's performance
after you perform the initial cal-

ibration steps.

Thermal stability is not a pri-
mary concern for this amplifier
because it will normally be op-

erating at room temperature.
However, even with relatively
wide ambient temperature
swings, the BERM's overall cal-

ibration is very stable and re-

mains unaffected by amplifier
gain changes.

Operational amplifier
The LM392N is a low-power
operational amplifier/voltage
comparator performs as both
an amplifier and comparator.
The high-gain, internally fre-
quency compensated op-amp is
IC1-a, and the comparator is
IC1-b. Both can operate from
a single power supply over a wide
range of voltages (3 to 32 volts).
Current drain is 600 microam-
peres—essentially independent of
supply voltage. The LM392
shown on Fig. 2 is in an 8-pin
DIP package, but the LM392 in
a metal can package can be
substituted.
The op-amp functions as a
current-to-voltage converter fol-
lowing the JFET's transcon-
ductance stage. Overall voltage

gain is about 60 dB. However,
amplifier power gain, due to the
impedance transformation, is
about 160 dB! To prevent re-
generative feedback, the JFET's
input must be electrically
shielded from the op-amp's out-
put, as will be discussed later.

Threshold detector
The comparator section
(IC1-b) operates as a pulse-am-
plitude discriminator and de-
tector. Under quiescent con-
tions, the positive input pin 3 is
about 0.5 volt more positive
than the negative pin 2, and the
open collector output is high
(high impedance).

When an ionization pulse oc-
curs, the op-amp output swings
sharply negative from its nor-
amal (half) supply voltage. Then
it rises slowly with a 0.1 second
time constant. If the negative-
going peak has more than a 0.5
volt amplitude, the comparator
switches state for a period deter-
mined by the pulse decay.

The combination of circuit
time constants allows the com-
parator to track the low-fre-
quency amplifier drift yet re-
spond to alpha ionization
pulses which are about five
times greater than threshold.
By adjusting amplifier gain to
match the ionization chamber's
signals, large alpha ionizations
can be detected easily, while
much smaller beta particles,
gamma ray, and noise ioniza-

tions are rejected.
The comparator's output is an open collector which goes low (low impedance) whenever an alpha particle is detected. This output can be interfaced to any logic device, digital counter, or count-rate meter. This will be discussed in detail in Part 2 of this article.

**Low-voltage power supply**

The optimum low-voltage power supply for the amplifier is a 9-volt battery. The BERM draws only a few milliamperes, so a 9-volt alkaline transistor battery is sufficient to provide an effective life in excess of 50 hours—in addition to permitting it to be a portable instrument. However, if you would prefer to power your BERM from the AC line, a schematic for a suitably filtered 120-volt AC to 9-volt DC converter will be in Part 2 of this article.

**Chamber arrangement**

Refer to Fig. 3, a cutaway drawing of the ionization chamber. The amplifier is built by point-to-point wiring methods on a prepunched 1/4-inch square circuit board with solder pads on one side. It can be seen, however, that all amplifier components except JFET Q1 are mounted and soldered on the component side of the board.

The drain and source leads of JFET Q1 are to be soldered onto the solder-pad side of the circuit board so that its plastic TO-92 package can extend into the can that forms the chamber through a hole formed in the bottom of the can. This arrangement effectively shields Q1's sensitive input from the rest of the amplifier circuit. As mentioned earlier, the anode wire is a direct extension of Q1's gate lead, bent 180° away from the other two leads.

**Cathode sleeve**

Refer to Fig. 3. The approximate 500 volts from charged capacitor C1 are applied between the aluminum can chamber, which is grounded, and a cathode made as an aluminum inner sleeve or lining separated from the can's inner wall by sheet plastic insulation. This sleeve-within-a can construction provides the unit with excellent shielding from electrical noise.

With this design, the effective volume of the ionization chamber is considerably reduced, compared to its physical volume, because the electric field includes the end surfaces of the can. These end-surface fields must be accounted for during instrument calibration.

**Chamber assembly**

Obtain three identical clean, undented, 12-ounce aluminum beverage cans. (They are 4.8 inches high.) Cut the top from the tab end of one can to form the ionization chamber with a can opener so that a crimped-on ring remains. Form a ½-inch hole in the center concave bottom of the can.

Then, using the blank 1½-inch square circuit board specified as a template, drill four small pilot holes on the rim at bottom of the closed end of the can, on top of its circular ridge. Later in the assembly procedure, self-tapping machine screws will be used to mount the circuit board on the end of the can as shown in Fig. 3.

Hold the circuit board in position on the end of the can with the solder tabs directed toward the can. Look in the open end of the can through the ½-inch hole and mark the locations of the solder pads that are suitable for Q1's drain and source pins. Plan your parts layout carefully so that one of those pads can be common to the ground or negative power supply pin on op-amp IC1-a.

**Circuit assembly**

Refer to Fig. 2. The selection of the value for drain resistor R1 will depend on the characteristics of the specific J201 JET (Q1) to be used in the circuit. Short the JFET's gate to its source and measure the drain-to-source current (I_DS) with a drain-to-source voltage of about 1.5 volts. Then calculate the drain resistor value based on this current and the voltage of the power source you intend to use.
Drain resistor \( R_1 = (V_S - 1.5)I_{DS} \)
For a J201 FET and a 9-volt battery, \( R_1 \) should have a value between 10 and 33 kilohms.

When constructing the amplifier, use 1-megohm resistors for both parallel resistors \( R_4 \) and \( R_5 \). Form the axial leads of both resistors and solder them so that \( R_5 \) will remain permanently in position while provision is made for the easy removal of \( R_4 \) during the calibration process. By doing this, gain can be adjusted later by shunting 1-megohm resistor \( R_5 \) with another value for resistor \( R_4 \) until an optimum value is found.

Solder a short tinned wire to the output pin 7 of op-amp IC1-\( \alpha \) to act as a test point to permit attaching an alligator clip lead or oscilloscope probe. Place a solder lug under one of the sheet metal screws holding the circuit board in position on the end of the can to act as a convenient circuit common or ground lug.

Other than this restriction on the placement of \( Q_1 \) on the circuit board, the layout of the other components is not critical. Use the convenient pad locations bridged by the components you’ve selected and any necessary jumper wires to complete the wiring of the circuit. Complete the insertion and soldering of all components on the circuit board except for JFET \( Q_1 \).

Insert and solder the source and drain leads of JFET \( Q_1 \) on the solder-pad side of the board. Then carefully bend the gate lead directly away from the other two leads so that it is perpendicular to the solder-pad side of the circuit board.

Solder a length of bare copper wire (28 to 32 AWG) about 4 inches long to the gate lead of \( Q_1 \), and straighten it so that it is perpendicular to the circuit board. Cut the free end of the anode wire to a length that is about \( 3/4 \) inches long. Twist a small loop (about \( 1/8 \) inch in diameter) on the end of the anode wire and solder the joint.

Carefully examine the circuit assembly to be sure that it was made according to the schematic, Fig. 2. Next, connect the chamber can solder lug to the circuit-board ground, connect the output of the comparator, positive supply, and ground connection to a three-conductor cable with plug attached.

Fasten the circuit board to the end of the chamber can with four No. 4 self-tapping sheet metal screws. Use small matching washers between the can rim and circuit board to act as standoffs to prevent the can rim from contacting any of the solder pads that exist on the circuit board.

Cathode assembly
Form the cathode for the ionization chamber by cutting both ends from another of the three cans, and slit the aluminum cylinder longitudinally. Being careful not to deform or flatten it. Trim, square the ends of this aluminum sleeve to a length of about 3.7 inches. File off any sharp edges or burrs that could cut through the thin plastic insulation layer to be applied later.

The aluminum in the can has intrinsic spring qualities, so that if its slit edges are overlapped about \( 1/4 \)-inch they will retain their tendency to spring open. Cut two slots about \( 3/4 \)-inch deep and about \( 1/8 \)-inch apart at right angles to the slit edge of the aluminum cylinder. Those slots form a "digit" for later termination of one end of capacitor \( C_1 \).

Wrap and crimp a short length of tinned lead wire around this digit as shown in Fig. 3 so that when the cathode sleeve is installed in the can, the lead can be soldered to one end of \( C_1 \).

The inner wall and ends of these cans have a plastic coating, but it is not dependable as an insulator between the cathode sleeve and the chamber can. Cut a sheet of polyethylene plastic approximately 2 mils thick sheet so that it will extend about \( 3/4 \)-inch beyond each end of the cathode sleeve and overlap its circumference. This material can be taken from sandwich bags, cleaner’s garment bags, or other sources.

Drill a small hole in the rim of the can and fasten a small solder lug inside with a No. 4-40 machine screw and a nut as shown in Fig. 3. After being sure that all the metal chips and filings have been cleaned from the chamber can, insert the insulating film and press it against the inner wall of the can and then insert the cathode sleeve. After the insulated cathode has been inserted, check to be sure that there is no metal-to-metal contact between the can and sleeve.

Capacitor installation
Carefully select high-voltage capacitor \( C_1 \) to make sure that it is a high-quality, low leakage component. If left fully charged, it should retain at least 37% of its charge for at least a month at room temperature.

Solder capacitor \( C_1 \) to the internal lug with as short a length of lead as possible, as shown in Fig. 3. Position the capacitor in the mouth of the can against the side wall as shown in Fig. 3. Then solder the short wire stub on the cathode to the free end of capacitor \( C_1 \). Clip its lead short and bend it toward the center of the can so that an alligator clip can be attached to it. Finally, check the resistance between the cathode sleeve and chamber can to be sure that it is effectively infinite.

Protective covers
Cut a third can in half and bend the tab of the top end back to its original unopened position. Carefully slip this top can half over the open end of the chamber can. Expect that it will form a tight "press fit." If the fit is too tight for easy removal, cut several longitudinal slits in the can half to permit slight expansion (see Fig. 3).

Drill a hole in the bottom of the other half can large enough to be able to insert a small rubber grommet which will pass the three-conductor cable. This can end will cover the circuit board and shield it from 60-Hz noise.

Continued on page 91
The vacuum-tube radio, once an important source of news and entertainment, has become a museum piece. But it's fun to revisit those old days of radio by restoring an abandoned set.

VINTAGE RADIO
MARTY KNIGHT

IT IS SATURDAY MORNING SO YOU DECIDE TO GO TO THE LOCAL FLEA MARKET TO SEARCH FOR AN ANTIQUE RADIO THAT YOU CAN RECOVER. YOU NEVER KNOW WHAT YOU'LL FIND AT THOSE OUTDOOR MARKETS. EVEN IF YOU DON'T FIND ANYTHING WORTH SAVING, AT LEAST YOU'LL BE WALKING AROUND IN THE SUNSHINE AND MINGLING WITH THE CROWD.

After trudging up and down the seemingly endless rows of tables you suddenly get lucky and chance upon a real gem. Its obsolete wooden cabinet only hints at its age, so you pull back the heavy cardboard cover at the back and peek in to see the shape of its vacuum tubes—the best clue as to its age. Aha, you're satisfied that you have latched onto a real "oldie but goodie."

Sure, the cloth on the line cord is torn and scruffy and the rubber insulation has turned to brittle clay. Maybe a knob is missing, and there are water stains and mold on the cabinet, but otherwise the set looks complete. After some hard bargaining you get the price down to $25—not bad for a piece of electronic history.

Once you get this "jewel in the rough" home, you begin your exploration by removing the heavy cover, knobs, and screws that hold the rusty metal chassis to the cabinet. After sliding out the chassis you say to yourself, "I'm a member of an elite group that gets a kick out of dabbling in electronic archaeology and restoring old radios to life."

Even before you remove the accumulated layers of dust and grime from the chassis, speaking years of neglect in an attic or basement, you examine the tubes. Their shape will give you the most reliable clues about the age of the set. Then as you happily strip away the grime, you carefully note any damaged components that should be replaced along with other components whose replacement is dictated by their age.

If you are lucky, your cleaning efforts might reveal an old paper schematic pasted to the back cover giving the names of the manufacturers of the set and the tubes. An old schematic will simplify your search for replacement parts and permit you to consult one of the many books and catalogs now available that document the history of antique radios.

However, even without a schematic, the shapes of the tubes, the parts layout on the chassis, and even the appearance of the old resistors and fixed and variable capacitors (condensers) should offer abundant clues and hint at manufacturer, circuit design, and the set's place in history—always exciting.

Regulation and set design
Perhaps it's not widely known, but there has long been a close correlation between the design of radio receivers and government broadcasting regulations. This was particularly true of those built during the 1920s. Radio communication was regulated in the United States from 1912 to 1927 by the Radio Act of 1912, administered by the Department of Commerce. This knowledge should come in handy if you chance upon a real "oldie."

The government didn't seem to give much thought to the future growth of radio broadcasting in the 1920s. For example, the Commerce Department licensed Westinghouse's radio station KDKA in Pittsburgh to operate at 500 kHz (in those days called kilocycles or kc). That also happened to be the maritime emergency radio band. Its hard to believe today, but this licensing policy meant that KDKA station engineers had to shut down their transmitter periodically to listen for distress calls from ships at sea!

Before 1922, radio licenses were haphazardly assigned to stations at frequencies between 500 and 1000 kHz without regard to their location or transmitting power. In fact, amateur radio operators had free access to the same frequencies. The cacophony of sound from competing radio stations reduced broadcast reception to audio babble.
TABLE 1

<table>
<thead>
<tr>
<th>1922—FIRST THORIUM FILAMENTS</th>
<th>1923—FIRST MAGNETIC GETTERS (LONG PIN)</th>
<th>1925—FIRST UX BASES (LONG PIN)</th>
<th>1930—FIRST DIGIT (MFS) DROPPED</th>
<th>1932—FIRST ST ENVELOPES</th>
<th>1935—FIRST METAL ENVELOPES</th>
<th>1939—LONKTAL BASES</th>
<th>BUTTON DESIGN</th>
<th>1940—FIRST MINIATURE</th>
<th>1941—NEO-RECTIFIER BASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>UV-200, C-30C; UV-201, C-301</td>
<td>-</td>
<td>-</td>
<td>2A5, 15, 48, 53, 59, 76, 77, 78, 79</td>
<td>2A3, 2A7, 5Z3, 12Z3, 25Z5</td>
<td>2A8, 2B6, 19, 48, 75</td>
<td>1A6, 185, 287, 5A7, 6A7, 6B7, 6C6, 6D6, 6F7</td>
<td>1C6, 12A7</td>
<td>9001, 9002, 9003</td>
<td>-</td>
</tr>
<tr>
<td>UV-216</td>
<td>WD-11, C-11</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>WD-12, C-12, UV-201A, C-301A</td>
<td>UV-190, C-299, WE-215A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>UX-199, UX-201A, C-301A</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>UX-112, UX-120, UX-210, UX-213</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>UX-216B</td>
<td>BH, KELLOGG 401</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>240, 340</td>
<td>-</td>
<td>-</td>
<td>30, 31, 32</td>
<td>36, 37, 35/51</td>
<td>33, 38, 47</td>
<td>34, 39, 46, 82, BR</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>171A, 222, 226, 227, 280</td>
<td>250, 350</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1920</td>
<td>'21</td>
<td>'22</td>
<td>'23</td>
<td>'24</td>
<td>'25</td>
<td>'26</td>
<td>'27</td>
<td>'28</td>
<td>'29</td>
</tr>
<tr>
<td>Vacuum Tube Development, 1921—1941</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Early in 1922 a policy was introduced that licensed all broadcast radio stations to operate on 833 kHz. Even with reduced transmitting power, interference made listening impossible. Meanwhile, radio set ownership had increased from about 50,000 in 1921 to about 100,000 in 1922. Imagine the complaints government officials received about poor radio reception!

The first National Radio Conference sponsored by the Secretary of Commerce in the winter of 1922 resulted in the assignment of specific frequencies for both high- and low-power stations. At that time, high-power stations (from 500 to 1000 watts) were assigned to 750 kHz, and low-power stations (below 500 watts) remained on 833 kHz.

It didn’t take long before that solution also proved to be inadequate. Because of their broadband reception characteristics, radios made at that time couldn’t discriminate between the two frequencies. In effect, the selectivity of early radios was zero. About 1.5 million radios were made in 1924, and the market grew to 4.4 million radios per year five years later.

Although it was still difficult to tune to a program without interference, radio ownership grew to 5 million receivers by 1926. This was eight years before the Federal Communications Commission (FCC) was formed: some call this act the true birth of modern radio broadcasting.

March of technology

The first radio broadcasts could be heard with simple crystal diode detector receivers—if you were close enough to the transmitter. They could either be purchased or built by listeners as they are today. Crystal radio receivers were unstable and finicky, and they lacked a way to amplify the audio. These drawbacks essentially restricted their use to a single listener wearing headphones.

The invention of the vacuum-tube diode detector as a replacement for the crystal detector did little to improve radio reception. Developed by British scientist J.A. Fleming, it had a filament and plate but, like the crystal diode, it was unable to amplify. However, when American inventor Lee DeForest developed a tube with a third electrode called the control grid, the modern receiving tube arrived. Other innovations developed during that period included the tuned circuit and the grid-leak detector.

However, radio reception took another giant leap forward with the invention of the regenerative receiver by Edwin Armstrong in 1915. It included the triode, a tuned circuit, and grid bias. Positive feedback offered improved sensitivity, se-
lectivity, and audio output power. However, its drawback was its dual-battery requirement—one to heat the filament and another for grid bias and plate voltages.

If you bought a radio in the early 1920s, you also had to buy several batteries, typically a dry LeClanche lantern battery and a lead-acid automotive battery. Needless to say, they called for a strong shelf under the radio table and posed the ever-present threat of spilled acid.

In the regenerative receiver, a small amount of amplified RF signal was fed back to the grid circuit of the triode, putting it on the verge of oscillation. This circuit design maximized signal gain and improved sensitivity, but the degree of feedback was difficult to control.

Slight changes in the ambient temperature, signal strength, battery voltage, or mechanical vibrations, for example, could cause the receiver to break into oscillation. (This was not surprising in view of the fact that an Armstrong regenerative receiver is essentially the same as an Armstrong oscillator.) If this occurred, the receiver was immediately transformed into a transmitter on the same frequency as the tuned signal. Imagine the howls that emitted from all the receivers in the neighborhood when one of them broke into oscillation!

Another frequently overlooked fact is that the regenerative receivers of the 1920s could continuously tune the maritime, limited broadcast and amateur bands that were located between 500 and 1500 kHz, all within the limits of today’s 540 to 1600 kHz AM broadcast band.

Regenerative receiver popularity declined in 1923 with the introduction of the tuned-radio-frequency (TRF) radio. Better vacuum tubes, improved manufacturing techniques, and experience gained from solving earlier reception problems led to the TRF receiver.

Little more than a tuned RF amplification stage and a non-regenerative detector, these receivers eventually evolved into standard five-tube receivers that included two tuned RF stages, one detector, and two audio amplification stages. By 1926 the TRF receiver dominated the market and broadcast

FIG. 1—THE CHANGES IN TUBE PROFILES WILL PROVIDE IMPORTANT CLUES about the age of the vintage radio you intend to restore.
stations were being licensed to operate over increments of 10 kHz. Radio was at last out of the dark ages!

But even the TRF receiver was not without its problems: strong signals were likely to cause the tuned triode RF stages to break into oscillation. The Neutrodyne receiver attempted to solve those TRF problems. It relied on a small amount of negative feedback to stabilize the tuned RF circuitry so the triodes did not oscillate.

After that development, second-generation TRF receivers took advantage of the screen-grid vacuum tube introduced in 1927. As a result, self-oscillation was eliminated and the door was opened for the first true "one-knob dialing" radios.

The TRF radio held the dominant share of the radio receiver market until 1932 when the Radio Corporation of America (RCA), under threat of antitrust suits, released its superheterodyne circuit for licensing by other manufacturers. After that landmark decision, the five-tube superheterodyne receiver became the most popular consumer radio.

**Receiving tubes**

Each major advance in home radio receivers was supported by improvements in vacuum tube design and reliability. The age of any radio you might find in an attic or flea market can usually be determined by observing the shape of the tube's glass or metal envelope. Figure 1 illustrates the evolution of radio receiving tubes by date of manufacture based on the changes in their outlines.

The first vacuum tubes had bulbous glass envelopes and tubes with bulb or bottle shapes were being made for many years after that, particularly rectifier tubes. However, early in the 1920s some receiving tubes had glass envelopes whose diameters barely exceeded the diameters of their bases. Tube bases and sockets were standardized by the 1920s, but developments in base style were still taking place as late as 1939.

The first receiving tubes with metal envelopes were introduced in 1935. However, miniature glass "peanut tubes" with glass button bases (stems) and wire pins were introduced in the 1940s. Most postwar receivers had complements of these miniature tubes, but the larger tubes were in hi-fi equipment well into the 1950s, particularly for output stages.

Three distinct periods of vacuum-tube evolution are recognized. The first included tubes developed and manufactured during the period extending from World War I to 1922. Crudely made and not particularly reliable, there were likely to be performance differences between individual tubes because of slight differences in construction. The early tubes had tungsten filaments that lit up like weak pilot lamps when filament voltage was applied. Those early filaments served both as heaters and cathodes. These filament/cathode tubes are lumped into the first of three groups.

Because so few radios were made during this early period, vintage radio buffs consider them to be the true antiques worthy of preservation. If you locate one of them, you have a true find. However, because their components are fragile and replacement parts (other than those custom made by skilled artisans) are no longer available, those antiques are essentially unrepairable.

The introduction of the thoriated filament marks the start of the second period. The filaments of these tubes were coated with thorium-based chemicals capable of emitting clouds of electrons when the filament was heated to a dull, cherry-red color. However, this electron cloud was reasonably uniform within a wide range of applied filament voltage that assured generally stable circuit operation.

The third and final stage in the development of vacuum tubes began in 1927 when RCA introduced its new generation of tubes designed for AC-line operation. These tubes had separate cathodes that were heated by a separate filament. The cathode was a more efficient electron source than the coated filament. This design concept lives on in all modern cathode ray tubes.

Another interesting development was the loctal-base tube, a spinoff from the standard octal base design. It was intended for use in automotive radios and the bulky portable receivers available in the pre-World War II years. The center stem of the base locked into a mating socket hole with a spring that prevented the tube from being shaken loose by shock and vibration. This innovation quickly spread to the newer tube designs.

Nevertheless, some radio historians recognize a fourth development period that extends from World War II to the start of the transistor era in the 1960s and includes a wide range of innovations such as tube miniaturization and the introduction of improved materials. Table 1 identifies the tube types developed between 1920 and 1942.

Commercial television inspired many new tubes. For example, the Compactron—effectively several discrete tubes in a single envelope—was introduced for TV sets. However the introduction of the transistor in 1947 cut the legs out from under further receiving tube development.

*Continued on page 76*
Plug a Friend into

Electronics Now

and Save $24.03*

This Christmas give an electrifying gift ... plug a friend into Electronics Now and brighten the whole new year! Whether electronics is your friend's livelihood or hobby, your gift will illuminate the whole spectrum of electronics throughout the coming year and provide a monthly reminder of your friendship.

Electronics Now will keep your friend informed and up-to-date with new ideas and innovations in all areas of electronics technology ... computers, video, radio, stereo, solid state devices, satellite TV, industrial and medical electronics, communications, robotics, and much, much more.

We'll provide great plans and printed circuit patterns for great electronic projects. In just the last year, Electronics Now has presented amateur TV equipment, computer peripherals, stereo transmitters, test equipment, speakerphones, robots, audio amplifiers, power inverters and much more.

PLUS ... equipment troubleshooting techniques ... circuit design ... reports on new technology and products ... equipment test reports ... in-depth coverage on computers, video, audio, shortwave radio ... and lots more exciting features and articles.

SAVE $24.03* ... CR EVEN $48.06* ... For each gift of Electronics Now you give this Christmas, you save a full $24.03* off the newsstand price. And as a gift donor, you're entitled to start or extend your own subscription at the same Special Holiday Gift Rate—you save an additional $24.03*!

No need to send 'money' ... if you prefer, we'll hold the bill till January, 1994. But you must rush the attached Gift Certificate to us to allow time to process your order and send a handsome gift announcement card, signed with your name, in time for Christmas.

So do it now ... take just a moment to fill in the names of a friend or two and mail the Gift Certificate to us in its attached, postage-paid reply envelope. That's all it takes to plug your friends into a whole year of exciting projects and new ideas in Electronics Now!

*Based sub rate — 1 yr/$19.97 2 yrs/$38.97
Learn the basics of waveform generation and shaping with bipolar transistor circuits that you can build and put to work.

RAY MARSTON

The subject of this article is waveform generation and shaping as performed by various kinds of multivibrator circuits and special-purpose oscillators. It is a continuation of last month's article on transistorized RC and LC oscillator circuits, and the astable multivibrator. Previous articles in this series have covered the basics of the bipolar junction transistor (BJT) and have presented a general roundup of popular BJT circuits starting with those basic transistor amplifiers: common-collector, common-emitter and common-base.

Multivibrator basics

A transistor multivibrator is a cross-coupled, two-stage switching circuit. Each active transistor stage is regeneratively cross-coupled to its companion; thus, one stage automatically turns on as the other turns off, and conversely. This cross-coupling can be arranged to give either stable or semistable switching. When stable cross-coupling is desired, the transistor switch locks permanently into the on or off state until it is forced to change state by an external signal.

When the circuit is cross-coupled in a semistable manner, the transistor initially locks into the on or off state, but then automatically becomes "unlocked" again after a delay period determined by the time constant of the cross-coupling components.

Schematics of the four basic transistor multivibrator circuits most commonly used are shown in Figs. 1 to 4. The Fig. 1 circuit is a manually triggered bistable (two stable state) multivibrator. The base-bias of each transistor is obtained from the collector of the other transistor, so that one transistor automatically turns off when the other turns on, and conversely.

The output can be driven low by briefly turning Q1 off with S1: the circuit locks into this state until Q2 is turned off by S2. At that time the output locks into the high state, and this action can be repeated as long as the circuit is powered.

Figure 2 shows a monostable (one stable state) multivibrator or one-shot pulse generator circuit. Its output is normally low, but switches high for a preset period (determined by the values of C1 and R2) if Q2 is briefly turned off with S1.

Figure 3 shows an astable (no stable states) multivibrator or free-running square-wave generator. The on and off periods of the square wave are determined by the values of R3 and C1 and R2 and C2.

Figure 4 shows a Schmitt trigger or sine-to-square waveform converter. Transistor Q2 switches abruptly from the on state to the off state, or conversely, as the base of transistor Q1 base rises above or falls below the predetermined trigger-voltage levels.

Several different practical astable multivibrator circuits were discussed in last month's article. This article will examine practical versions of three other multivibrators.

Monostable circuits

The monostable multivibrator circuit in Fig. 2 acts as a triggered pulse generator. Normally transistor Q2 is driven into saturation through R2, so the output (taken from transistor Q2's collector) is low. Transistor Q1, which derives its base-bias from transistor Q2's collector through resistor R4, is cut off under this condition, and its collector is at the full supply voltage.

When a start signal is applied to Q2 by momentarily closing switch S1, Q2 switches off, driving the output high and driving Q1 on through R4. Regenerative switching action is caused by the reopening of S1.
Transistor Q2's base is driven negative by the charge on C1, and as soon as the regenerative response is complete, C1 starts to discharge through R2. Eventually its charge falls so low that Q2 turns on again, thus initiating another regenerative response. Now both transistors revert to their original states, and the output pulse terminates, completing the action of the circuit.

Thus, a positive-going pulse is developed at the output of this circuit each time an input trigger signal is applied by momentarily closing switch S1. The pulse period is determined by the values of R2 and C1. The relationship is:

\[ \text{Pulse period} = 0.7 \times R2 \times C1 \]

Where the pulse period is in microseconds, C is in microfarads, and R is in kilohms.

The circuit in Fig. 2 can be triggered either manually by closing a momentary switch or by introducing an input trigger signal. That trigger signal can be either a negative pulse applied to the base of Q2, or a positive pulse applied to the base of Q1.

Figure 5-a is a practical schematic for a manually triggered monostable multivibrator. It can be triggered with momentary switch S1 by feeding a positive pulse to Q1's base through R2. Figure 5-b shows the circuit's waveforms.

In Fig. 5, the base-emitter junction of Q2 is reverse-biased during the operating cycle by a peak voltage equal to the supply voltage. This means that the maximum supply voltage should be limited to about 9 volts to prevent damage to the transistor. However, a supply voltage greater than the reverse base-emitter breakdown value of Q2 can be applied safely if silicon diode D1 is placed in series with Q2's base, as shown in Fig. 5.

This higher supply voltage provides the same kind of frequency correction that was described for the astable multivibrator in last month's article.

The value of timing resistor R3 in the Fig. 5 circuit must be large with respect to R1, but must be less than the product of R5 and the \( h_{fe} \) of Q1. The pulse period for Fig. 5 equals 50 milli-seconds divided by the value of capacitor C1 in microfarads; it will be 5 seconds with the value of C1 shown.

**Long delays**

If a Darlington transistor pair is substituted in place of Q2 in Fig. 5, the circuit will be able to provide very long timing periods. That substitution results in a very high effective \( h_{fe} \), and permits the use of large values of R3, as shown in Fig. 6.

The Fig. 6 circuit can be powered from any DC source with an output between +6 and +15 volts to give a pulse output period of about 100 seconds with the values of the resistors and capacitors shown.

Keep in mind that a manually triggered monostable circuit such as those of Figs. 5 and 6 is dependent on the duration of the input trigger signal. The circuits trigger at the moment that a positive-going pulse is applied to the base of Q1 in Fig. 5 or Q3 in Fig. 6. If this pulse is removed before the monostable multivibrator completes its normal timing period, the period will end regeneratively, as previously described.

However, if the trigger signal has not been removed by the time the monostable completes its natural timing period, the timing cycle will end non-regeneratively. This means that the output pulse will have a longer period and falltime than if the trigger signal were removed earlier.

**Waveform triggering**

Figures 7 and 8 show alternative ways of applying input signal triggering to the monostable pulse generator. In each case, the circuit is triggered by a square-wave input signal with a short rise time. This waveform is differentiated by the differentiation circuit consisting of C1 and R1 to produce a brief trigger pulse.

In the Fig. 7 circuit, the differentiated input signal is rectified by diode D1 to provide a positive trigger pulse on the
This period can be conditioned with the values of capacitor Q2. Trigger signal change gate is shown in Fig. 11-A. The circuit makes the trigger signal indifferent to the low state by a momentary closing switch S2. (Alternatively a negative pulse can be applied to the base of Q2.)

The circuit then "remembers" this state until it is reset to the low state by a momentary closing of S1 (or by applying a negative pulse to the base of Q1). The circuit needs a sinewave input signal, the circuit will generate a squarewave output signal at half the input frequency.

The circuit generates a pair of output signals that are 180° out of phase. Shown here as Q1 and Q2. The introduction of CMOS IC versions of the bistable counter circuit have largely eliminated any need for the construction of these circuits from discrete components.

**Schmitt trigger**

The last member of the multivibrator family to be discussed here is the Schmitt trigger circuit. It is a voltage-sensitive switching circuit that changes its output state when the input signal exceeds or falls below preset upper and lower threshold levels. Figure 11 shows how the Schmitt trigger converts sinewaves to square waves.

The Schmitt trigger circuit is emitter-coupled and has cross-coupling between the base and collector of transistor Q1, which provides the required regenerative switching. Capacitor C2 speeds up the switching action by shunting R4. The sinewave input signal is superimposed on a DC voltage. The voltage is determined by trimmer potentiometer R8 and resistors R1 and R2) that is applied to the base of Q1.

A practical Schmitt trigger needs a sinewave input signal with an amplitude of at least 0.5V. The circuits in Figs. 7 and 8 can be triggered by sine or other non-rectangular waves if they are conditioned by a Schmitt trigger or similar sinewave-to-squarewave converter circuit. (The Schmitt trigger circuit is discussed later in this article.)

**Bistable circuits**

Figure 9 is practical schematic for the manually-triggered bistable multivibrator shown in Fig. 1 and described earlier. This circuit is also known as a R-S (reset-set) flip-flop and, like a toggle switch, it is also an elementary digital memory. Its output can be set to the high state by momentarily closing switch S2. (Alternatively a negative pulse can be applied to the base of Q2.)

The circuit then "remembers" this state until it is reset to the low state by a momentary closing of S1 (or by applying a negative pulse to the base of Q1). The circuit then "remembers" this new state until it is again set by S2. This cycle can be continued indefinitely as long as power is applied.

The circuit in Fig. 9 can be modified to provide a divide-by-two or counting function by including two steering diodes (diodes D1 and D2) and associated components, as shown in Fig. 10.

The Fig. 10 circuit changes state each time a negative-going trigger pulse is applied. If, for example, the input pulses are derived from a squarewave input signal, the circuit will generate a squarewave output signal at half the input frequency.
Sawtooth generators

The astable multivibrator shown in Fig. 3 is one of a variety of circuits that can generate sawtooth waveforms. For example, it can generate negative-going sawtooth waves at the bases of both transistors Q1 and Q2. As a result, the astable multivibrator can be considered as another free-running sawtooth generator.

Similarly, the monostable multivibrators shown in Figs. 5 to 8 each generate a negative-going sawtooth on the base of Q2 during its active phases. They can be considered as triggered sawtooth generators.

Practical versions of Figs. 5 to 8 generate slightly nonlinear sawtooth waveforms because each of their timing capacitors charge exponentially (rather than linearly) through their timing resistors. This aberration can be easily overcome by replacing each timing resistor with a constant-current generator capable of generating linear waveforms.

A timing circuit based on the 555-type integrated circuit timer offers the best way to generate positive-going triggered sawtooth waveforms. However, if you want to generate free-running, positive-going sawtooth waveforms, this can be done with a unijunction transistor or UJT, connected in the circuit shown in Fig. 12.

The UJT is a three-terminal transistor whose terminals are identified as emitter (E), base 1 (B1), and base 2 (B2). A UJT is connected as shown in Fig. 12 as Q1 with its B2 positive with respect to B1, and with the input applied to its emitter terminal.

The emitter of the UJT Q1 presents a very high impedance until the input (emitter) voltage reaches a specific firing voltage. At that time, UJT Q1 switches abruptly to the on state. When it is on, the emitter presents a low input impedance, and it draws a significant amount of current from the input circuitry. However, if this input current falls below a certain threshold value, UJT Q1 automatically switches back to its high input impedance state.

In Fig. 12, capacitor C1 charges exponentially towards the positive supply voltage through trimmer potentiometer R4 and R1 until the voltage on C1 reaches the firing value of the UJT Q1. At that time, Q1 switches on and rapidly discharges C1. As soon as C1 is discharged, Q1 turns off again, so C1 starts to recharge again through R4 and R1.

This circuit generates a stable but nonlinear sawtooth waveform that can be varied from 25 Hz to 3 kHz by R4, with the value of capacitor C1 shown. Transistor Q2 and Q3 are connected as a Darlington emitter-follower
buffer stage. This arrangement makes a low-impedance sawtooth waveform available at an output terminal taken from the wiper of output level potentiometer R5.

The linear sawtooth generating circuit in Fig. 12 can be modified to become an oscilloscope timebase generator. The modified circuit is shown in Fig. 13. Capacitor C1 is charged by a constant-current source. In this circuit, Q1 functions as a temperature-compensated, constant-current generator. Its current can be varied from 35 to 390 microamperes by adjusting frequency trimmer potentiometer R6.

The linear sawtooth is available as a variable output whose amplitude can be varied by setting level potentiometer R7. The output between R7 and ground can be fed via a coaxial cable to the external timebase jack of an oscilloscope.

Positive "flyback" pulses taken between resistor R5 and B1 of UJT Q2 at the beam-blanking output can be used to blank the oscilloscope beam if taken through a high-voltage blocking capacitor.

The operating frequency of the Fig. 13 circuit can be varied from 60 to 700 Hz with R6 if all of the component values are as shown. Other frequency ranges can be obtained by substituting other values for capacitor C1. The timebase generator can be synchronised to an external signal by feeding the external signal to UJT Q2 through the synch input capacitor C2.

This external signal, which must have a peak amplitude between 200 millivolts and 1.0 volt, effectively modulates the supply voltage (and thus the trigger point) of UJT Q2. It causes UJT Q2 to fire in synchronism with the external trigger signal.

Capacitor C2 must have a lower impedance than resistor R4 at the sync signal frequency. Also, capacitor C2 must have a working voltage that is greater than the external voltage from which the external signal is applied. If the sync signal has a rectangular form with short rise and fall times, the value of C2 need only be a few hundred picofarads.

**White-noise generator**

"White noise" is another useful waveform. It is a signal that contains a full spectrum of randomly generated frequencies, each having equal mean power when averaged over a unit of time. White noise is useful for testing audio and radio frequency amplifiers, and it is widely used to mask background noise to serve as a sleeping aid.

Fig. 14 is the schematic for a simple, practical white-noise generator. In operates on the principle that all reverse-biased Zener diodes inherently generate white noise. In Fig. 14, R2 and D1 are connected in a negative-feedback loop between the collector and base of common-emitter amplifier Q1. Negative feedback stabilizes the DC working levels of the generator. Capacitor C1 serves to decouple alternating current from the circuit.

The Zener diode acts as a
**Crystal oscillators**

Crystal oscillator circuits generate accurate, stable frequencies because they include precisely cut piezoelectric quartz crystals which function as high precision electromechanical resonators or tuned circuits. The crystals in these circuits typically have Qs of about 100,000, and they can provide as much as 1000 times greater frequency stability than can conventional inductive-capacitive (LC) tank-circuit oscillators.

A piezoelectric crystal's operating frequency of a few kHz to 100 MHz is determined by its mechanical dimensions. The crystal, can be cut to provide either series or parallel resonant operation. Series-mode crystals present a low impedance at resonance, while parallel-mode crystals present a high impedance at resonance.

Figure 15 is a practical schematic for a crystal oscillator that is designed for a parallel-mode crystal. The circuit is actually a Pierce oscillator, and it will oscillate with most 100-kHz to 5-MHz parallel-mode crystals without any circuit modification.

Figure 16 shows an alternative 100-kHz oscillator that was designed for a series-mode crystal. It is known as a Colpitts oscillator.

Its tank circuit, consisting of L1, C1, and C2, is designed to resonate at the same frequency as the crystal. However, the tank circuit component values must be changed if any other crystal frequencies are desired.

Figure 17 is the schematic for a useful two-transistor oscillator that will work with most 50 kHz to 10 MHz series-resonant crystals. In this circuit, Q1 is connected as a common base amplifier, and Q2 is an emitter follower. The output signal (from Q2’s emitter) is fed back to the input (Q1’s emitter) through C2 and the series-resonant crystal. This is a versatile oscillator circuit that will work even with a low-cost, marginal crystal. Because of that, the circuit can form the heart of a simple crystal tester.
Panel controls
As the concept of the radio receiver changed from that of a laboratory curiosity to household furnishing, the packaging of radios underwent dramatic changes. For example, tuning dials in the mid-1920s were round, fluted knobs two to four inches in diameter. Typically, they were molded from black bakelite with contrasting recessed white scale markings from 0 to 100.

Dial calibration in units of 10 to 100 remained common as late as 1928. Toward the end of that decade, tuning dials that indicated tuning frequency were placed inside the cabinet and appeared in a small semicircular window. Numbers printed on a translucent drum were backlit by a small incandescent lamp, and an embossed escutcheon plate formed the pointer. Later innovations, such as full-vision dials and the rotating pointer with fixed half-circle etched faceplate, were introduced between 1930 and 1932.

The excitement and glamour of airplanes had a major impact on the design of radio controls, particularly after Lindberg's successful solo flight to Paris in 1927. The aircraft-style round dial, mimicking an altimeter or tachometer, became quite popular. Those dials had a pointer that moved over nearly 360°. Demand for larger diameter dials grew from 1933 to 1941. The popular slide-rule dial first appeared in 1938; it has retained its popularity in transistorized radios because its pointer tracks across a long, easy-to-read faceplate.

Cabinet styles
Cabinet form is probably the most distinctive characteristic for determining the age of a radio. Unfortunately it's not practical to provide a simple identification diagram because of the many variations in style. The earliest radios were either an assembly of parts on a board or they were enclosed in boxes like laboratory instruments. Any exposed circuit became an excellent dust collector, making it almost impossible to clean without displacing or damaging some coil or capacitor.

In the early 1920s a radio receiver sold for about $40. Add to that the price of the horn-type loudspeaker, a table, batteries, and an antenna system, and the final price of the radio "system" could exceed $100.

Consumer product designers soon recognized that style would sell radios. Many cabinets were oversized furniture and could easily have held as many as four radio chassis. That brings up an important point—when you get interested in vintage radios, consider where you will keep your collection before you add to it.

Most radios made in the 1940s had socketed tubes in metal chassis and were powered by the AC line. By that time effective and reliable rectifier tubes had been developed. The postwar years saw the growing popularity of radios with molded plastic cabinets in a variety of colors as well as simulated wood. Many of these radios incorporated the rounded streamlined shapes that characterized the ongoing "art-deco" style.

Getting started
The flea market is where you will probably get the best bargain—but don't forget the "buyer beware" warning. You might also try antique shops, but expect to pay more for an old radio in any established store that must pay its clerks a salary and pay overhead out of sales.

You might also search the classified pages of your local newspaper for announcements of auctions or estate sales. Also, keep your eyes open for announcements posted on trees or phone poles for garage sales or in shop windows for church benefit sales. Charity thrift stores are other possible sources.

Who knows, the exploration of your older relatives' attics might pay off. And don't forget neighborhood trash barrels on collection days. They might contain some forgotten treasures. (Naturally you'll be out walking your dog.) Your primary objective, of course, is to get a vintage radio in reasonably good condition.

If you are also a camera enthusiast, photograph your "new" old radio before, during, and after its restoration. Browsing a pictorial record of your work will give you a lot of pleasure over the years.

Be sure to record as much information as you can about the set. Look for nameplates, logos and trade names. Copy out patent numbers and their dates if you can find any. Tube location charts were often pasted on surfaces inside the cabinet. Attempt to learn as much as possible about the receiver. Marc Ellis' Antique Radio column in Popular Electronics is a valuable source, and there are many good books on the subject available.

Examine the catalog files in your local library. You'll be surprised about what you can find out about old radios on the shelves your local libraries. Look for advertisements of books on antique radio in this and other publications, and take advantage of fax and 800 phone numbers to obtain catalogs. You can also obtain a free copy of Antique Radio Classified by requesting one from A.R.C., P.O. Box 802-L11, Carlisle, MA 01741. It is a valuable resource in this field.

Restoring your set
It's important that you re-Continued on page 86
1993 ANNUAL INDEX
Volume 64

1993 Annual Index Electronics Now Volume 64

Abbreviations: (ARE)Ask R·E; (AUD)Audio Update, (C)Construction; (CC)Computer Connections; (D)Department; (DB)Drawing Board; (ED)Editorial; (ER)Equipment Reports; (HH)Hardware Hacker; (LET)Letters (OA)Q&A; (VN)Video News; (WN)What's News

3-D Print Software, Stereo (ER) Feb 22
50-ohm Termination (OA)Aug 92
(LET)Aug 14,Nov 16
100-Watt Dummy Load (Robertson)(C) Nov 61
386 Stack Overflow (QA) Jan 8
1992 Annual Index Jan 65
1992 IC Master CD-ROM Plus (ER) Jan 16

Acoustic Field Generator II (Tempin)(C) Apr 37
Active Filters (Marston) Aug 69
Aerobic Exercise Software (Lancaster)(HH) Oct 71
10 AFGIL. Build the the AFGIL (Tempin)(C) Apr 37
Air Hop Light Beam Communicator (Kreuter)(C) Jan 60
Airline Phones (QA) Nov 8
Alarm, Combustible Gas (Williams)(C) Jul 39
Allegro New Media TurboBooks (Hoittman)(HH) Jun 88
Alternators As Steppers (Lancaster)(HH) Nov 73

AMATEUR RADIO
Autopatch Selector for Radio Amateurs (Lovellock)(C) Nov 64
World Band Radio Receiver (Przychynch)(C) Jan 31
Amplifiers, Common Collector (Marsion) Oct 57
Analog Multiplier ICS (Carr) Jul 65

ANTENNA
100-Watt Dummy Load (Robertson)(C) Nov 61
Build A Diversity Antenna and Improve the Performance of Any Car Stereo (Nevess and Lewis)(C) Nov 31
The J-Pole (Sala)(C) Feb 71
April 8: Electronics Technicians Day (Stecker)(C) Apr 82
Artisoft's Lastnicast (Hoittman)(HH) Feb 67
Asian Electronic Sources (Lancaster)(HH) Jan 69

AUDIO
Answerman, More From The (Klein)(AUD) Apr 88
the: Part 1 (Klein)(AUD) Mar 85
Build the AFGIL (Tempin)(C) Apr 37
Audio Expander (Hausman)(C) Mar 71
Diversity Antenna and Improve the Performance of Any Car Stereo (Nevess and Lewis)(C) Nov 31
How Do They Get So Much Bass Out of Such Little Boxes? (Blackwell) May 67
Level Controller (Szabo)(C) Feb 41
Music (OA) Oct 12
Musician's Friend (Eady)(C) Jun 47
Scrambling System (Sheets and Graf)(C) Dec 37
ThumbDrum (Simorton and Clark)(C) Jun 35,Jul 55
Wireless Camera Microphone (Yost)(C) Feb 31
Guitar Transmitter (Bhala)(C) Jun 40

AUDIO UPDATE (D)Klein
Jan 30,Feb 8,Mar 8, May 13
Apr 8,May 8,Jun 22
Jul 8, Aug 26, Sep 16
Oct 11,Nov 8,Dec 8

Audio Answerman, The: Part 1 Mar 85
Buying A Speaker System Aug 26
Part 2 Sep 16
Cable Conflicts Dec 80
CD Decade, The Nov 84
Excellent Reference Book, An May 84
 Loudspeaker Power Ratings

Part 1 Jun 82
Part 2 Jul 88
More From The Audio Answerman Apr 88
Multi-Channel Made Easy Feb 88
Poor King's Indoor Antenna, A. Jan 90
What's Happening? Oct 81

Aurora Monitor (Petrunellez)(C) Sep 66
Autocoupler-Phone-Line (Hagans and Magrill)(C) Jun 83
Automatic Four-Line Telephone Selector (Zugriss)(C) Aug 48
Automatic Power Controller (Nov 92) (LET)Apr 14

Build A Diversity Antenna and Improve the Performance of Any Car Stereo (Nevess and Lewis)(C) Nov 31
Build The Smartstare (Tuthill)(C) Apr 45
Remote Car Starter (Fournier)(C) Jul 31,Mar 66
Smart Signum (Sweeney)(C) Sep 66

Autopatch Selector for Radio Amateurs (Lovellock)(C) Nov 64
AVCOM PSA-37D Spectrum Analyzer and PRT·25A Portable Test Receiver (E's) Jul 22
Avoiding Energy Scams (Lancaster)(HH) Jun 73

B
BASIC Stamp Controller (Lancaster)(HH) Aug 74
B + K-Precision Model 1666 DC Power Supply (ER) Mar 18
Bipolar Transistors (Marston) Sep 57,(LET)Nov 14
Bit Meter in Every Basement, A (Hoittman)(C) Jul 91
Boot Your PC Remotely (Black) Jan 55,Feb 65
Broadcast Trade Journals (Lancaster)(C) Feb 75
BUILD A & THE THRS (SEE CONSTRUCTION) Jul 22
Bulb Driver (QA) Aug 48
Buying A Speaker System (Klein)(AUD) Aug 26
Speaker System: Part 2 (Klein)(AUD) Sep 16

C
Cable Conflicts (Klein)(AUD) Dec 80
Cable Ready or Not (QA) Sep 88
Capacitors (Marston) Mar 57
Car Starter, Remote (Fournier)(C) Apr 71,(LET)Aug 16
CD Decade, The (Klein)(AUD) Nov 84
Christmas Ornaments, High-Tech (Hollman)(C) Dec 33
Combustible Gas Alarm (Williams)(C) Jul 39,(LET)Nov 14
Common Collector Amplifiers (Marston) Oct 57
Communications Trade Journals (Lancaster)(HH) Jun 73
COMPUTER CONNECTIONS (D)Hollman) Jan 87
Feb 87,Mar 90
Apr 66,May 67,Jun 88
Jul 89,Aug 90, Sep 91
Oct 84,Dec 84

Bit Meter in Every Basement, A Jul 91
Confluence of Technologies, A Jun 88
Desktop Video Jan 87
Emerging Electronics, The Mar 90
Eyes and Ears of the World, The Oct 84
Holy Grail of the Computer Industry, The Dec 84
Microsoft and Intel Take On the World Apr 96
New and Interesting Products Sep 91
Operating System Wars Aug 80
PC is the Computer Industry, The May 87

Video Computing Feb 87
Computer Language (QA) Jun 12
COMPUTERS (SEE ALSO COMPUTER CONNECTIONS)
Boor Your PC Remotely (Black)(C) Jan 55,Feb 65
Interactive Image Technologies Electronics Workbench (ER) Dec 18
Micro Scopec 75.0 Diagnostic Software (ER) Oct 16
PC-Based Test Equipment (Byers) Oct 39
Post Code Reader For Your PC (Moore)(C) Aug 31
S02 Print Software (ER) Feb 22
Static ROM (Easy)(C) Dec 66
The Enemy -fighter (Jackson)(C) Jul 31,Aug 93
Ultrasonic Radar (Jackson)(C) Sep 31
Unlocking the Secret Software Jan 55,Feb 65
Weather Station (Jackson)(C) Oct 31,Nov 40

Confluence of Technologies, A (Hoittman)(C) Jun 75
CONSTRUCTION
100-Watt Dummy Load (Robertson) Nov 61
Audio Level Controller (Szabo) Feb 41
Scrambling System (Sheets and Graf) Dec 37
Aurora Monitor (Petrunellez) Sep 66
Automatic Four-Line Telephone Selector (Zugriss) Aug 48
Autopatch Selector for Radio Amateurs (Lovellock) Nov 64
Build The 250-Volt Benchtop Power Supply (Cuthbert) Feb 45
Audio Expander (Hausman) Mar 71
Single Chip DVM (Caristi) Apr 59
Ultrasound Cleaner (Melz) Mar 33
Combustible Gas Alarm (Williams) Jul 39,(LET)Nov 14
Digital Video Change (Williams) Jan 39
DMM Decoder (Hampshire) Nov 53
High-tech Xmas Ornaments (Holman)(C) Dec 33
J-Pole Antenna, The (Sala) Feb 71
Light Beam Communicator (Kreuter) Jan 90
Micro TV Transmitter (McKinney and Brace) Dec 29
Muscations Friend (Eady) Jun 47
Part-68 Interface (Hagans and Magrill) May 56
PC-Based Universal Remote Control (Bek) Jun 68
Phone Pager, The (Carter) May 45
-Link Autocoupler (Hagans and Magrill) Jun 63
Wireless Phone System (Sala)(C) Aug 58
Post Code Reader For Your PC (Moore) Aug 31
Precision Digital Scale (Caristi) Jul 43
Printer-Minder (Cook) Jul 81

Remote Control
Car Starter (Fournier) Apr 71,(LET)Aug 14
Control Power Switch (Lasco) Jul 33
Control Tester (Plavcan) Mar 83
Smart Turn Signal (Sweeney) Sep 63
Static ROM (Fournier) Dec 66
Talking Telephone Ringer (Lambert) May 41
The Experimentor (Jackson) Jul 31,Aug 64
The Spectrum Analyzer (Vesaca) Sep 46
Thiunx Drum (Schnivon and Clark) Jun 35,Jul 55
Time Delay Relay (Melton) Mar 69
Triple-Output DC Power Supply (Kedel) Oct 48

January 1994 Electronics Now
A Mini computer? Do they make Mickey, Donald, and Goofy computers too?

This one must be really difficult. You've been working on it for five years!

Shouldn't we plug these holes up so all the electricity doesn't leak out?
New hacking opportunities seem to be emerging daily. Word has it that there are bunches of new applications for those video camera CRT viewers and their support chips. Such applications include tiny oscilloscopes, VGA interfaces, virtual-reality lashups, 3D stereo, and even precision graphics.

Another exciting new area is called binary optics, in which millions of plain old opaque dots can replace exotic combinations of costly lenses. This one is a sure-fire college thesis winner. At least one researcher is using nothing but PostScript and a grunty phototypesetter for his optical designs. Cheaper CD-ROM optics will be an important early use.

More on these two topics as they unfold. Meanwhile, let us look at an obscure standard that has lots of nonobvious new hacker uses.

Tone signaling
I get lots of helpline requests for schemes that permit voice and data to be routed over the same audio channel at the same time—interference-free, of course. You might want to do this to control a multimedia slide show, for selective calling on a multi-party intercom, or for remote robotics.

Other applications include an aide for the handicapped, home automation, a monitor for an alarm system, as an animation script to be saved to a cassette tape, as an "I’ve got the answer!" game or quiz response, to synchronize effects on a carnival ride, or for use as a radio private-calling feature.

Since any particular communication channel has a well-defined bandwidth, there are definite limits to what you can and cannot do here. So, we’ll assume that low data rates are okay.

Touch Tones could be used, but all of those beeps might be annoying. The Touch Tone chips are offered by Teltone, Silicon Systems, and Radio Shack.

But MX-Com appears to have found a much better way. There is an obscure mobile communication scheme called CTCSS, which is short for Continuous Tone Controlled Sub-audible Squelch. The related standard is EIA-220-B.

As Fig. 1 shows, there are 39 standard or nearly standard tones in the specification, ranging from 67 hertz up to 250.3 hertz. In their intended use, these tones may be combined with voice messages on any radio channel. Only those channels set up to decode their selected tone can hear the message. The tone frequencies are subaudial in that most phone or mobile communication gear sharply attenuates audio below about 300 hertz.

The MX365A is a typical chip that can be used either as the encoder of tones in Fig. 2 or the decoder of tones in Fig. 3. This device offers you a choice of hardware programmable tones or a serial computer control. I’ve shown the hardware mode, using the coding of Fig. 1. The MX365A costs $8 in single quantities.

If you apply low-frequency signaling tones directly, any lower speech or music frequencies could interfere with transmission. This is known as talk-off. And you will hear the actual tones on receive.

To beat those problems, a special on-chip digital high-pass filter is included. In the transmit mode, the filter gets rid of any low-frequency audio that could interfere with the tones. You run your input audio through the filter and then combine the tones with the filtered output.

The presence of tones causes the decoder output at pin 13 to go low. For normal use, a low on pin 13 also turns off the output audio. Pin 18 is a push to listen feature. You can hold that pin at the positive supply level to provide continuous tone-independent audio.

There is also one really cute hack included in the encoder that can get rid of any squelch tails during normal communication. See the data sheet for details. Also, you’ll need several receiver chips if you want to use several different tones at once.

The tone frequencies are set by the 1-MHz crystal. Presumably, you could lower the input clock frequency to lower all the available tones or to hit some "magic" frequency. This would end up as nonstandard, of course, but it would let you improve your audio quality as a result of an improved low-frequency response. And it might make your tones even more invisible.

The maximum data rates would also have to be sharply reduced for lower tone frequencies. Consider around 30 tone cycles as a minimum signaling interval. At 30 Hertz, this would mean about one command-per-second maximum. If you want baud rate, you’ve got it; one baud! Use the lower tone frequencies for minimum audio interference and the higher ones for faster signaling.

MX-Com offers several variations
The digital Bogey

Some people think that computers will be smarter than people. The time that this will happen is arguable, but it definitely will occur somewhere between 2:24 and 2:26 AM PST on April 17, 1998.

Note that the one-gigabyte RAM is rapidly approaching production, as is 1000:1 fractal and wavelet compression. At that point, we will routinely be handling both gigabytes of RAM and terabytes of efficiently compressed and realtime HDTV material, all at low cost.

Sometimes after that, all parts of a...
multimedia experience could be handled fully digitally. Everything in a movie will consist of easily manipulated data. There will be no difference between actors and props! Everything will be a special effect.

Live actors will, of course, be totally unnecessary. As will the gaffers and grips and Foley's.

Given these stunning increases in desktop computing power, within two or three decades at most, it should be possible for an individual at home to produce something comparable to a first-run movie, at a total cost of, say, $75. Compare that to the $75,000,000 or so for today's old-line flicks. This should give us a one million to one reduction in the costs for producing movie-like experiences.

The primary video distribution, of course, would be by way of Internet IV, with later releases through library Teracubes, each of which can hold a decade or so of movies.

Naturally, the original script writer receives the lion's share of all income generated. And the final product will be exactly what the script writer had in mind.

I'll call this inevitable happening the Digital Bogey. As in Humphrey. A digital database should be able to totally define an actor's persona on a pixel-by-pixel basis. Both at macro and micro levels. It's the same way we process words and desktop publish today.

After teaching the data base all of the existing Bogey flicks, we could simply switch to auto and let 'er rip. Presto! Zillions of brand new Bogey movies.

For our contest this month, tell me more about the new upcoming Digital Bogey. Show me in 175,000 words or less what the consequences will be for a 1,000,000:1 reduction in all the costs of producing and distributing an entertainment experience comparable to a first-run movie.

Among other things, we can expect a shift in smog levels in the LA basin. All types of LA smog.

As usual, there'll be a dozen or so of my new Incredible Secret Money Machine II books going to the better entries, with an all expense paid (FOB Thatcher, AZ) tinaja quest for two that will go to the best of all.

Elegant simplicity again

Elegant simplicity is a theme that we return to over and over again here. It should be one of your foremost hardware hacking goals. Just
as the P-38 can opener is by far the finest invention of the twentieth century bar none, there are electronic circuits that clearly do more with less. They use the bare minimum of parts to provide unexpectedly sophisticated final results.

We've run many elegantly simple circuits on these pages, but there is one clear-cut winner which remains head and shoulders above all of the others put together. This, of course, is the original Hewlett Packard audio sine wave generator.

Linear Technology has long had a LT1037 ultra-low noise op-amp that it is still real proud of. The gain of 20 million, offset of 25 microvolts, and common-mode rejection of 117 decibels are all right up there in the "adequate" range, beyond "fair to middlin'."

The circuit is shown in Fig. 4. It is an ultra-pure 1 kHz sine wave generator. How pure? Less than 0.0025% distortion and 0.001% percent noise for a 6-volt rms output. The circuit is called a Wein Bridge oscillator. Temporarily assume that the light bulb acts like an ordinary resistor, providing a fixed gain of +3 for the op-amp. Now, at precisely 1 kHz, the series RC network will have twice the impedance of the shunt RC network, and both will offer the exact same phase shift. So, you'll have a sine wave running around an op-amp having a gain of 3 and a network that has a loss of ½.

The feedback network can act as...
a single-pole, high-pass filter while the shunt network acts as a single-pole, low-pass filter. Should the frequency change, the shifting impedance levels will automatically return the frequency to where it belongs.

Now for the most elegant part.

FIG. 4—AN ULTRA-LOW-DISTORTION 1-kHz sinewave generator. The pilot light acts as a stabilizing AGC loop in this elegantly simple circuit.

The circuit works only when the op-amp already has a sinewave present and a gain of precisely 3.0. If the gain is even a tad less than that value, the amplitude dies out. Slightly more, and the amplitude keeps getting bigger until it distorts badly.

Obviously, for this circuit to work, we need some way to regulate the gain of the op-amp. Set it above 3 to get it started, and then continuously adjust things to stabilize the desired amplitude. Naturally, you could do this with an AGC or automatic gain control loop. Maybe you could use an amplifier, a detector, and some sort of fancy multiplier stage. Any aerospace engineer could come up with a 10-chip, $500 solution, if he is given a few technicians and enough simulation time on a mainframe.

Would you believe you can use a plain old light bulb instead?

An incandescent light bulb is an example of a nonlinear resistance. If there is very little voltage across it, the resistance of the cold filament stays fairly low. When the voltage across the filament (and the current through it) increases, the filament warms up and its resistance increases.

The light bulb is a fully automatic, one-piece AGC circuit! On power up, it has a low resistance, and gives enough gain to start oscillating. At run time, its resistance continuously
adjusts itself to give a constant and low-distortion output. The thermal inertia of the lamp guarantees that all the AGC variations stay long-term only, instead of distorting the output waveform. This gives you elegant simplicity at its very finest.

Both RC networks must be matched very carefully, preferably better than one percent. That No. 327 bulb is a stock pilot light rated at 28 volts and 40 milliamperes.

As a second contest this month, tell me about your favorite example of elegant simplicity. Concepts similar to this super tinewave oscillator, a P38 can opener, or a vortex cooler are what I’m after.

 Coin changers
I have recently received lots of requests for low-cost sources of video-game coin mechanisms. As surplus, these are largely catch-as-catch can. But Marlin Jones, American Science & Surplus, and Herbach & Rademan sometimes stock them.

For larger quantities, try the ads in RePlay, Playmater, or the Automatic Merchandiser. For antique versions, try the Player Piano Company or the ads in Always Jukin’ magazine.

Lutech and American Changer are two sources for the dollar-bill changer mechanisms.

If you learn about other sources here, please let me know.

New tech lit
The Electrochemical Society is a good source for information on new battery technology, fuel cells, electropolating, corrosion, conductive polymers, and even Buckeyballs. It publishes Interface magazine and holds lots of trade conferences.

The third edition of the Almanac of UFO Organizations and Publications is offered by Phaedra. It’s authored by David Blevins and costs $19.50. This is a combined Thomas Registry and Michelin Guide to the field. Of the 400+ resources listed, at least one of them (AI-TRAD) puts its money where its mouth is: one million dollars cash to anyone who’s able to provide some solid evidence of either UFOs or aliens.

A fine selection of books and other resources for the handicapped is found at the Disability Bookshop.

Free samples of socket head caps are available from Shear-Loc. These caps instantly convert plain old cap screws into knurled knobs or thumbscrews, rosette grips, or tee-handles. Only a bench vise is needed to assemble the caps.

You can quickly and conveniently get copies of just about any technical standard from Global Engineering Documents. But note that it is often much cheaper to go directly to the standards associations themselves. We saw a full listing of these back in Hardware Hacker, December 1991, and in my on-line and hard-copy reprints.

Two rather strange and wondrous publications for this month are the Iron-Man Album and Gas Engine. They’re for restorers of antique steam- and gas-powered tractors, respectively.

If you want to start up your own tech venture, be sure to get a copy of my newly revised Incredible Secret Money Machine II.
move the years of dust and grime from your new find with great care. First remove the chassis from the cabinet. Some models will have the loudspeaker mounted on the cabinet rather than the chassis: it too must be removed.

Also, many old radios have loop antennas attached to their back covers. Disconnect the leads to the antenna and set it aside. Whenever you disconnect or cut leads, note what you did and where in a notebook with comments on wire size and insulation color.

It is also a good idea to attach masking tape “flags” to the ends of any wires you cut or disconnect as well as to their termination points. Write codes or other useful data on the flags so that you can easily reconnect the wiring correctly at a later date—and avoid costly time-consuming mistakes.

Draw a parts layout diagram of the chassis showing the relative locations of the principal components, especially the tubes by type number. Remove the tubes and clean them with a damp cloth. Visit a TV/radio repair shop and ask the proprietor if you can use his vacuum tube tester. Tell him what you are doing, and you’ll probably find that he will be glad to help you. Many independently run service shops stock replacement tubes.

However, if you are unable to find a local shop that handles tubes, check the classified pages of this magazine for mail-order companies that sell vacuum tubes. Some might be new unused products and others might be tubes that have been salvaged and rebuilt. Expect to find that pricing has increased markedly over their original prices, but if you only need a few, you’ll find the prices to be reasonable.

Work on the chassis next. With a stiff one-inch paintbrush, remove most of the dust from the exposed surfaces. Caution: Do not use a vacuum cleaner—it might pull off an important part that you’ll lose. Clean the surface of the chassis with a cloth dampened in water only—do not use soap or detergent! Cotton swabs such as Q-Tips are handy for cleaning in tight corners. Look under the chassis for obvious damage such as broken wires, split capacitors or broken resistors.

Replace the line cord even it appears to be in good condition. An AC cord with a hidden break in the insulation could prove to be lethal. If you are restoring a radio that was manufactured before World War II, look for a replacement cloth-covered cord. Try your local home lighting store or an electrical hardware supplier. It is important that the restored radio look authentic down to the line cord.

If practical, check the internal resistance of all paper (wax-covered) capacitors. Some vintage radio restorers replace all of those capacitors with modern film-type units with the same ratings that are approximately the same size.

Inspect all electrolytic capacitors for leakage: evidence of past leakage will show up as chalky dust or resinous seepage. Replace all electrolytic capacitors with their modern equivalents. Match the capacitance ratings as closely as you can, even if it means wiring several capacitors in parallel to obtain the right value. Also try to match the voltage ratings of the original equipment capacitors.

Now, reconnect the loudspeaker and loop antenna, and apply power to the radio with an auto transformer (commonly called a Variac). Bring the voltage up slowly while observing the filaments and plates of the rectifier tube (examples include the type 80, the 5U4, or the 35Z5).

Raise the output of the auto-transformer slowly until the tube filaments glow with a dull cherry-red color. A DC voltmeter between cathode and chassis ground might indicate the presence of a DC voltage before you see the rectifier filament glow. The slow increase of voltage will reform the oxide dielectric layers in the electrolytic capacitors without damaging them. Take at least a half hour to raise the autotransformer voltage to AC line voltage.

Keep an eye on the rectifier plates that surround the tube's filaments. If they should begin to glow, turn the radio off immediately! This condition indicates a short-circuit. It will then be necessary for you to troubleshoot the radio and make all necessary repairs.

Clean the cabinet with a damp cloth that can contain mild soap, but be sure you remove all traces of soap when you have finished the cleaning. Knobs and removable plastic parts can be scrubbed with a wet toothbrush rubbed in mild soap. Rinse these parts well in warm water and let them air dry.

The cleaning of the dials and related faceplates, pointers and cords will require special care. Because of the many different forms taken by these assemblies, only general cleaning instructions can be given. Proceed cautiously with water-dampened cotton swabs or suitable soft artists’ brushes.

You might want to replace the loudspeaker grille cloth of your restored radio if it is embedded with dust and grime. You might be able to obtain grille cloth with a suitable matching color and weave from your local electronics store; if not try one or more of the many mail-order electronics distributors.

The woodwork or finish on the cabinet might need repairs. Broken parts of the cabinet or seams might need to be reglued. Don't attempt this work yourself unless you have had experience in fine furniture repair. An amateurish job will detract from the restored radio’s appearance and value. Unless the finish is badly scarred, confine your finishing work to a light coat of furniture wax.

If you must refinish the cabinet yourself, seek the advice of an expert in a paint or hardware store before you purchase any stains, varnishes, or lacquers. It’s important to keep the cabinet's original color and tone because that’s part of its history. 

---

VINTAGE RADIO
continued from page 76
For many serious music listeners, the advent of digital reproduction raised a troubling question: Can their present low- or medium-powered amplifiers cope with the 90-dB dynamic range inherent in CD technology?

Although my real-time analyzer confirms that well-recorded CDs register peaks 10 dB or so higher than the same music on an analog tape or disc, the average sound level in the listening room—which is determined by the volume control setting—is essentially unchanged. Furthermore, the dynamic range potential of a CD is not likely to be realized on most discs and, in any case, is usually manifested as a reduction in noise at low levels rather than as an increase in sound at high levels. And so, for the vast majority of listening, their CD players will not push amplifiers above and beyond the call of conventional duty.

**Power adequacy**

Whether your system has adequate amplifier power depends on: (1) speaker efficiency, (2) the acoustics and size of the listening room, (3) the kinds of music you listen to, and (4) how loudly you play it. Let’s discuss the four factors in order.

(1) Speaker efficiency is usually given as a sensitivity rating written as 86 dB/W/m. This translates into the speaker producing a sound pressure level of 86 decibels when fed 1 watt of test signal and measured at an on-axis distance of 1 meter. A high-sensitivity (very efficient) speaker might have a rating around 94 dB, medium sensitivity is about 87 dB, and low sensitivity is about 81 dB.

For a practical perspective on these figures, it should be appreciated that a 3-dB increase in speaker sensitivity means that for a given volume level, 50 percent (!) less amplifier power will be required. In other words, a 30-watt amplifier feeding a speaker with an 84-dB sensitivity will sound as loud as a 60-watt amplifier feeding an 81-dB speaker. However, a 3-dB increase in output level is barely discernible; it takes a 5- to 6-dB increase (a tripling or quadrupling) of applied power to be audibly significant. (See Fig. 1.)

(2) The size and acoustic properties of a listening room can significantly influence power requirements. Reducing room size by half will cut the amplifier power requirement by about one third. Room furnishings can have an even greater effect, changing the power requirements over a range of about three to one.

A highly reflective (“live”) room with metal and glass furniture and exposed hardwood or tile floors will need far less power than a “soft” room with absorbent carpeting, heavy drapes and heavily cushioned furniture. The soft room soaks up sound reflections before they have a chance to contribute to the overall acoustic energy level. Of course, the excessive reflectivity of a very live room will cause the sound to be overly “bright” and will confuse the stereo image, so a balance must be struck between a listening room’s absorptive and reflective properties. Fortunately, the decor of most living rooms brings them fairly close to a happy medium.

(3) A listener whose taste runs exclusively to flute solos will need a lot less audio power than an audiophile whose compact-disc library consists of organ works, drum solos, and four different versions of the “1812 Overture.”

(4) It has been estimated that listening-level preferences among individuals vary over a 30-dB range, with women usually preferring to listen at lower levels. (Whether the female preference derives from a greater sonic acuity or sensitivity or simply reflects an absence of “the louder, the better” audio machismo certainly won’t be resolved without further research.) In any case, a 30-dB difference in preferred listening level translates into a 1000-to-1 difference in amplifier power requirements!

I’ve not given specific wattage figures for any of the circumstances discussed above, simply because of the difficulty in precisely specifying...
Prices of both hardware and software continue to drop, but this may be a mixed blessing. This month we'll examine trends in the hardware arena.

Intense price competition (as well as natural technological evolution) has roughly halved the cost of high-end PCs during the past two years. The effect has been to force many smaller PC clone vendors out of business, and consolidation among those that remain. For example, several years ago Tandy (Radio Shack) bought Grid systems, a maker of high-end portables. More recently, AST Research bought Tandy's computer line, lock, stock and barrel, thereby hurling AST into a position as one of the three largest PC vendors. These trends are likely to continue. Industry analysts foresee the day, not far off, when most of the market will be dominated by just a few vendors.

These mega vendors will compete primarily on the basis of manufacturing efficiency. This will be a mixed blessing. On one hand, it will help keep prices low, and it should help keep quality high. On the other hand, it might well stifle innovation. And it will almost certainly reduce service and support because competitive pressures are off.

Think of how refrigerators are sold. Just a few characteristics—cubic feet, color, horizontal or vertical style—distinguish most models. Optional add-ons such as ice makers tend to be very expensive relative to the overall cost of the unit.

This is not a bad situation for refrigerators because they, compared to computers, are vastly simpler to use, operate, and maintain. Vendors do not require support centers staffed by hundreds of highly trained support technicians and engineers. Most people are capable of filling their own ice trays without having to be stepped through the procedure.

The situation with computers is obviously different. Every computer is different. Unlike adding water to an ice tray, adding peripherals to a computer requires extensive knowledge of computer architecture, in general and of the specific model in particular.

A solution to this peripheral add-in problem would be for the industry to arrive at a consensus about what constitutes a computer. This means standards—real ones, base-level standards that apply across the board and apply to all computers.

**Standards are needed**

Standards might reduce the number of computer configurations available, which—is usually touted as an advantage. Some mail-order vendors proudly build systems to order. But what they gain by doing so is guaranteed to create support headaches down the road.

Standard bus interfaces allow one to add and upgrade peripherals over time. However, the lack of standards in other related areas (use of hardware and software interrupts, I/O ports, and memory-mapped I/O addresses) creates a morass of support and maintenance (S/M) problems.

Ask yourself what a car is. Write down your list of components. I'll bet your list is pretty similar to mine. Now ask yourself what a computer is. What would you like to bet that our lists differ significantly? Do you include a mouse? A CD-ROM drive? A sound board? A fax? A modem? What kind of video system? How much RAM? What kind and how large a hard disk? What type of bus? What CPU speed?

What type of floppy? Did you include a backup system? How about an uninterruptible power supply?

What's needed is a general definition of what constitutes a personal computer, a definition meaty enough to account for the broad range of possibilities. The definition should include standard hardware and software interfaces for all common devices, thereby reducing the potential for conflict and the effort and expertise required to overcome that conflict.

For example, a mouse should have a standard and unique connector so that it could never be mistakenly plugged into the wrong port. In a similar way, there should be a unique software interface based on a predefined software interrupt. When that mouse is plugged in, it should work correctly. When it is not plugged in, the computer should still work correctly. The same principles should apply to all other system components.

When I was a kid, the only way to buy a quality stereo system was to mix and match components from various vendors. Today, this is no longer the case. Quality systems that far exceed the needs finesse of the vast majority of listeners can be obtained for very reasonable prices.

The PC industry is still in the mix-and-match stage. In fact, this industry has grown up with an attachment to—a love affair with—the mix-and-match philosophy. However, most people have gripes about it. Users complain about the problems it creates, and manufacturers complain about its S/M cost.

Looking at the way cars are sold, rather than refrigerators, might provide a more relevant model. The automobile is a mechanism whose complexity is comparable in scope to that of the computer. There is
wide diversity in kinds of automobiles, but this diversity is not, for the most part, based on fundamental technical differences among models. Further, the peripheral or "add-on" market is well standardized. Adding a trailer hitch, a luggage rack, or a better stereo seldom requires reconfiguring other system components.

It may be awhile

The fact is that cars and refrigerators evolved over fairly long periods of time before settling down to stable, consistent configurations. By contrast, computer technology is still in the rapid growth part of the curve. By way of illustration, in the late 1970s an editorial in one computer publication boldly proclaimed that 16-bit microprocessors would never catch on because most people used personal computers for word processing, and eight bits were enough to do everything that needed to be done. Today people wonder whether 32-bit devices will be able to satisfy our needs.

Some "standards" were created to compensate for a lack of prior direction. Take the EMS memory standard, for example. Until 386 and 486-based machines came to dominate the market, EMS was the most popular (and on 8088-based machines, the only) way to increase memory beyond 640K. In other words, EMS was needed only to satisfy shortsightedness in the original PC design. This response is much more common than most people realize. In fact, the very concept of a "PC Compatible" is really just a kind of patchwork quilt of pseudo-standards that have evolved to meet various needs. These standards are loose, ill-defined, and unenforced. To list just a few examples: AT bus timing, interrupts associated with serial ports above COM2, and EMS page frame mapping.

At bottom, what the PC industry did was agree to disagree. Rather than adopt standards for all these things, the industry instead opted to build the maximum possible versatility into each component. This versatility is great—except that it's so flexible. Versatility is precisely what leads to the system-compatibility headaches we've been discussing.

Large corporations might not like system-compatibility problems, but they typically have resources to deal with them. This is not the case with the so-called SOHO (small office and home office) market, which can seldom afford the technical expertise required to support complex system configurations, networks, and system upgrades.

Solution: PnP

How can these problems be solved? Can they be solved at all? They could be solved if computer hardware were made completely plug and play. Indeed, this is the focus of a new initiative spearheaded by Microsoft, Intel, and several key PC manufacturers. The Plug and Play (PnP) specification defines a way to avoid hardware conflicts. All peripherals connected to a PC would automatically be reconfigured every time the machine was powered up, without requiring any user intervention.

PnP has an ambitious goal, one that cannot be accomplished solely on the current generation of ISA bus computers. Hence PnP provides a migratory path that allows three levels of compatibility.

1. PnP cards will interoperate electrically and functionally with standard ISA cards in any existing ISA PC; however, that PC might not be fully auto-configurable.
2. By adding PnP software (utilities, BIOS enhancements, operating system enhancements, and user interrogation), a mixed system can be made increasingly auto-configurable.
3. A system with only PnP cards and appropriate software will be fully auto-configurable.

In some ways PnP is like the microchannel architecture (MCA) and extended industry standard architecture (EISA) buses introduced in the late 1980s. Both EISA and MCA provide intelligent system-configuration tools and standards. However, PnP provides a smoother transition than did either EISA or MCA, which introduced buses that were physically incompatible with the AT bus, now known as the industry standard architecture (ISA) bus.

PnP works as shown in the flowchart in Fig. 1. After power up or a hard reset, devices required to

---

FIG. 1—THE PLUG AND PLAY ISA SPECIFICATION PROVIDES AN AUTOMATED WAY FOR A PC TO RECONFIGURE ITSELF EACH TIME IT IS RESET OR POWERED UP. INTELLIGENCE BUILT INTO ADAPTER CARDS, THE SYSTEM BIOS, AND THE OPERATING SYSTEM ARE INTENDED TO FUNCTION TOGETHER TO EASE USER CONFIGURATION HEADACHES.
boot the system come up in an active state, and other devices come up in an inactive state. The system then performs an analysis of those devices present. Next the system assigns each resource in a way to prevent contention by two or more devices over that resource. The protocol for performing the analysis, an outline of the hardware requirements, and provisions are all defined in the PnP spec. You can get a copy of the spec on CompuServe; go PLUGPLAY.

PnP concerns

Two big concerns surround PnP. First is whether it can provide any value to the millions of PCs that already exist. Second is whether new expansion cards with PnP support will be more expensive than existing cards.

The point of the first concern is that if users need to upgrade their BIOSes, their operating systems, and the firmware (if any) on their peripheral cards to gain any advantage from PnP, they probably won’t perform those upgrades. So even if every PC and every expansion card from now on came with built-in PnP support, it would still take 5-10 years before the standard could become universally accepted.

Cost is the second concern. If vendors chose to use PnP as a differentiating factor, i.e., to charge more for products that are otherwise identical to non-PnP products, users probably won’t go for it. And why should they? It is questionable whether a mixed system can provide any benefit over a pure non-PnP system.

Conclusions

PnP might be too little too late. We need something like it, but by itself it might be insufficient. PnP does not cover SCSI device configuration. In addition, it is unclear how devices on standard 32-bit buses, such as those from the Video Electronics Standards Association (VESA) and Intel (PCI) can be managed. In addition, there is currently no support for other buses (e.g., those from Apple, Sun, and the other workstation vendors), nor operating systems (e.g., OS/2, Macintosh, and the UNIX dialects).

audio update

continued from page 87

all the variables involved. If you never intend to listen to music above a moderate level, 20 watts per channel should be adequate, whatever the sensitivity of your speakers. But if you want to listen to music at near-true levels, you’ll need a great deal more power, particularly if your goal is to reproduce accurately the up-to-12-dB momentary music peaks found in most classical music—and certainly on CDs. To reproduce such peaks without clipping, an amplifier must be able to deliver, without faltering, almost 16 (1) times its average power. If its average power is 2 or 3 watts, then 16 times that figure is likely to be no problem. However, if you are running inefficient speakers in a large, well-damped room, the 12-dB peaks might exceed your amplifier’s output rating. Some of today’s better medium-power amplifiers have up to 6 dB dynamic “headroom.” This helps ease the stress of handling large momentary peak powers—and perhaps avoids the expense of a super-power amplifier.

Clipped sound

Theory aside, what do amplifiers sound like when they run out of power? That depends on several factors, such as the specifics of the amplifier circuitry, the program material, and the severity of the clipping. At one time there were amplifiers on the market that really went strange when driven into clipping. According to one well-known designer, the pulses and noise bursts produced by amplifier misbehavior on clipped signals were responsible for far more tweeter damage than the generally acknowledged culprit: the excessive high-frequency energy in the clipped waveforms.

However, assuming that the clipping is responsible for damage only to your audio sensibilities rather than your speakers, what does it do to the sound? A research project on the audibility of clipping done by Roy Allison in 1973 revealed some interesting facts. For example, waveform clipping that’s barely visible on an oscilloscope is seldom audible. Overloads greater than 3 to 6 dB (depending on program material) were necessary before a critical listening panel clearly heard the ill effects. That means that a moderate-power, 25-watt amplifier could sound as if it had 25 to 75 more watts available than it really did under normal circumstances.

Another interesting effect: As the amplifier’s input level control was turned up past the clipping point, the sound nevertheless continued to get louder, despite the fact that its peaks are clipped. This same psychoacoustic “trick” is used in radio and TV broadcasts to make commercials relatively louder than the average program level. By simultaneously limiting signal peaks and raising the average signal level, loud, attention-getting commercials are obtained without risking transmitter overload.

When amplifier clipping does reach the audible level, there is no mistaking its effects. Some program material is more revealing than others. For example, clipped piano music produces a rattling distortion with each note. For other instruments there is a loss of transient clarity, a “ mushiness” in the musical attacks, or a harsh rasp at the moments of overload.

The bottom line

Theory aside, there is an easy way to resolve the question of whether your sound system would benefit from more power. Beg or borrow from a friend or friendly dealer an amplifier with at least three times the power of your present unit.

While playing your most demanding discs, listen carefully for a new openness, clarity, tighter bass, and lack of strain. To make sure you don’t fool yourself, make notes listing whatever positive (or negative) changes you hear. Reconnect your original amplifier for another listening session with the same program material before you make your final decision.

If your listening tests reveal your old amplifier to be underpowered, you’ll probably wonder how you nevertheless managed to live with it all those years.
Initial checkout

Apply power to the ionization chamber with the cable and connect an oscilloscope to the op-amp test point shown in Fig. 2. After several minutes, JFET Q1 should have stabilized at its normal operating point with the drain at about 1.5 volts. The output of op-amp IC1-a should be half the 9-volt supply voltage with about 50 to 200 millivolts of low frequency noise riding on top of it.

When the amplifier is working properly, try to avoid bumping or vibrating the chamber because it is a sensitive vibration sensor, made even more sensitive as long as the anode wire remains unsupported. Shocks or vibrations will show up as large-amplitude, slow decaying sinewaves.

If the amplifier oscillates, produces square waves, or will not settle down after several minutes, check the drain voltage of JFET Q1 and the quality of the coupling capacitor C2. The amplifier circuit might have too much gain which can be reduced by substituting smaller values for resistor R4. Start with a 333 kilohm resistor which will reduce gain about 50%.

Anode support

Punch two small holes on the opposite sides of the can’s rim as shown in Fig. 3. Insert a length of nylon monofilament fishing line through one hole, pass the free end through the loop at the end of the anode before passing it through the second hole. Pull both free ends of the line together around the outside rim of the can and, keeping tension in the line, tie them together with a knot. If the tension on the line is sufficient, the end of the anode will remain centered in the mouth of the can.

If a persistent 60-Hz waveform appears at the test point, pass a length of insulated hook-up wire through the cable grommet in the bottom of the end cap and hook it up to repeat the test. Press on the end cap and examine the waveform again. If this shielding doesn’t cure the problem, check carefully for other construction errors such as a missing ground connection or a noisy power supply.

Gain adjustment

Assuming that the ionization chamber and amplifier comply with the initial checkout requirements, it should be ready to detect alpha particles. However, additional amplifier gain adjustments might be necessary. Charge the capacitor C1 to 500 volts, and put the end cap back on. If you have no means for charging the capacitor, this can be done with either the voltage-tripler circuit shown in Fig. 4 or the DC converter shown in Fig. 5.

The voltage tripler shown in schematic Fig. 4 operates directly from the 120-volt AC line. It will produce a voltage close enough to 500 volts for satisfactory operation of the BERM. Because of the shock hazard associated with line-powered circuits, the use of a grounded, three-wire plug and line core is strongly recommended. This circuit should be enclosed in a suitable protective case to prevent accidental contact with the power line and any of the three large electrolytic capacitors C1, C2, and C3.

The DC converter schematic shown in Fig. 5 is a blocking-oscillator flyback circuit which can be powered from an adjustable, low-voltage DC supply. It will produce an output of several hundred volts with an input as small as 1 volt. Measure the converter’s output with any voltmeter capable of measuring 100 volts before connecting the output to capacitor C1. Transformer T1, used as a step-up transformer in Fig. 5, can be any stock 20 VA transformer with a 120-volt primary and a 12-volt secondary.

Apply power to the amplifier and wait for its activity to settle. Typically, it will take several minutes for JFET Q1’s gate to charge up and probably will take another minute for the coupling capacitor to charge before amplifier output reaches half supply voltage.

With the oscilloscope set for 1 volt per division and very slow sweep (0.2 second per division), the test point voltage should vary slightly as you wait to see an event. Expect the appearance of a large negative pulse (see the waveform in Fig. 2) on the oscilloscope screen indicating that you have just been lucky enough to capture your first alpha particle.

In a typical home you will see a few of these pulses each minute. However, because you are observing a random radioactive process, you might see several pulses or none in any given minute. Watch the oscilloscope screen for a few minutes and estimate the pulse amplitudes.

If the BERM amplifier has too much gain, the amplifier’s output will saturate. However, if most of the pulses have an amplitude less than 1/2 volt, gain must be increased. The optimum gain setting occurs when pulses with peak amplitudes of about 2- to 3-volts appear without saturating the amplifier. Adjust the values of feedback resistors R4 and R5 to accomplish this.

Comparator

The last step in the check-out procedure, after gain adjustment has been completed, is to verify comparator operation. With an external pull-up resistor (100 kilohm to 1 megohm) connected to the positive supply, check its output with the second channel of your oscilloscope.

You should be able to verify that pulses with amplitudes over 1/2 volt drive the output low. Then complete the assembly of the BERM by putting the circuit board end cap back on.

Pulse counting and calibration

The second part of this article covers alternative pulse-rate counting techniques, calibration, sources of error and the conversion of pulse counts to specific activity to determine estimated amounts of radon present in the air.
**BUYER’S MART**

**FOR SALE**

**TUBES.** "oldest", "latest". Parts and schematics. SASE for lists. STEINMETZ, 7519 Maplewood Ave, NE, Hammond, IN 46324.

**TUBES, new, up to 90% off, SASE, KIRBY, 298 West Carmel Drive, Carmel, IN 46032.**

**CABLE test chips. Jerrold, Tocom, S.A., Zenith. Puts cable boxes into full service mode! $29.95 to $59.95. 1 (800) 452-7090, (310) 902-0841.**

**SECRET cable descramblers! Build your own descrambler for less than $12.00 in seven easy steps! Radio Shack parts list and free descrambling methods that cost nothing to try included. Send $10.00 to: INFORMATION FACTORY, Dept. 4, PO Box 1790, Baytown, TX 77522.**

**CABLE TV converters: Jerrold, Oak, Scientific Atlanta, Zenith & many others. "New MTS" stereo add-on: mute & volume, ideal for 400 and 450 owners! 1 (800) 826-7623, Amex, Visa, M/C accepted. B & B INC., 3584 Kennebec, Eagan, MN 55122.**

---

**INTERFACES for IBM compatibles. 48 line digital I/O, 16 channel analog input. 8 relay board, 8 opto input board. Control motors, lights, measure temperature, voltage. To get flier, send SASE to JOHN BELL, 1381 Saratoga St., Minden, NV 89423.**

---

**CLASSIFIED AD ORDER FORM**

To run your own classified ad, put one word on each of the lines below and send this form along with your check to: Electronics Now Classified Ads, 500-B Bi-County Boulevard, Farmingdale, NY 11735

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of $25.00.

- Plans/Kits ( ) Business Opportunities ( ) For Sale
- Education/Instruction ( ) Wanted ( ) Satellite Television

Special Category: $25.00

Please print each word separately, in block letters.

(Note: no refunds or credits for typsetting errors can be made unless you clearly print or type your copy. Rates indicated above are for standard classified ads only. See below for additional charges for special ads. Minimum: 15 words.)

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$1,000,000 distributor inventory. Loads of AMP & other connectors, semiconductors, tubes, fuses, etc. Everything discounted. C & H DISTRIBUTING, 215 So. George St., York, PA 17403. Phone (717) 843-7881, Fax (717) 843-3875.

---

**CB RADIO OWNERS!**

We specialize in a wide variety of technical information, parts and services for CB radios. 10-Meter and FM conversion kits, repair books, plans, high-performance accessories. Thousands of satisfied customers since 1976 Catalog $2.

CIBC INTERNATIONAL
P.O. BOX 31500RE, PHOENIX, AZ 85046
CABLE TV DESCRAMBLER LIQUIDATION
FREE CATALOG!
Hamlin Combos $44, Oak M3SB $80 (min. 5), etc.
WEST COAST ELECTRONICS
For Information: 818-709-1758
Catalogs & Orders: 800-628-9656

TEST equipment pre-owned now at affordable prices. Signal generators from $50.00, oscilloscopes from $50.00. Other equipment including manuals available. Send $2.00 U.S. for catalog refunded on first order. J.B. ELECTRONICS, 3464 Dempster, Skokie, IL 60076. (708) 982-1973.


CABLE test-chips as low as $9.95, for testing cable boxes in full service mode. Jerrold; Starcom VI & VII; Pioneer, clears E2 thru E6; Pioneer cassettes: BA-5000 thru BA-6700; Tocom 5503/5552; Scientific Atlanta: 8500 thru 8600; Zenith: all but P21; remote $10.00; money back guarantee. N.E. ENGINEERING, 1 (800) 528-4030, fax (617) 770-2305.

CABLE TV DESCABLERS Wholesalers, Inc.
BEST PRICES—BEST PRICES
Immediate Shipping—COD's Satisfaction Guaranteed
FREE Catalog—Call Now 800-841-7835

PLANS AND KITS
60 SOLDERLESS Board projects in two easy-to-read pocket books. Complete with circuit schematics, schematics, parts layouts, component listings, etc. Both books (BP107 & BP113) only $11.95 plus $3.50 for shipping. USA and Canada only. US funds, ETT, PO Box 240, Massapequa, NY 11762-0240.

BUGGED? Telephone $90.00, $2.00 postage. (212) 330-8035. 

SEND ORDERS TO:
Goldmine
5000 S. Alameda
Bldg. 12
San Antonio, TX 78213

SUPER PC BOARD
BLOWOUT
This is your chance to stock up on prime copper clad for making all types of custom PC boards. Various sizes: 2 x 7 to 12 x 14 or larger. High quality glass/epoxy double sided copper clad. G3995 $5.95.

GEIGER COUNTER KIT
One of the lowest priced Geiger Counter kits available anywhere! Ultra-supersensitive Alpha, Beta, and X-ray radiation and emits clicks in propor- tion to the intensity of the radiation. Skill level 2. Operates on 9V battery (not included). C6430 $59.95.

JUMBO RECTANGULAR RED LED
High brightness jumbo rectangular red LED with diffused red case. C3996 $8.00.

4" ROUND SOLAR CELL
Produced in size 1 amp 1 volt. Silicon type with solder tabs. G2308 $7.50

DELUXE OHM L+ BIT ASSORTMENT
Large assortment of quality solder tinned carabile drill bits. The most popular bits are packaged 194 per box, 4 different bits from very large to very small.

Send $10.00 for hand catalog of our complete selection of soldering equipment and supplies.

CIRCLE 184 ON FREE INFORMATION CARD

January 1984, Electronics Now

93

CABLE TV DESCABLERS
Best Prices in the U.S.A! Guaranteed to Work!
QUANTITY DISCOUNTS

JERROLD PANASONIC
SCIENTIFIC ATLANTA PIONEER
The Newest & the Latest
DMTB-A • all Jerrold Impulse & Starmax series
SA3-DFA • all Scientific atlanta including 1551, 1593, 8800, Drop-field
PN-3A • all Pioneer systems

FT3B, SA3, TZPC145G
24 HOUR SHIPMENTS
30 DAY MONEY BACK GUARANTEE
FREE CATALOG & INFORMATION
1-800-772-6244
M-F 9-6 EST
U.S. Cable TV, Inc. Dept. KEN014
4100 N. Powente Rd, Blvd. 4 F Pompane Beach FL 33073
NO FLORIDA SALES!

CIRCLE 125 ON FREE INFORMATION CARD
ALL ELECTRONICS
P.O. Box 567 • Van Nuys, CA 91408

13.8 Vdc @ 6 AMPS POWER SUPPLY

Solid State, fully regulated 13.8 Vdc power supply. 6 AMPS constant, 8 AMPS surge. Features 100% solid state construction, fuse protection, LED indicator and automatic cutoff short protection.

$44.00 each

CAT# DVP-612

3 Vdc MOTOR

Johnson Motors # MF213G-2050 DC motor draws 30 ma at 1.5 Vdc to 4.5 Vdc, 0.72” x 0.94” x 1.38” long. 0.08” (2 mm) diameter shaft is 0.25” long.

LARGE QUANTITY AVAILABLE

CAT # DCM-42

2 for $1.00

150 for 40¢ each - 600 for 30¢ each

25 AMP SOLID STATE RELAY

Crydom CSE2425-4626 Control voltage: 15-32 Vdc (will work 9-32 Vdc) Load: 25 amps @ 48-240 Vac Standard “hockey-duck” package, 2.25” x 1.75” x 0.85” high. 1/4” quick connect terminals.

$12.50 each

CAT# SSRLY-25A

8 mm Video Camcorder Users!

We have a new supply of these popular T-120 (120 minute) Hi-8 video cassettes. These are top quality, metal oxide cassettes that were used for a short time, then bulk erased. Each cassette has its own plastic storage box. New, they would sell for considerably more than we are asking. We’ve sold thousands, and our customers love them.

10 for $28.00

CAT# VCU-8

ORDER TOLL FREE 1-800-826-5432

CHARGE ORDERS to Visa, MasterCard or Discover

TERMS: Minimum order $10.00. Shipping and handling for the 48 continental U.S. $4.00 per order. All states including Al., Hi., Pr. or Canada must add full shipping. All states delivered via CABLE/UPS. Must include sales tax: CA 7%, WA 6.5%, OR 6.5%, IA 6%, IL 7%, MA 6.5%. Quotations Limited. No COD. Prices subject to change without notice.

Call or Write for A Free 64 Page CATALOG

MAIL ORDERS TO: ALL ELECTRONICS CORPORATION P.O. Box 567 Van Nuys, California 91406

FAX (818) 781-2653

CIRCLE 107 ON FREE INFORMATION CARD

ELECTRICITY DEALS!! ★ CABLE TV DESCRAMBLERS ★ CONVERTERS ★ ACCESSORIES ★ Name Brands ★ Great Service ★ Immediate Delivery ★ Lowest Prices ★

CALL FOR FREE CATALOG (800) 777-7731

PRIME TIME Electronics, Inc.

FASCINATING, useful, fun and educational kits! Lasers, voice changers, message recorders, software, detectors, timing clocks and more. We supply all the parts. You build using our detailed manuals. Send $1.00 (refundable) for catalog:

LNS TECHNOLOGIES, 20993 Foothill Blvd, Suite 307R, Hayward, CA 94541-1611

NEW! DTMF selectable alert decoder kit. Uses preprogrammed logic (PLD) in easy to build three digit tone decoder. Features user selectable three digit access, automatic reset, visual or audible alarm, microphone input — no direct connection required, 9.18 VDC power. Preprogrammed PLD and schematic $19.95. Seven segment display P/N $10.95 extra. WAYNE HALL ELECTRONICS, 361 Gifford Valley Rd., Northville, NY 12134. (518) 863-2055.

RADIATION alert! Our Geiger counter utilizes one of the most sensitive GM tubes available and no nonsense circuitry. Operating information, schematic, and parts availability $11.95 to: ELECTRONIC SAFETY INSTRUM, Box 156, 2927 West Liberty Ave., Pittsburgh, PA 15216.

SATELLITE TV

FREE catalog — Lowest prices worldwide. SKYVISION, 1012 Frontier, Fergus Falls, MN 56537. 1 (800) 334-6455. See full page ad the Shopper section.

VIDEOCYPHER II descrambling manual. Schematics, video, and audio. Explains DES, Eeprom, ClonerMaster, Pay-per-view (HBO, Cinemax, Showtime, Adult, etc.) $16.95, $2.00 postage. Schematics for Videocypher Plus, $20.00. Schematics for Videocypher 03, $15.00. Collection of software to copy and alter Eeprom codes, $25.00. VCII Plus, Eeprom, binary and source code, $30.00. CABLETRONICS, Box 50502R, Bethesda, MD 20824.

BUSINESS OPPORTUNITIES

MAKE $75,000.00 to $250,000.00 yearly. Learn IBM monitors repairs, (solutions most brands). New home based business program. Software available. Information: USA-Canada $3.00 cash (no checks), dealers wanted worldwide ($35.00). US funds. RANDALL DISPLAY, PO Box 2168 R, Van Nuys, CA 91404 USA.

LET the government finance your small business. Grants/loans to $500,000.00. Free recorded message: (707) 449-8500. (K51).

HOME assembly work available! Guaranteed easy money! Free details! SASE WORK HOME/R, Box 520, Danville, NH 03831.

EDUCATION & INSTRUCTION


ELECTRONIC engineering. 8 volumes complete. $109.95. No prior knowledge required. Free brochure. BANNER TECHNICAL BOOKS, 1203 Grant Avenue, Rockford, IL 61013.

CABLE/SATELLITE

UNDETECTABLE cable/satellite descrambler will work on all systems guaranteed! Send SASE/info, $94.95/kit, $14.95/plans. MYSTICAL ELECTRONICS, PO Box 481, Cooper Station, New York, NY 10276.

CABLE TV TURN-ON CHIPS


PATENTING

INVENTORS: THE CONCEPT NETWORK represents people who want to patent and market their new product ideas. Schematics or prototype preferred but not required. Free information kit. Call 1 (800) 635-2246 ext 67.

CB’S AND SCANNERS

SCANNERS, C.B.’s, radar detectors. Call or write for free catalog. (800) 829-3411. C.B. DOCTOR, PO Box 2842, Orlando, FL 32809, (800) 29116-2842. To place order call 1 (800) 569-1393.

INVENTORS

INVENTORS! Can you patent and profit from your idea? Call AMERICAN INVENTORS CORP. for free information. Serving inventors since 1975. 1 (800) 338-5656.
This 270-page reference contains both model and part-number cross-references updated to include 1992 units. VCR's are made in a few factories from which hundreds of different brand names and model numbers identify cosmetically-changed identical and near-identical manufactured units. Interchangeable parts are very common. An exact replacement part may be available only a few minutes away from you even though the manufacturer supplier is out-of-stock. You may be able to cannibalize scrap units at no cost!

The ISCET VCR Cross Reference is pre-punched for standard loose-leaf binding. $38.00 plus $3.00 for shipping for each Reference.

**ADVERTISING INDEX**

Electronics Now does not assume any responsibility for errors that may appear in the index below.

<table>
<thead>
<tr>
<th>Free Information Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>108 AMC Sales</td>
<td>29</td>
</tr>
<tr>
<td>182 Active Surplus Electronics</td>
<td>23</td>
</tr>
<tr>
<td>107 All Electronics</td>
<td>94</td>
</tr>
<tr>
<td>176 American Reliance Inc.</td>
<td>25</td>
</tr>
<tr>
<td>77 B&amp;K Precision</td>
<td>11</td>
</tr>
<tr>
<td>— CIE</td>
<td>33</td>
</tr>
<tr>
<td>— CLAGSK Inc. Video Offer</td>
<td>9</td>
</tr>
<tr>
<td>— Command Productions</td>
<td>29</td>
</tr>
<tr>
<td>— Copyright Clearance Center</td>
<td>21</td>
</tr>
<tr>
<td>127 Deco Industries</td>
<td>25</td>
</tr>
<tr>
<td>125 Electronic Goldmine</td>
<td>93</td>
</tr>
<tr>
<td>— Electronic Industry Association</td>
<td>19</td>
</tr>
<tr>
<td>— Electronic Tech. Today</td>
<td>2, 34</td>
</tr>
<tr>
<td>— Electronic Tech. Today</td>
<td>96</td>
</tr>
<tr>
<td>— Electronics Book Club</td>
<td>7, 48</td>
</tr>
<tr>
<td>121 Fluke Corporation</td>
<td>CV2</td>
</tr>
<tr>
<td>— Grantham College</td>
<td>17</td>
</tr>
<tr>
<td>86 Heathkit</td>
<td>30</td>
</tr>
<tr>
<td>181 IDV Solutions</td>
<td>25</td>
</tr>
<tr>
<td>114 Jameco</td>
<td>95</td>
</tr>
<tr>
<td>89 MAT Electronics</td>
<td>21</td>
</tr>
<tr>
<td>179,180 Mini-Circuits</td>
<td>CV4, 1</td>
</tr>
<tr>
<td>— NRI Schools</td>
<td>12</td>
</tr>
<tr>
<td>183 Parallax</td>
<td>CV3</td>
</tr>
<tr>
<td>— Star Circuits</td>
<td>25</td>
</tr>
<tr>
<td>177,178 The School of VCR Repair</td>
<td>83, 85</td>
</tr>
<tr>
<td>— World College</td>
<td>5</td>
</tr>
<tr>
<td>184 Zentek Corp.</td>
<td>93</td>
</tr>
</tbody>
</table>
For New Ideas In Electronics read Electronics Now® every month.

Electronics Now® will carry timely articles on:
- audio
- video
- personal computers
- VCR servicing
- interactive video
- robotics
- experimenter circuits
- TV scrambling and descrambling
- solid-state technology
- exceptional construction projects

Electronics Now® offers a unique combination of articles on electronics technology, service, audio, video, computers. Keep up-to-date! Subscribe Today!

For Faster Service Call Today
1-800-999-7139

Subscribe today to the magazine that keeps you up-to-date with the newest ideas and innovations in electronics. (If you already are a subscriber, do a friend a favor and pass this subscription card along to them.)

check offer preferred
- 1 year—12 issues ONLY $19.97
  (You save $22.03 off single copy price)
- 2 Years (SAVE MORE)—24 issues $38.97
  (You save $45.03 off single copy price)

Basic Subscription Rate
Canada—12 issues $27.79*
Canada—24 issues $54.54*

ALL SUBSCRIPTIONS PAYABLE IN U.S. FUNDS ONLY
- Payment enclosed
- Bill Me
- Check here if you are extending or renewing your subscription

Name (Please print) _____________________________________________

Company Name (if applicable) __________________________________

Address _______________________________________________________

City __________________________ State __________ Zip _____________

Allow 6-8 weeks for delivery of first issue.

*Includes G.S.T.

For New Ideas In Electronics read Electronics Now® every month.

Delivers projects for the beginning and advanced builder, articles that help you get the most from your hobby, news and reviews on the hottest new consumer and hobby gear, monthly columns on computers, ham radio, shortwave listening, antique radio, and more!

SUBSCRIBE TODAY!
Paperback Books

GREAT PAPERBACKS AT SPECIAL PRICES

- **COMPUTER HOBBYISTS HANDBOOK**—BP251—$8.95
  Subjects covered include microprocessors and their register sets; interfacing serial, parallel, monitor, games and MIDI ports; numbering systems, operating systems and computer graphics. While the book is aimed at the computer hobbyist, it should also prove useful to anyone who intends to use a computer to follow their interests.

- **INTERNATIONAL RADIO STATIONS GUIDE**—BP255—$9.95
  Provides the casual listener, amateur radio DXer and the professional radio monitor with an essential reference work designed as a guide for the complex radio bands.
  Includes coverage on Listening to Short Wave Radio, ITU Country Codes, Worldwide Radio Stations, European Long Wave and Medium Wave Stations, Broadcasts in English and more.

- **FURTHER PRACTICAL ELECTRONICS CALCULATIONS**—BP144—$9.00
  450 pages crammed full of all the formulae you are likely to need.

- **WIRELESS & ELECTRICAL CYCLOPEDIA**—ETT1—$5.75
  A slice of history. This early electronics catalog was issued in 1918. It consists of 176 pages that document the early history of electricity, radio and electronics. It was the "bible" of the electrical experimenter of the period. Take a look at history and see how far we have come. And by the way, don't try to order any of the merchandise shown, it's unlikely that it will be available. And if it is, the prices will be many times higher.

---

**SHIPPING CHARGES IN USA AND CANADA**

<table>
<thead>
<tr>
<th>Range</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.01 to $5.00</td>
<td>$1.50</td>
</tr>
<tr>
<td>$5.01 to $10.00</td>
<td>$2.50</td>
</tr>
<tr>
<td>$10.01 to $20.00</td>
<td>$3.50</td>
</tr>
<tr>
<td>$20.01 to $30.00</td>
<td>$4.50</td>
</tr>
<tr>
<td>$30.01 to $40.00</td>
<td>$5.50</td>
</tr>
<tr>
<td>$40.01 to $50.00</td>
<td>$6.50</td>
</tr>
<tr>
<td>$50.01 and above</td>
<td>$8.00</td>
</tr>
</tbody>
</table>

**SORRY No orders accepted outside of USA & Canada**

- Total price of merchandise
- Shipping (see chart)
- Subtotal
- Sales Tax (NYS only)
- Total: Enclosed

All payments must be in U.S. funds
ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

<table>
<thead>
<tr>
<th>Free Information Number</th>
<th>Page</th>
<th>Free Information Number</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A&amp;D Electronics</td>
<td>126</td>
<td>Index Publishing Group</td>
<td>163</td>
</tr>
<tr>
<td>Accord</td>
<td>146</td>
<td>Information Unlimited</td>
<td>147</td>
</tr>
<tr>
<td>Accurate Technologies Inc.</td>
<td>158</td>
<td>Insteck Corp.</td>
<td>124</td>
</tr>
<tr>
<td>Ace Communications</td>
<td>141</td>
<td>Interactive Image Technology</td>
<td>164</td>
</tr>
<tr>
<td>Active Micro</td>
<td>114</td>
<td>ITC Instruments</td>
<td>105</td>
</tr>
<tr>
<td>AD JAM (JDR)</td>
<td>166</td>
<td>ITC Microcomponents Inc.</td>
<td>173</td>
</tr>
<tr>
<td>Alfa Electronics</td>
<td>125</td>
<td>J&amp;M Microtek, Inc.</td>
<td>162</td>
</tr>
<tr>
<td>All Electronics</td>
<td>154</td>
<td>Jan Crystals</td>
<td>100</td>
</tr>
<tr>
<td>Allen Engineering</td>
<td>134</td>
<td>JP Video</td>
<td>115</td>
</tr>
<tr>
<td>Alltronics</td>
<td>117</td>
<td>Kelvin Electronics</td>
<td>159</td>
</tr>
<tr>
<td>AlphaLab</td>
<td>150</td>
<td>Lake Sylvan Sales</td>
<td>174</td>
</tr>
<tr>
<td>Andromeda Research</td>
<td>160</td>
<td>Lindsay Publications</td>
<td>148</td>
</tr>
<tr>
<td>B&amp;S Sales</td>
<td>127</td>
<td>M&amp;G Electronics</td>
<td>163</td>
</tr>
<tr>
<td>BAC Distributing Corp.</td>
<td>160</td>
<td>M.D. Electronics (Everquest)</td>
<td>173</td>
</tr>
<tr>
<td>Basic Electrical Supply</td>
<td>148</td>
<td>Mark V Electronics</td>
<td>122</td>
</tr>
<tr>
<td>Beige Bag</td>
<td>161</td>
<td>MCM Electronics</td>
<td>143</td>
</tr>
<tr>
<td>Bel-Merit</td>
<td>151</td>
<td>Mendelson Electronics Surplus</td>
<td>119</td>
</tr>
<tr>
<td>BG Micro</td>
<td>139</td>
<td>Meredith Instruments</td>
<td>138</td>
</tr>
<tr>
<td>Billabong Electronics</td>
<td>167</td>
<td>Merrimack Valley Systems</td>
<td>173</td>
</tr>
<tr>
<td>Brigar Electronics</td>
<td>102</td>
<td>Micro 2000</td>
<td>111</td>
</tr>
<tr>
<td>Bsoft Software, Inc.</td>
<td>140</td>
<td>Micro Code Eng.</td>
<td>166</td>
</tr>
<tr>
<td>C&amp;L Electronics</td>
<td>134</td>
<td>Micro Video Products</td>
<td>162</td>
</tr>
<tr>
<td>C&amp;S Sales, Inc.</td>
<td>120</td>
<td>MicroTHinc</td>
<td>172</td>
</tr>
<tr>
<td>Cable Warehouse</td>
<td>114</td>
<td>Midwest Laser Products</td>
<td>114</td>
</tr>
<tr>
<td>Caig Labs</td>
<td>131</td>
<td>Mondo-tronics Inc.</td>
<td>170</td>
</tr>
<tr>
<td>Capital Electronics</td>
<td>156</td>
<td>Motron Electronics</td>
<td>173</td>
</tr>
<tr>
<td>Cellular Link</td>
<td>142</td>
<td>Movie View</td>
<td>112</td>
</tr>
<tr>
<td>Chase Scientific Co.</td>
<td>124</td>
<td>MKW Industries</td>
<td>152</td>
</tr>
<tr>
<td>Command Production</td>
<td>136</td>
<td>Needham Electronics</td>
<td>134</td>
</tr>
<tr>
<td>Compup Video Products (VIZ)</td>
<td>130</td>
<td>New Sensor Corp.</td>
<td>104</td>
</tr>
<tr>
<td>Computer Business Service</td>
<td>114</td>
<td>Oakley Electronics</td>
<td>132</td>
</tr>
<tr>
<td>Consumertronics</td>
<td>132</td>
<td>Ocean State Electronics</td>
<td>116</td>
</tr>
<tr>
<td>Contact East</td>
<td>140</td>
<td>Ohio Automation</td>
<td>114</td>
</tr>
<tr>
<td>Conway Engineering Inc.</td>
<td>103</td>
<td>Paladin Electronics</td>
<td>162</td>
</tr>
<tr>
<td>Cool Amp Conduto Lube</td>
<td>135</td>
<td>Parts Express Inc.</td>
<td>144</td>
</tr>
<tr>
<td>Crestwood Products</td>
<td>140</td>
<td>PC Boards</td>
<td>158</td>
</tr>
<tr>
<td>Dalhani Electronics</td>
<td>171</td>
<td>RC Distributing Co.</td>
<td>166</td>
</tr>
<tr>
<td>Danbar Sales</td>
<td>128</td>
<td>Resources Unltd.</td>
<td>161</td>
</tr>
<tr>
<td>DC Electronics</td>
<td>149</td>
<td>RS Electronics</td>
<td>118</td>
</tr>
<tr>
<td>Debeco Electronics</td>
<td>133</td>
<td>Rescom Inc.</td>
<td>167</td>
</tr>
<tr>
<td>Demax Corp.</td>
<td>169</td>
<td>Rescom Inc.</td>
<td>158</td>
</tr>
<tr>
<td>ECSE Corp.</td>
<td>157</td>
<td>Skyvision Inc.</td>
<td>107</td>
</tr>
<tr>
<td>Electronic Brokers Inc.</td>
<td>108</td>
<td>Southpaw Electronics Inc.</td>
<td>110</td>
</tr>
<tr>
<td>Electronic Goldmine</td>
<td>139</td>
<td>Su-Mar</td>
<td>126</td>
</tr>
<tr>
<td>Electronic Rainbow</td>
<td>101</td>
<td>Tech Systems</td>
<td>136</td>
</tr>
<tr>
<td>Emac Inc.</td>
<td>146</td>
<td>TECI</td>
<td>138</td>
</tr>
<tr>
<td>Fair Radio</td>
<td>138</td>
<td>Toronto Surplus &amp; Scientific</td>
<td>106</td>
</tr>
<tr>
<td>Foley-Belsaw Co.</td>
<td>166</td>
<td>Tucker</td>
<td>123</td>
</tr>
<tr>
<td>Fotronics</td>
<td>146</td>
<td>United Electronic Supply</td>
<td>150</td>
</tr>
<tr>
<td>Gateway Electronics</td>
<td>142</td>
<td>Universal Electronics, Inc.</td>
<td>156</td>
</tr>
<tr>
<td>Gateway Products</td>
<td>130</td>
<td>Universal Electronics, Inc.</td>
<td>148</td>
</tr>
<tr>
<td>Genoa Group</td>
<td>172</td>
<td>Vanguard Electronic Labs</td>
<td>162</td>
</tr>
<tr>
<td>Geo-Ban Engineering</td>
<td>152</td>
<td>Vantage Point Technologies</td>
<td>150</td>
</tr>
<tr>
<td>Graymark International</td>
<td>169</td>
<td>Visitest Inc.</td>
<td>152</td>
</tr>
<tr>
<td>Greenleaf</td>
<td>126</td>
<td>Western Test Systems</td>
<td>153</td>
</tr>
<tr>
<td>Highlander (Gault)</td>
<td>113</td>
<td>WPT Publications</td>
<td>160</td>
</tr>
<tr>
<td>Howard Electronics</td>
<td>162</td>
<td>Xandi Electronics</td>
<td>156</td>
</tr>
</tbody>
</table>
**SUPER SNOOPER BIG EAR**

Listen through walls, hear conversations across the room. Add a parabolic reflector & hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra-sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. 13"x7.5" to 12vDC

AA-1 $10.95

**PHONE RECORDING SWITCH**

This phone powered switch is small enough to be installed any where. Every time the phone is picked up the recorder will record both sides of the conversation automatically. Use it in your office, record all phone calls so you don't lose important information.

1x6" TEL-SW1 $12.95

**CAPACITANCE METER**

This kit will turn your digital volt meter into a capacitance meter with 1 degree resolution. Measures temperature from -40°F to 250°F degrees. It has a remote sensor 25" long and can be mounted many feet away. Size 1.5x1.2" 9vDC

DT-3 $8.95

**WIRELESS FM MICROPHONE**

Small but mighty, this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80-MHz to 120MHz FM. The frequency of any broadcast FM radio. Includes a mini-electret mike. 8.5"x5 to 12vDC

WM-1 $14.95

**VOLTAGE MONITOR**

This kit has 7 multi-colored 130MHz FM. Build it to work in 1v, 2v, or 1/4v steps. Great for nicad packs, autos, boats, mobile homes, or battery chargers. P.C.B. 1"x3.2x0.7" 9vDC

VM-1 $7.95

**BLINKY LIGHT**

This kit is perfect for decorating hats, name badges, & model trains. Add a box, set on the dash of your car, use it as an auto burglar alarm. Comes with 2 alternate flashing led's. Size 5"x5x9 to 12vDC

RB-2 $3.95

**WIDE BAND PREAMP**

Ideal for preamp for scanners, handheld radios, frequency counters. Amplifies low level (weak) signals. If the signal is extremely low 2amps can be used in series. 1MHz TO 25MHz @ 2.8dB of 1dB compression +0 dBm gain: 1MHz-20dB to 2.5GHz-6dB Requires 12vDC @ 18Ma

WBA-6 $19.95

**INDUCTANCE METER**

This is the kit every one has been asking for. Turn your digital volt ohmmeter into an inductance meter. It will read inductors 3uH to 7MH. Size 1.5"x1.6" 9vDC

IA-1 $14.95

**CAPTAIN**

$8.95

**THE ZAPPER**

activates any radar detector within 3/4 of a mile. Check the brake lights of that sports car that just went by 90 miles an hour. Back off those 18 wheelers trying to eat your back bumper. PUT the fun back in driving. THE ZAPPER is a 10GHz amateur transmitter the size of a cigarette pack, operates on a 9v battery, when the button is pushed, brake lights and radar detector light the skies. Complete with the rules of the new ROAD WARRIOR GAME... TROLLING FOR TAILGATES, America's fastest growing highway participatory sport.

Built Kit $49.95

$39.95

**DF-222 Kit**

$14.95

This Manual contains all schematics, parts & P.C. board layouts for all of the Rainbow Kits. Use your own parts to construct any of our kits.

KIT BOOK $14.95

$5.00 off if you buy any kit

Please add sufficient postage

First LB $4.00

We will accept telephone orders for Visa & Mastercard

To Order Call

317-291-7262

**ELECTRONIC RAINBOW**

6254 LaPas Trail • Indianapolis, IN 46268

**TV NOTCH FILTERS**

Our TV filters eliminate unwanted TV channels or interference that alters both sound & video with a beep-beep-beep. Works on cable channels 2 thru 22. and the 'SNOOPER & BULLET'.

Note: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

**RAINBOW KITS**

SUPER SNOOPER BIG EAR

PHONE TRANSMITTER

STROBE LIGHT

DIGITAL THERMOMETER

CAPACITANCE METER

WIRELESS FM MICROPHONE

VOLTAGE MONITOR

BLINKY LIGHT

WIDE BAND PREAMP

INDUCTANCE METER

THE ZAPPER

TV NOTCH FILTERS
**ANSWERING MACHINE CODE-A-PHONE 1750**

**FEATURES:**
- One-Touch Playback
- Auto Out Going Message Check
- Built in Cassette
- Voice-Activated Recording
- Fast Forward, Pause, & Rewind
- Ring Delay (1, 2, 3, 4)
- LED Message Display
- Variable Outgoing Message (Save or Erase)
- No Call Disconnect
- (RFE MINT COND)
- Commercial Quality
- Original Cost $179.99
- BRIGAR SPECIAL SALE!
  - $16.95 EA.  10 FOR $140.00

**RECTANGULAR LED SALE**
- Green - Diffused 2mm x 5mm
- MFG: HEWITT PACKARD
- PART # HLMP-S500
- 1 - 499 pcs .14 ea.
- 500 pcs & up .10 ea.

**FASTENERS & HARDWARE**
- **TYPE SBH**
  - BINDER HEAD MACHINE SCREW
- 8-32 1/4" LONG ROUND HEAD SLOTTED
  - 100 PCS... $1.50 4.5 MILLION PCS.
  - 500 PCS... $7.00 IN STOCK QUANTITY
  - 1000 PCS... $12.00 DISCOUNT AVAILABLE

**DISKETTE FILES**
- Fellows 5.25" Diskette Filing Tray, Convenient Desktop Storage for Up To 60 Diskettes. Includes Protective Feet, Snap Closure Lid, Front Handle and Adjustable Dividers. List Price $9.00
- BRIGAR PRICE $4.00 EA.
  - 5@$3.50ea. 10@$5.00ea.

**6 DIGIT LED DISPLAY MODULES SENIOR / SEA8014SP**
- Display units mounted on PC board
  - 5 1/2" LONG X 3" WIDE WITH RESISTORS & LEDs
  - LED DISPLAY SIZE: 1 1/16" HIGH X .75" VIDE
  - COLOR: RED
  - GREAT FOR 6 DIGIT CLOCK
  - COST $12.95 EA.
- BRIGAR SPECIAL ONLY $2.00 EA.

---

**POWER TRANSFORMER**
- WITH 6' BLACK SVT 3 COND 18AWG POWER CORD. (#B1-1721-001-B)
- INPUT: 115VAC 60HZ. OUTPUT ONE: 9.5VDC 10MA. OUTPUT TWO: 38VDC 250MA. GREAT FOR MAKING POWER SUPPLY. TRANSFORMER
  - $3.50 EA.
  - 10 FOR...$32.50
  - 100 FOR...$300.00  SCHEMATIC INCLUDED

**MAGNETIC LATCHING RELAY DPDT 24 VDC**

**LATCHING RELAYS 24 VDC DPDT**
- P&B #R30-E0011 OR ALLIED CONTROL #T351X-41
- COIL 600 OHMS OPERATING, 1.6K OHMS LIST PRICE @ 100 FOR...$30.00 10@$3.00 EA.
- 15VA, OPERATING, CONTACT RATING 10 AMP, CONTACT RESISTANCE 100 MILLION OHMS, PROTECTORS, BROWN OUTS. SINGLE OUTLET

**POTTER & BRUMFIELD RELAY T90 SERIES LOW COST 30AMP DC COIL PC BOARD RELAY**
- P&B RELAY P/N T90W1D1215-02
- 12 TO 15VDC, SPST, NORMALLY OPEN
- HORIZONTAL MOUNT, OPEN FRAME, 430 OHM COIL RESISTANCE, CONTACT RATING 30 AMP @ 250VAC. BRAND NEW P&B BOXED
  - PRICE $5.50; 10 FOR $50.00; 100 FOR $40.00

**SURGE PROTECTORS**
- PROTECT COMPUTERS, PHONE EQUIP, VCR'S & OTHER SENSITIVE DEVICES FROM ELECTRICAL STORMS & BROWN OUTS. SINGLE OUTLET.

**SL WABER - POWERMASTER MODEL#EP1**
- LIST PRICE $8.95
- BRIGAR SALE PRICE $3.95

---

**SALE**

**PHONE MAIL OR FAX IN YOUR ORDER TODAY**

**FAX: 24 HOURS**
- 607-723-3111
- (607) 723-5202

**SEND FOR FREE CATALOGUE**

**PHONE**
- 607-723-3111

**BRIGAR ELECTRONICS**
- 7-9 Alice Street - Offices and Warehouse - Binghamton, N.Y. 13904

---

**Digital Panel Meters**

---

**CIRCLE 266 ON FREE INFORMATION CARD**
DATA ACQUISITION WITH THE PC

CONWAY Engineering, Inc. distributes the complete range of computer controlled measuring instruments of TiePie engineering. Connecting these instruments to a PC (MS-DOS 3.0 or higher) results in a number of comprehensive test instruments:

- oscilloscope;
- voltmeter;
- spectrum analyzer;
- frequency meter;
- transient recorder.

All measured data can be stored on disk or be printed out. Because of the many trigger possibilities you can measure a variety of signals, while the powerful software enables you to carry out a multitude of measurements in a straightforward manner. Application areas: service; medical research; automatic test systems; research and development; and education.

LOW COST: HANDYPROBE

Connect the HANDYPROBE to the parallel printer port of the PC and start the software. Measuring can be carried out at once. The HANDYPROBE does not need external power supply. Some technical specifications:

- 0.5 ... 400 volt software select input range;
- 100,000 samples/sec.;
- one input channel;
- 8 bits resolution (overall accuracy 2%).

A complete software program consisting of a digital storage oscilloscope, spectrum analyzer, voltmeter and a transient recorder is provided. HANDYPROBE is very suitable for servicing and educational purposes.

MULTIFUNCTIONAL: TP5008

The TP5008 is an interface card that provides an analog output in addition to two input channels. This output in combination with the two inputs may be used for the setting up of a complete control loop. The output may also be used as a function generator. The TP5008 has a resolution of 8 bits and a sampling rate of 200,000 samples/sec (200 KHz). The input range may be set to 0.5 ... 20 volt full scale deflection. The output range covers 1.25 or 2.5 volt. The TP5008 is fitted with BNC connectors and is delivered complete with a user manual and software. Separately available are 1:1-1:10 probes and 1:100 oscilloscope probes.

BEST PERFORMANCE: HANDYSCOPE

The HANDYSCOPE is connected to the parallel printer port. This makes it possible to carry out measurements with a laptop or notebook PC. Due to its high resolution (12 bits), the HANDYSCOPE is a very accurate unit. The measuring time is 100,000 samples/sec. Either of the two channels can be set independently over a range of 0.5 ... 20 volt (with a 1:10 probe up to 200 volt). The advanced software enables many measurements to be carried out. Two probes (switchable 1:1-1:10) are provided. The HANDYSCOPE is constructed as a small table model with two BNC connectors. The length of the cable linking the PC and the HANDYSCOPE is 1.8 m which can be extended to 3.8 m.

VERY HIGH SPEED: TP208

The TP208 is an interface card with a measuring time of 2x20 Megasamples/sec (8 bits). Phenomena shorter than 1 millisecond of a second can still be measured well. The completely digitized triggering ensures very stable triggering with many trigger possibilities. The TP208 has an input range of 5 mvolt/div ... 20 volt/div (12 steps) and an auto calibration function. Since both channels may be sampled simultaneously, phase differences can be measured very accurately. Even single phenomena can be measured since each channel has a 32 KByte memory. Comprehensive software is provided.

Interested? Then call 1-800-626-6929 (toll-free) for a FREE demo diskette!

CONWAY Engineering, Inc.
8393 Capwell Drive, Oakland, California USA 94621-2113. Tel.:(510) 568-4028. Fax:(510) 568-1397
CIRCLE 294 ON FREE INFORMATION CARD
### VACUUM TUBE DEALER PRICE LIST October '93

**SOVTEK®, RUSSIA**

<table>
<thead>
<tr>
<th>Tube</th>
<th>5881/6L6WGC</th>
<th>5AR4/GZ34</th>
<th>5U4G</th>
<th>5Y3GT</th>
<th>6550WA</th>
<th>6922</th>
<th>6CA7/EL34</th>
<th>6L6GC</th>
<th>6V6GT</th>
<th>7199</th>
<th>12AX7WA/7025</th>
<th>12AX7WB/7025</th>
<th>EL84/6BQ5</th>
<th>6L6M/6BQ5WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$6.90</td>
<td>$6.90</td>
<td>$4.90</td>
<td>$3.90</td>
<td>$15.90</td>
<td>$9.00</td>
<td>$9.50</td>
<td>$3.60</td>
<td>$3.90</td>
<td>$5.90</td>
<td>$10.90</td>
<td>$12.00</td>
<td>$2.40</td>
<td>$6.50</td>
</tr>
<tr>
<td>October '93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**USED BY:**
- FENDER, SOLDANO, VTL, BRUNO
- MATCHLESS
- MESA BOOGIE DUAL RECTIFIER
- AUDIO RESEARCH, MANLEY, JADIS
- AUDIO RES., MELOS, CONVERGENT
- SLM
- HARTKE, (Hi Gain 12AX7) CARVIN, DEMETER
- PEAVEY, HUGHES & KETTNER

#### SINO, CHINA

<table>
<thead>
<tr>
<th>Tube</th>
<th>300B</th>
<th>807</th>
<th>845</th>
<th>2A3</th>
<th>6L6GC</th>
<th>&quot;Coke&quot;</th>
<th>12AT7/ECC81</th>
<th>EL34</th>
<th>5U4GB</th>
<th>7868</th>
<th>6550a</th>
<th>12AT7/ECC81</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$79.00</td>
<td>7.90</td>
<td>8.40</td>
<td>11.50</td>
<td>4.80</td>
<td>12.00</td>
<td>$3.90 each</td>
<td>$8.00</td>
<td>$12.80</td>
<td>$17.50</td>
<td>$11.50</td>
<td>$3.90 each</td>
</tr>
<tr>
<td>October '93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**EI, YUGOSLAVIA**

<table>
<thead>
<tr>
<th>Tube</th>
<th>12AT7/ECC81</th>
<th>EL34</th>
<th>E83CC/12AX7a</th>
<th>5U4GB</th>
<th>5U4GB</th>
<th>807</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$3.90 each</td>
<td>$8.00 each</td>
<td>$5.80</td>
<td>$12.80 each</td>
<td>$11.75 each</td>
<td>$79.00 each</td>
</tr>
<tr>
<td>October '93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GE, USA**

<table>
<thead>
<tr>
<th>Tube</th>
<th>5U4GB</th>
<th>12AT7/ECC81</th>
<th>EL34</th>
<th>E83CC/12AX7a</th>
<th>5U4GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$12.80 each</td>
<td>$3.90 each</td>
<td>$9.50</td>
<td>$5.80</td>
<td>$12.80 each</td>
</tr>
<tr>
<td>October '93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### SOLID STATE RECTIFIER

Built into tube socket. Direct plug-in replacement for all 5Y3, 5U4 and 5AR4 types. $5.90 each, 10 at $5.50 each.

<table>
<thead>
<tr>
<th>Tube</th>
<th>5U4GB</th>
<th>12AT7/ECC81</th>
<th>EL34</th>
<th>E83CC/12AX7a</th>
<th>5U4GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$12.80 each</td>
<td>$3.90 each</td>
<td>$9.50</td>
<td>$5.80</td>
<td>$12.80 each</td>
</tr>
<tr>
<td>October '93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MATCHING AVAILABLE ON MOST OCTAL POWER TUBES 75¢ extra per tube. Free on 26+ on one tube. "PLATINUM" MATCHING ALSO AVAILABLE WITH 24 HOUR TEST AND BURN-IN, ENSURING PREMIUM MATCH. PAIRS, QUADS or SEXTETS $2.00 extra per tube.**

**MINIMUM ORDER $50.00**

**SURFACE SHIPPING: ADD $5.00 PER ORDER USA, $10.00 PER ORDER CANADA, HAWAII, ALASKA**

**NEW SENSOR CORPORATION**

133 Fifth Avenue New York City, NY 10003
(212) 529-0466 1-800-633-5477 Fax (212) 529-0486
CIRCLE 268 ON FREE INFORMATION CARD
"ITC" The Only Affordable Full Function Spectrum Analyzer

PRICES START AT $1295.00
SA600 MODEL 2mHz - 600mHz

A MUST FOR:
- COUNTERSURVEILLANCE
- SATELLITE TELEVISION
- RF ALARM SYSTEMS
- TWO-WAY & HAM RADIO
- ALL RF BASED SYSTEMS

You Do Not Have To Spend $10K To Get a Full Function Spectrum Analyzer (HP. TEK etc.) And Don't Spend $3K to $4K For So Called Low Cost Limited Function Analyzers. (Avcom, B&K, ProTek) ITC delivers full function Analyzers for less. Let's look at the features ITC Spectrum Analyzers provide.

SA SERIES PRICES:
SA600A $1295.00
2mHz to 600mHz
SA1000A $1595.00
2mHz to 1000mHz
SA1800A $1895.00
2mHz to 1800mHz

80 dB DYNAMIC RANGE ON SCREEN. ITC Exclusive EFPLA Log Amp. (pat. pending) Other low priced units only have 60 dB or 70 dB on screen.

-110 dB SENSITIVITY AT ALL SPAN WIDTHS. Only ITC provides -110 dBm .7 uv. sensitivity at wide & narrow span widths. Other low cost units provide 80 - 95 dB only at narrow Spans.

HIGH STABILITY Only ITC Analyzers provide high stability and low drift at any span. (I < then 1kHz per Hr. after warm-up)

CALL 1-800-232-3501 FOR SPECIAL INTRODUCTORY OFFER ON ALL MODELS

FUNCTIONS:
- 105
INDUSTRY STANDARD
TEKTRONIX 491
SPECTRUM ANALYZER
Covers 10 Mhz - 40 Ghz. Solid state portable unit features internal phase lock, minimum sensitivity is -100 dBm. A 12.4 Ghz mixer is included with each unit. External mixer kit (40 Ghz) and attenuators are available with purchase of each 491 for $400.00 extra per set. Price: $1,200.00 ea. Checking.

R390A RECEIVER
"The CLASSIC RADIO RECEIVER that is still a great investment". These units are complete with orig meters and cover the frequency range of 0.5 - 32 Mhz in AM, CW, MCW with direct frequency readout via mechanical digital display - checked complete, less covers. Price: $295.00 Used Repairable

EATON 380K11/PM3802
SYNTHESIZED SIGNAL GENERATOR
This high speed RF Sweep Generator operates from 1Mhz-2000Mhz. Modulation is AM, FM, or Phase. This unit contains a high performance ovenized oscillator and HPIB interface. High-speed frequency switching time of 20 microseconds is unique to this unit, manuals available. Price: $3775.00 Checked/Operational

COLLINS 30L-1
POWER AMPLIFIER
One of the finest mid-size linear amplifiers ever produced specifically for the Premier Ham Radio Operator. It covers the 80,40,20,15 and 10 meter bands in either SSB, CW, RTTY or SSTV modes. Input drive power is 70-100 watts for full output. Power input is 1200watts, @ 115/230 vac 60 Hz. Output power is 650 watts RF (1000w @ reduced duty cycle).

Price: $3775.00

RACAL RECEIVER
RA 6790/GM
Superior quality and design are standard in this 500Khz-30Mhz general coverage receiver. Modes of operation are AM,FM, CW, U/LSB, LSB -optional, with room for seven bandpass filters. The illuminated LCD display features large readable digits for frequency and mode status as well as AF or RF signal strength. Tuning can be directly entered via keypad or with a tuning knob. Three different gain modes are Manual, Automatic, and Automatic with selectable threshold. Fully Checked & Operational. Price: $995.00 Radio only-less filters. Bandpass Filters: 400Hz/1.2KHz/2KHz/6.8KHz 16KHz/USB/LSB are $65.00 ea. max 4 per unit.

All Prices in U.S. Dollars
Please include telephone/fax number with mail-in orders. Orders must be prepaid by guaranteed Instrument.

Manuals available at extra cost

MARCONI SYNTHESIZED SIGNAL GENERATOR
Model 2018
Freq range 80Khz-520Mhz with calibrated output levels from -127 dBm to +13dBm. Resolution 10Hz. It can be Freq, phase or amplitude modulated from ext or int modulation sources. RF output resolution is 0.1dB, reversepower protection of up to 50W is possible without damage to the instrument. This instrument is microprocessor controlled and very easy to use, a must for any serious repair or development lab. Price: $1500.00 Fully Checked

HEWLETT PACKARD
8568A SPECTRUM ANALYZER
This High Performance instrument features 10 Hz resolution over the 100Hz - 1.5GHz freq range. Automatic zoom, signal track, multiple store/recall are only a few of the very useful functions you will find coupled with high accuracy time base and built in frequency counter. Price: $9995.00 Fully Checked

R1051B RECEIVER
Covers 2Mhz - 30 Mhz LSB, USB, ISB, AM, CW & FSK Navy Shipboard Design. Direct Frequency readout, Accurate High Stability Time Base. Requires 115VAC 60 Hz for operation. Price: Used Repairable $275.00

CIRCLE 199 ON FREE INFORMATION CARD
viewing signals from antenna aiming. The analysis subcomponent. noise temperature affect picture quality. The changing parameters orientated TVRO owners. Demonstrates how professionals installing An
VHS time flat with this professional video. 5.25' and listed. The user presently world-wide View-elevation angles and range
The aiming especially useful program performs both TVRO system analysis and professionals installing VHS time flat with this professional video. 5.25' and listed. The user presently world-wide View-elevation angles and range
The aiming especially useful program performs both TVRO system analysis and professionals installing VHS time flat with this professional video. 5.25' and listed. The user presently world-wide View-elevation angles and range
The aiming especially useful program performs both TVRO system analysis and professionals installing VHS time flat with this professional video.

Skyvision Inc.*
1046 Frontier Drive, Fergus Falls, MN 56523 - Toll Free 800-334-6455
Mail in coupon or call today for the SKYV/SION Satellite TV Product Catalog/Buyers Guide Delivered free to your mailbox in U.S. and its possessions.

☑ Send Free Domestic Satellite TV Products Catalog
☑ Send International Satellite Catalog (For International Catalog add $5.00 to cover S&H)

Name ............................................ Phone ( )
Address ..........................................
City ...............................................
State ...............................................
Zip ............................................... 

Install A System, Upgrade & Repair Yourself And Save $$$$ 

Call Toll Free 800-334-6455 International 1-218-739-5231 Fax 218-739-4879
<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1001-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1002-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1003-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1004-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1005-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1006-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1007-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1008-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
</tbody>
</table>

**MISCELLANEOUS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1601-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1602-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1603-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1604-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1605-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1606-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1607-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1608-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
</tbody>
</table>

**PRECISION LAB INSTRUMENTATION**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1801-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1802-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1803-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1804-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1805-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1806-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1807-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
<tr>
<td>1808-077-00</td>
<td>METER, FDS 224940 SPECTRUM ANALYZER 300 MHz</td>
<td>$1,090.00</td>
</tr>
</tbody>
</table>

**OVERSTOCK SALE!!!**

AS IS/OFF SHELF

**THE LARGEST USED & REFURBISHED TEST EQUIP**

**120 DAY WARRANTY**

ALL EQUIPMENT GUARANTEED
### Prices You Can't Beat!

**IMMEDIATE SHIPMENT FROM STOCK • SATISFACTION GUARANTEED**

**SOUTHPAW ELECTRONICS**
Serving The Electronics Industry For Over 50 Years

---

### Capacitors

<table>
<thead>
<tr>
<th>MFD Volts</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>.35 ea.</td>
</tr>
<tr>
<td>33</td>
<td>.35 ea.</td>
</tr>
<tr>
<td>47</td>
<td>.35 ea.</td>
</tr>
<tr>
<td>68</td>
<td>.35 ea.</td>
</tr>
<tr>
<td>82</td>
<td>.35 ea.</td>
</tr>
<tr>
<td>100</td>
<td>6.3/10</td>
</tr>
<tr>
<td>150</td>
<td>1.50 ea.</td>
</tr>
</tbody>
</table>

Minimum 10 pieces per type

---

### Hobbyist Special!

#### Display Assortment

- **Contents:** Half - Single - Dual Digit Units
- **Common Cathode/Anode:** Reds & Greens
- **25 pc. ass't:** $9.95

---

### New Special

**486 SUPER COOLER FAN SYSTEM**

- **Snap on mount — no tools required!**
- **Spring loaded heat sink — assures maximum heat transfer!**
- **Powerful 5500 RPM 12 VDC Fan**
- **Dual power plugs — fits all PC's individually boxed**

**$19.95 each**

---

### LED's

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>T.I.</td>
<td>$9.60</td>
</tr>
<tr>
<td>G.E.</td>
<td>$3.30</td>
</tr>
<tr>
<td>G.E.</td>
<td>$3.25</td>
</tr>
</tbody>
</table>

### Transformer

**Power X'tmer**
- **General Purpose:**
- **American Mfg.:** Primary: 115V 60Hz
- **Secondary:**
  - #1 5VAC @ 4.0 Amp
  - #2 24VAC @ 4.0 Amp
  - 3-1/2" Mounting Centers
  - 2-1/2" x 3" L x 1" W

**Special:** $5.75 ea

### POWER Supply

**230 Watt Cherokee Switching Power Supply**

### ELECTRICAL TAPE

- **Black Electrical Tape:** 3/4" x 60'
- **PVC, Made In USA:** $7.75 per roll

### Solder

- **Kester 60/40 Rosin Core Solder:** 1 lb. Rolls
  - $5.99 each

### Electrolytic Capacitors

- **Nichicon - Snap-In Lytic**
  - 220MFD 160VDC
  - (22x30mm) $6.0ea
  - (25x50mm) $15.0ea
  - 470MFD 200VDC
  - (35x30mm) $6.0ea
  - 10,000MFD 25VDC
  - (30x31mm) $2.25 ea

### COAX Cable

- **50Ω Teflon Electric**
  - Type RG178/U1100-
  - $20.00-
  - $14.15

### LED Kit - "Super Value"

- **All Colors - All Sizes**
- **Kit #100**
  - 100 asstd. $4.99/kit
- **Kit #500**
  - 500 asstd. $18.90/kit

### COOLING fans

- **285 VAC @ 150 MA**
- **Import $4.50 ea.**
- **Import $2.75 ea.**

---

### Auto Adapters

- **Standard 12V Auto Lighter Adapters**
  - 18/2 Cable
  - 4 Long Stripped/Tinned
  - $1.20 each
  - 10 Lot/$1.00 each
  - With 4 Amp Fuse
  - No Case
  - $1.50 each
  - 10 Lot/$1.25 each

## Order Toll-Free 1-800-851-8870

FREE CATALOG & INFORMATION (516) 352-7070 • FAX (516) 775-5091

Minimum Order $25.00 • VISA - MasterCard • Checks & Money Orders On Mail Orders • Open Account Available To Qualified Firms

No COD • NY, NJ, CT Orders Add Sales Tax • Shipping & Handling $4.75 For Continental U.S. • All Others Pay Full Shipping Charges

Prices Subject To Change Without Notice • Quantities Limited On Some Items • Call/Write For FULL-LINE CATALOG & Quantity Pricing

Mail Orders To: SOUTHPAW ELECTRONICS, PO Box 886, New Hyde Park, NY 11040-0311

CIRCLE 314 ON FREE INFORMATION CARD
Recognized as the two best
PC-diagnostic tools on the market.

NOW AVAILABLE IN ONE GREAT PACKAGE...

Micro-Scope™
UNIVERSAL DIAGNOSTIC SOFTWARE

Recently named as PC Upgrade Magazine's Utility of the Month.

MICRO-SCOPE Universal Computer Diagnostics was developed to satisfy the expanding need for accurate system diagnosis in the rapidly growing desktop computer market.

- CACH MEMORY—"Micro-Scope" Ver. 5.0 now fully tests cache memory and the cache controller subsystem.
- LOW LEVEL FORMAT Ability to do factory style initialization of all IDE drives, together with the ability to do factory style low level formatting on all drives, including MFM, RLL, ESDI, SCSI and all IDE drives.
- O/S INDEPENDENT—Does not rely on O/S for diagnostics. Talks to PC on a hard-ware level regardless of the O/S or CMOS setting.
- TRUE HARDWARE DIAGNOSTICS—Accurate testing of CPU, IRQs, DMA, memory, hard drive, floppy drive, video cards, etc.
- DISPLAY DRIVE TYPE—Reads and displays the actual drive parameters for any drive type automatically.
- CPU DETERMINATION—This capability is necessary for accurate system diagnosis on 386sx, 486DX and 387 and 487 chip implementations. Because each of these specific chips has its own unique instruction set, and therefore cannot be accurately diagnosed with any program which cannot recognize these differences.
- MEMORY TEST—"Micro-Scope" 5.0 has no limitations as to the size of memory it can accurately test. Micro-Scope now also tests VIDEO MEMORY (up to 2 MB)! MEMORY EXAMINE—Displays any physical bit of memory. Very useful for determining memory conflicts. Very useful for determining available memory space.
- BATCH CONTROL—All tests, even destructive, may be selected for testing.
- ERROR LOGGING—Automatically inputs errors during testing to an error log.
- AUTOMAPING—Automatically bad sector maps errors found on hard disk.
- IRQ DISPLAY—Shows bits enabled in IRQchip for finding cards that are software driven. (Network, Tape Backup, etc.)
- IRQ CHECK—Talks directly to hardware and shows IRQ address and IRQ of devices that respond.
- SECTOR EDITOR—Allows the editing of any sector of floppy or hard disk media (even track 0).
- AND MUCH MORE... We don't have enough space here for everything this software can do!

The only Power-On Self-Test card you need to debug any "dead" PC!

SERVICE NEWS

Recently named as Product of the Month in the July issue of Service News.

"This is the only card that will function in every system on the market. The documentation is extensive, and not only covers the expected POST Codes for different BIOS versions, but also includes a detailed reference to the bus signals monitored by the card." —Scott Mueller from his globally recognized book, 'Upgrading & Repairing PCs, Second Edition'

- Includes pads for voltmeter to attach for actual voltage testing under load.
- 4 LEDs monitor +5vdc -5vdc +12vdc -12vdc.
- Monitors Hi & Lo clock and OSC cycles to distinguish between clock chip or crystal failure.
- Monitors I/O Write and I/O Read to distinguish between write and read errors.
- Monitors memory write/read to distinguish between address line failures and memory chip failures.
- Monitors ALE for proper CPU/DMA operation.
- Monitors Reset to determine if reset is occurring during POST, indicating short.
- Monitors progress of POST without POST codes.
- Read: POST codes from any IBM or compatible that ems POST codes. ISA/EISA/MCA.
- Compatible with Micro Channel computers.
- Dip switch allows easy selection of I/O ports to read.
- Includes tri-state LOGIC PROBE to determine actual chip failures.
- Manual includes chip layouts anc detailed POST procedures for all major BIOS's.

This is the perfect package for all repair technicians and self-maintainers.

Call MICRO 2000, Inc. for volume discounts and after sales service!

• 1-800-864-8008 •
1100 E. Broadway, Suite 301
Glendale, California 91205
818-547-0125 • Fax 818-547-0397

CIRCLE 304 ON FREE INFORMATION CARD

January 1994, Electronics Now
**WHERE YOU'RE TREATED POLITE AND GIVEN INDIVIDUALIZED ATTENTION!**

INFO (708) 250-8690/FAX (708) 250-8755
P.O BOX 26 • WOOD DALE, IL 60191
Call C.S.T. Monday thru Friday 9:00 - 6:00 • Sat. 10:00 - 2:00
Friendly Courteous Service • 12 Yrs. Experience • 6 Mo. Warranty

<table>
<thead>
<tr>
<th>JERROLD</th>
<th>PIONEER</th>
<th>SCIENTIFIC ATLANTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEW TRI/BI COMBO (FTB)</td>
<td>1-3</td>
<td>NEW SA-PIO-COMBO</td>
</tr>
<tr>
<td>NEW TRI/BI PAN</td>
<td>130.00</td>
<td>NEW SA-PIO-PAN W/SWITCH</td>
</tr>
<tr>
<td>NEW SB-3 COMBO</td>
<td>115.00</td>
<td>NEW ORIG. BA-6100 PAN</td>
</tr>
<tr>
<td>NEW SB-3 PAN</td>
<td>60.00</td>
<td>CALL</td>
</tr>
<tr>
<td>DPV-7212</td>
<td>CALL</td>
<td>CALL</td>
</tr>
<tr>
<td>CAMOUFLAGE TRI/MODE</td>
<td>CALL MIKE</td>
<td>MIKE</td>
</tr>
<tr>
<td>NEW FTB-2</td>
<td>85.00</td>
<td>NEW SA-3 COMBO (SA-3B)</td>
</tr>
<tr>
<td>NEW SB-2</td>
<td>75.00</td>
<td>NEW SA-3 PAN</td>
</tr>
<tr>
<td>HAMLIN</td>
<td>60.00</td>
<td>8550:</td>
</tr>
<tr>
<td>NEW HAMLIN COMBO(CH 2 OR 3)</td>
<td>1-3</td>
<td>8580:</td>
</tr>
<tr>
<td>NEW HAMLIN MLD-1200</td>
<td>110.00</td>
<td>8580:</td>
</tr>
<tr>
<td>MLD-1200-2</td>
<td>50.00</td>
<td>CALL</td>
</tr>
<tr>
<td>Price effective 1/1/93</td>
<td>(Subject to change without notice)</td>
<td></td>
</tr>
</tbody>
</table>

**MOST ORDERS SHIPPED SAME DAY!**

<table>
<thead>
<tr>
<th>QTY.</th>
<th>ITEM</th>
<th>PRICE EA.</th>
<th>TOTAL PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SUB TOTAL**

**SHIPPING** Add $4.00 per unit

**$4.50 PER COD TAG/CREDIT CARDS** Add 5%

**TOTAL**

**ABSOLUTELY NO ILLINOIS SALES**

**SIGNATURE**

Yes, I am paying for full service. This is only to be used as a second unit.

DECLARATION OF AUTHORIZED USE • I, the undersigned, do hereby declare, under penalties of perjury, that all products purchased, now and in the future, will only be used on cable TV systems with proper authorization from local officials or cable company officials in accordance with all applicable federal and state laws. FEDERAL AND VARIOUS STATE LAWS PROVIDE FOR SUBSTANTIAL CRIMINAL AND CIVIL PENALTIES FOR UNAUTHORIZED USE.

**VISA-MASTER □**

**CASHIER’S CHECK □**

**C.O.D. □**

**MONEY ORDER □**

ORDERS ONLY: 1-800 735-5912

Card # _ Exp. Date _

Name _

Address _

City _ State _ Zip _

Phone ( )

If for any reason you are not satisfied with any item purchased, you may return it within 30 days of delivery for a full refund.

CIRCLE 300 ON FREE INFORMATION CARD
Panasonic®

CONVERTER

WITH ANY DECODER

$69 EA.

Test Kits & Chips
ALL AD PRICES ARE FOR 10-19 PIECES

STARCOM 7BB .................. $14.50
STARCOM 6BB .................. $14.50
SA 8580 ........................ $14.50
TOCOM 5503 MAPPER .......... $7.00
TOCOM 5507 ........................ $7.00
DP-5 CHIP ........................ $7.00
ZENITH ST ...................... $8.00

Combination Units
ALL AD PRICES ARE FOR 5-9 PIECES

ZENITH ST-1600 $199
W/KEY FOR PARENTAL GUIDANCE
NEW REMOTE, A/V OUTPUT

JERROLD DP-7, DPV-7 $159
ONE PIECE, REPLACEMENT
BRAND NEW! WITH REMOTE

Call for other Original Equipment by Jerrold, Pioneer, SA, Tocom...

C.O.D.  VISA  MasterCard  DISCOVER

HIGHLANDER

800-338-0400
6325-9 Falls of the Neuse Road Raleigh, NC 27615

30 day Money Back Guarantee. Your Satisfaction is Guaranteed!

BE SAFE!
Don't buy Cable Equipment from anyone that isn't authorized to display this seal
CHRISTMAS SALE!

Save on cable rental fees!

CABLE TV
DESCRAMBLERS
WE'LL BEAT ANY PRICE
JERROLD—TCom—ZENITH—HAMLIN—OAK
PIONEER—SCIENTIFIC ATLANTA
• 24 HOUR SHIPMENTS!
• 30 DAY MONEY BACK GUARANTEE! • QUANTITY DISCOUNTS!
MASTER CARD / AMEX / VISA / C.O.D
Have make and model number of equipment used in your area ready. All Shipping & Handling Fees at Customer's Expense.

CALL TOLL-FREE 1-800-284-8432
CABLE WAREHOUSE
10117 West Oakland Park Blvd., Suite 315, Sunrise, FL 33351
NO FLORIDA SALES
Anyone implying theft of service will be denied assistance.

Earn $4,000 Per Month From Your Home With A Computer!

Begin part-time and still retain the security of your present position. This is a proven turnkey business an individual or couple can run. If you purchase our software and business program, we will give you the computer and printer. If you already own a computer, you may receive a discount. You do not need to own, or know how to run, a computer—we will provide free, home office training. Financing available.

FREE CBSI 466 SX Computer

Learn how other couples, and individuals like yourself, are building a lifetime income!

To receive your free cassettes and color literature, call toll-free:
1-800-343-8014, ext. 1156
(in Indiana: 317-758-4415) Or Write:
Computer Business Services, Inc., CBSI Plaza, Ste. 1156
Sheridan, Indiana 46069
LATEST TECHNOLOGY

- DESCRAMBLERS
- CONVERTERS
- COMBINATION UNITS

WE'LL BEAT ANY PRICE!

LATEST DESCRAMBLER MODELS
Add On Descrambler for all JERROLD Systems (Except Base Band) Guaranteed to Work Anywhere Coast to Coast (Model JD-3)
$89 6-10
$119 1-5
Add On Descrambler For All PIONEER Systems. Guaranteed to Work Anywhere Coast to Coast. (Model PD-3)
$89 6-10
$119 1-5
Add On Descrambler For All SCIENTIFIC ATLANTA Systems (Except 8570, 8590, 8600). Guaranteed to Work Anywhere Coast to Coast. (Model SAD-3)
$89 6-10
$119 1-5

1. ZENITH
$259 6-10
$289 6-10
Features
- Wireless Remote Control
- Frequency: 550MHz (99 Channel) capacity
- Volume Control
- Parental Lock-Out
- Programmable Favorite Channel Memory

2. SCIENTIFIC ATLANTA 8580
$259 6-10
$289 6-10
Features
- Wireless Remote Control
- Favorite Channel Recall
- Parental Lockout

3. ADD ON DESCRAMBLERS
1-5 6-10
FTB-3 49.00 39.00
TVT OR TBI 55.00 47.00
SA-3 59.00 49.00
KN12-3 59.00 49.00
MDL1200-3 49.00 39.00

4. CONVERTERS
1-5 6-10
PANASONIC 1453G 79.00 69.00
JERROLD DON7-3 75.00 65.00
STARGATE 2001 75.00 65.00

FREE COLOR CATALOG!
1-800-950-9145

CIRCLE 197 ON FREE INFORMATION CARD
0078 CODE KEY
Adjustable, heavy-duty brass brace with half-scaling poles. Designed for 1.25" holes. 3/8" plated posts...
$11.75

MASTERING THE Morse Code
This book teaches the beginner how to learn the Morse Code. Some of the topics covered are rules for practicing the Code, the step alphabet, how to send and receive code, how to build and hook up a code practice oscillator, 32 pages...
$2.50

MAGNET WIRE
= Standard enamelled wire for winding coils, transformers and terminals. Prices for 1/4 lb. spools...

#14 .024 .325 0.373 #18 .028 .385 #22 .035 .420 #26 .039 .440...

REGULATED POWER SUPPLIES
13.8 VDC
Perfect for ham equipment, 800 car radios, etc. and other 13.5 VDC devices. LED on indicator, how to set and receive. Protective. Binding post. 2 year warranty...

3 AMP $29.50
4 AMP $29.50
5 AMP $29.50
10 AMP $29.50
30 AMP $139.50

ORPDI ELECTRIC
110 VAC 60Hz 15A 700W...

CODE PRACTICE
Oscillator & Monitor in Kit
A solid state code practice oscillator and monitor that uses the standard IC SN75176. It contains a 2.7 built-in speaker, headphone terminals, a volume control and a tone control. It is all kit packaged. Includes 2 coil formers. With the addition of a few parts, the unit can easily be converted into CW monitor. The kit can then be used as an operating aid after the coater has been loaded. KIT...
Wired $24.95

DELUX CODE KEY
Adjustable, heavy-duty brass brace with half-scaling poles. Designed for 1.25" holes. 3/8" plated posts...
$12.95

TO LEARN COMPUTER THEORY BY BUILDING THIS KIT
DIGITAL TRAINER MODEL MM-8000
Starting from scratch you build a complete computer system. Our Micro-Master Trainer teaches you to write in Plikie. ROMs and a 1001 microprocessor. You select the instruction set and build the system to suit your requirements. Each module is designed to build a working computer system. They are relatively inexpensive, very easy to understand and very effective in building a working computer system. Includes 16 pages of instructions. Price...
$24.95

TO ORDER
Call 1-800-866-6626
$18.95

(a) Catalog requests can not be taken on toll free number.

2.25

$19.95

ORDERED AT $12.95

TO ORDER
Call 1-800-866-6626

$2.25

Before shipping)

HAWAII $9.00

ALASKA $9.00

ALBERTA $10.00

ORDERS ONLY

$7.50

$12.00

$5.95

$14.95

CIRCLE 260 FOR FREE INFORMATION CARD

116

OCEAN STATE ELECTRONICS
PROFESSIONAL, AMATEUR, OR COMMERCIAL - WE'RE YOUR ONE STOP ELECTRONIC SOURCE
CALL OR WRITE FOR OUR FREE 112 PAGE CATALOG 1-401-596-3060

200 Watt Inverter
Plug into your lighter and run...

- Ham Equipment
- Lectures
- Smoothing iron
- Power Tools
- 12V TV with VCR
- MUCH MORE...

$99.95

DIGITAL CAPACITANCE/ INDUCTANCE METER
DIGITAL LCR meter measures inductance, capacitance and resistance. At Last! An LCR meter that everyone can afford! No calibration required. Comes with instructions, 20 page manual and 20 test leads. Price...

$119.95

VERNIER DIALS

- 5/2" Diameter - 0.001 Marking...
- 2" Diameter - 0.001 Marking...

$8.25

$10.25

SIGNALTRAN NE502AN
Sincrotron WDM-60. Padded mirror. Experimental building for DC and super high frequencies...

$2.49

$5.69

THE FORREST MIMS ENGINEERS
NOTEBOOK Forrest Mims
This notebook contains the number of power supply circuits—handbook for the Forest-Engineering students. The book contains a wealth of material on electronic circuitry. Price...

$14.95

MULTIVOLTAGE AC ADAPTER
Rated Input: 115VAC...

$10.95

$8.00

$2.25

$1.25
3.5 DIGIT MULTIMETER
Six functions, 14 ranges, AC/DC voltages up to 500V, diode and battery tests. Suntex 8701001
(92Z023) $12.95 each

PELTIER JUNCTION
Thermoelectric heat pump. Use to cool that '466, build a drink cooler, etc. Up to 65°C temperature differential. Size 1.1875" x 1.1875 x 0.125" Each with spec sheet. (93J004) $24.95 each

ELECTRET CONDENSER LAPEL MIKE
Operating voltage 3 - 9 V. Current 50 - 100 µA. Impedance out approx. 10 kΩ. (92J003) $4.95 each

WALL WART
110 VAC in, 9VAC @ 3.4 A out. (93J012) $5.95 each

2708 EPROMs
Brand new, cherry virgin. 39¢ each - 100 for $30.00

BUHELER 500:1 DC GEAR MOTOR
12 VDC, 70-110 mA. 10 RPM, 28 oz./in. torque, operating range 4-30 VDC. Measures approx. 1.5" x 1.5" x 1.25". Output shaft is 0.125" x 0.4375". (93M003) $7.95 each

6-WIRE STEPPER MOTOR
Superior Electric M091-FD-401, 6-wire stepper. Unipolar. 1.8°, 2.9V, 3.0A, 110 oz.-in. running torque, 15 oz.-in. holding torque. (93M004) $24.95 each

ROBOTPUSSY
This fun feline with an internal microprocessor control system is a marvel of state of the art technology, featuring DUAL DC DRIVE MOTORS with GEAR REDUCTION and two-inch diameter RUBBER TREED DRIVE WHEELS that provide excellent mobility and traction. Special integrated sound analysis and recognition circuitry allow you to command your Robot Kitty with simple hand claps. When your Robot Kitty hears your commands, it moves, meows and purrs, and its eyes light up. If you ignore it, it will "go to sleep" and then awaken at your command. Original retail price over $100.00! (92T003) $29.95 each

LAN CONNECTOR
Crimp on BNC male for RG-62 (93522). Amphenol PIN 999-226. (93J014) $12 for $9.95

MINI AUDIO AMP
One half Watt. Up your volume with this little gem. Easily hooks to your walkie-talkie or Walkman, or hook it up to your electronic guitar as a practice amp. Drives a speaker or headphones. Runs on 9-12 Volts. Specs and schematic included. Easy hook-up. (92A021) $9.95 each

FAMOUS BRAND SOLDER
Solid core, 0.25" dia.,eter. 29T/70L. (92Z012) $9.95 each

MINI SWITCHER
110 VAC input. Output +5VDC @ 2A, +12VDC @ 1A. -5VDC @ 1A. Measures 4" x 5.5" x 2". (92E042) $7.95 each

HAZARD LIGHT
Perfect for the boat, car, camper or for backpacking. The Vexilite Strobe Light provides an omnidirectional signal that is visible for miles. Uses ordinary "C" batteries (not included). (93L007) $14.95 each

'486 COOLING FAN
Brand new, in package. (92P004) $11.95 each

DB25 MALE TO DB25 FEMALE
3' long. (93W014) $3.95 each

CD ROM CAD
Fits Sony, Chicon, Toshiba, etc. Brand new. (93C018) $4.95 each

DIODE GRAB BAG
200 assorted diodes - signal, power, Schottky. Zener, etc. (925040) $3.95 each

DIFFUSED PLANAR DIODE
No. FDQ300 In-200mA @ V=1-0.9V I=1.0 mA @ V=125V, 25°C Iox=3 µA @ V=25V, 150°C. Capacitance @ 0V=6.0pF, Pd=500mW. Vref=125 V. Fast switching. (92P052) $1.25 each or 10 for $9.95

MINI ROTARY HEX SWITCH
(93B003) $1.79 each or 10 for $14.95

50 Lb. CARE PACKAGE
Surplus goodies from Silicon Valley. This is not junk, just material we've acquired in quantities too small to catalog: electronic and mechanical subassemblies for everything from robots to rock-ets. Assortments may include IC's, caps, connectors, bearings, diodes, hardware, circuit boards, cables. Weird and wonderful stuff. Most folks are happy with the assortments we send and reorder. (92J034) 50 Lbs. $49.95

MAR-3 MMIC
(93S003) $2.00 each
10 for $13.95

ALLEGRO 1.5A STEPPER MOTOR DRIVER IC
UCN5804. Single step, two phase and half step modes. New. (93S002) $4.50 each
+ Package with 12V stepper motor and schematics. (93S003) $9.95 each

DOMINO SIZED SUPER MAGNET
Approx. 500 Gauss. Measures approx 0.75" x 1.75" x 0.625". Very strong for its size. (93N011) 3 for $9.95

Also Visit:
Alltronics of Las Vegas
6283 Industrial Avenue
Las Vegas, NV 89118
(702) 897-7237

Circle 215 on free Information Card
INDUSTRIAL PRODUCTS AT HOBBYIST PRICES!

**Protek TEST INSTRUMENTS**

**20 MHz Afford-A-Scope**
- Dual channel, 6” CRT.
- Sensitivity 5 mV/div to 20V/div.
- Vertical modes: CH1, CH2, dual, add, subtract.
- Time Base 20 steps from 0.2 µsec plus X5 mag, X-Y, video sync.
- Two-year warranty.

P-3502 $389.00

**Regulated DC Power Supply**
- Output 0 - 30V, CV, 0 to 3A, CC.
- Two separate LED Displays (Green for voltage, Red for current).
- Short circuit overload protected with indicator LED.

3003 $249.00

**True RMS Expanded Function DMM**
- 3-3/4 digit, 4000 count, with bar graph.
- Auto ranging, with optical data output of V-O-A-Hz-CAP.
- Has relative set, min/max, memory data & range hold, plus unique adapter mode.
- Supplied with protective holster/stand, deluxe safety probes.

D-937 $139.00

**“Super-Value” VOM**
- 20 KΩ/V Sensitivity.
- Measures AC/DC volts, DC current to 10A, resistance, dB and battery test.
- Color coded meter scales, with anti-parallax mirror.
- Overload protected by Silicon Double Diode and 2A/250V fuse.

D-981 $125.00

**3-3/4 Digit “High Capability DMM”**
- Extra Large LCD, 4000 count with Bar Graph.
- Fully auto ranging for AC/DC volts, resistance, temp, capacitance and frequency, plus range and data hold, relative, min/max and auto power off.
- Supplied with protective holster, safety probes, “K” temp. probe.

A-403 $19.00

**Controlled-Output Soldering Stations**

**Weller**

WTCPT $149.00

- Transformer powered soldering station complete w/lightweight, low voltage, temp. controlled soldering iron.
- Special “closed loop” method of controlling maximum tip temperature...to protect temperature sensitive components.
- Power unit housing features impact resistant plastic for durability.
- Quick disconnect plug for soldering iron and lighted on/off switch.
- Station housing and iron are grounded with separate conductor that terminates @ third pin of power cord.

**Transistors-Diodes-ICs**

**Rectifiers-SCRs-TRIACs**

262,000 Item Cross Reference $4.95 ea.

ECG SEMICONDUCTORS

#1 Philips ECG Distributor in the U.S.!

RS ELECTRONICS

34443 Schoolcraft, Livonia, MI 48150

1-800-366-7750

FAX 313-525-1184

CIRCLE 312 ON FREE INFORMATION CARD
Diskettes/CD Storage Case
Convenient carrying handle with snap lock. Translucent hinged duct cover for maximum protection. Sectioned dividers for easy access. Cushioned feet to protect surfaces.

Power Supply Fan
12VDC @ 200mA ball bearing fan. 36 CFM with 12" wire leads. Size: 3-5/8" sq. x 11".

DOS® and Windows® Diskettes
Dos includes 0WBASIC

28 Watt Switching Power Supply
Input: 110/230VAC. Output: +5V @ 2A, +12V @ 1.5A. Power connections for disk drive and fan. Great external power supply. Size: 7" x 5-7/8" x 3-1/4".

No. 500-0084F $9.95 ea.

IBM PC/AT Case
Genuine IBM Case
Full Size AT Case
Accepts Micros
Full Size Motherboards
Slide-off Top
8 Slot Frame. Made in U.S.A.

No. 220-2758F $49 ea.

Mini 120V Vacuum Cleaner
Comes with 2 ft. hose and 10 ft. power cord. IBM part #071347. Removed from equipment, good condition. Includes one filter bag. Size: 4" Dia. x 12" (L).

No. 650-0205F $14.95 ea.

20" ECL Monitor
Non-working 20" paper white monitor has resolution of 1280x640 and includes 80 watt switching power supply, 18kV high voltage supply module and fuses power input module with voltage selector. Unit has 2PCB's with a great selection of parts such as case, voltage regulator, IC's, transistors, pots, etc. Metal and plastic case measures 14 1/2" (H) x 18" (W) x 18" (D).

No. 220-2762F $49.00 ea.

Single Channel Monitor Kit
This unit was originally a fixed frequency monitor on 157.255 MHz. With simple tools and minor modifications, you can monitor a VHF frequency (138-174 MHz) of your choice. Installation and optional squelch circuit data sheets included. Requires crystal. (Not included.)

No. 660-0043F $12.95 ea.

Radar Detector Mount
Window suction mount for easy installation. Complete with Valor pads for quick removal.

No. 660-0189F $99.95 ea.

IBM PC/AT Guide to Operations
An idea getting started guide for beginners. Comes with Exploring IBM Personal Computer Software. Learn the basics: keyboard commands, printer functions, disk storage, dos, basic programming and Winword a basic word processing package. Includes IBM AT Diagnostics Disk. (IBM #280102)

No. 220-0073F $80.00 ea.

240V Tabletop Transformer
Output: 15.5 VDC @ 23.25 Watts (1.5 amps) Input: 240 VAC, 50 Hz. 6 ft. input cord to transformer with 3 conductor fused United Kingdom type plug. Output line cord is 6 ft. with 2.5 mm coastal plug. Motorola #SPN4067A

No. 500-0205F $5.95 ea.
TEST EQUIPMENT AT DISCOUNT PRICES

48 HOUR SHIPPING

DIGITAL METERS

- Digital Multimeter
  w/ Inductance & Capacitance
  $75.00
  LCM-1850
  Ten Functions
  by Elenco

- Digital Capacitance Meter
  CM-1550B
  $58.95
  9 Ranges
  100 MHz, 10 uF, 00001 F
  5% basic accuracy
  Zero control w/ case
  Big 1" Display by Elenco

The Survivor
Model 2860
$89
B+K's Best DMM
Large 3-1/2 Digit
Rugged
Construction
Full Featured

Fluke Multimeters
Model 12... $79.95
Model 701... $65.00
Model 707... $145.00
Model 791... $169.00
Model 87... $289.00
Model 93... $1,095.00
Model 97... $1,695.00
All Models Available - Call

QUALITY AMERICAN MADE POWER SUPPLIES

- Digital Triple Power Supply
  XP-765
  $289
  0-20V @ 1A
  0-20V @ 1A
  5V @ 5A
  Fully regulated, Short circuit protected
  with 2 limit control, 3 separate supplies
  XP-660 with Analog Meters $195

- 12A DC Power Supply
  B+K 1686
  $169.95
  3-14V @ 12A
  Fully regulated & protected
  Separate Volt & Current Meters
  Current Limiting, Low Ripple

- Quad Power Supply
  XP-580
  $69.95
  2-20V @ 2A
  12V @ 1A
  5V @ 3A
  Fully regulated and short circuit protected

- Triple Power Supply
  XP-820
  Assembled $75
  Kit $49.95
  2 to 15V @ 1A
  2 to 15V @ 1A
  (or 4 to 30V @ 1A)
  and 5V @ 3A
  All the desired features for doing experiments.
  Features short circuit protection, all supplies.

GENERATORS & VIDEO PRODUCTS

- Function Generator
  Blox
  #9600
  $28.95
  Provides sine, triangle, square wave
  from 1Hz to 1Mhz
  AM or FM capability

- Color Convergence Generator
  SG-250
  $89.95
  Kit $69.95
  Finest in the industry
  10 rock steady patterns
  RF & Video output

- Wide Band Signal Generators
  SG-9000
  $129
  RF Freq 100K-450MHz AM Modulation
  of 1KHz Variable RF output
  SG-9500 w/ Digital Display &
  150MHz built-in counter $249

Ramp, Video Products

- Digital Multimeter
  with Training Course
  Elenco Model
  M-2665K
  $49.95
  Fun & Easy to Build
  Ideal School Project

- Robotic Arm Kit
  Model Y-01
  $48.95
  Teaches basics of robotics. Arm moves
  & releases, lifts & lowers,
  & pivots from side to side

AM/FM Transistor
Radio Kit

- with Training Course
  Model AM/FM 108
  $27.95
  14 Transistors + 5 Diodes
  Easy to build because schematic
  is printed right on the PCB
  Makes a great school project
  Model AM 550 AM Only $17.95

Learn to Build and Program
Computers with this kit

- Includes All Parts, Assembly and
  Lesson Manual
  Model MM-8000
  $129.00
  Starting from scratch you build a complete system.
  Our Micro-Master trainer teaches you to write into
  RAMs, ROMs and run a 8085 microprocessor, which
  uses similar machine language as IBM PC.

EDUCATIONAL KITS - FUN & EASY TO BUILD

- X5-500 Digital / Analog Trainer
  A complete mini-lab for building, testing, prototyping analog and digital circuits
  Elenco's Digital/Analog Trainer is specially designed for school projects, with 5 built-in power supplies.
  Includes a function generator with continuously variable sine, triangle, square wave forms.
  All power supplies are regulated and protected against shorts.

Power Supplies
  $159.95 Assembled $129.95 Kit

- Sweep/Function Generator
  with Freq. Counter
  Model GF-8026
  $259
  Int/Ext Operation
  Sine, Square, Triangle, Pulse,
  Ramp. 2 to 2MHz, Freq Counter. 1-10MHz

- Digital Multimeter
  with Training Course
  Elenco
  F-1200
  1.2GHz
  $229
  Measures Frequency, Period, Totalizer
  8 LED digits, Crystal Oven Oscillator
  .5%ppm Accuracy

C&S SALES INC.
1245 ROSEWOOD, DEERFIELD, IL 60015
FAX: 708-520-0085 (708) 541-0710

CALL TOLL FREE
1-800-292-7711
1-800-445-3201 (Can.)

15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY
WRITE FOR FREE CATALOG
PRICES SUBJECT TO CHANGE

CIRCLE 289 ON FREE INFORMATION CARD
ELENCO S-1325

25MHz
2 Channel

$349

2 Channel

20MHz

$395

DS-203 20MHz, 10MS/s

Digital Storage Oscilloscope

2048 Pts Hor. Resolution
8 Bit Vert. Resolution
8k Word Per Channel

$775

S-1340 40MHz

Dual Trace Oscilloscope

$495

High luminance 6" CRT
1mV/div sensitivity
10kV Acceleration Voltage
9ns Rise Time
X-Y Operation

S-1360 60MHz

Dual Trace - Delayed Sweep

$775

Automatic Beam Finder
Built-in Component Tester
1mV Sensitivity
Dual Time Base
Illuminate Internal Gradicule

B+K 2120

20MHz $395

Model 2125 $539.95

2 Channel

Delayed Sweep

40MHz DUAL-TRACE

Model 1541B

1mV/div sensitivity
Video sync separators
Z axis input
Single sweep
V mode - displays two signals unrelated in frequency

749.95

60MHz DUAL-TRACE

Model 2160

1mV/div sensitivity
Sweep to 5 ns/div
Dual time base
Signal delay line
V mode - displays two signals unrelated in frequency
Component tester

949.95

100MHz THREE-TRACE

Model 2190

1mV/division sensitivity
Sweep to 2ns/division
Dual time base
Calibrated delay line multiplier
Signal delay line
19kV accelerating voltage

1,395.95

20MHz ANALOG

WITH DIGITAL STORAGE

Model 2522

20MHz analog bandwidth
10MS/s sampling rate
2k memory per channel
20MHz equivalent time sampling
Pre-trigger capture

869.95

1.0GHz PORTABLE

SPECTRUM ANALYZER

Model 2610

AC/DC operation (battery included)
70dB dynamic range
Resolution bandwidth of 10kHz
50Ω and 75Ω input impedance (switch selectable)
Fixed bandwidth setting for viewing TV signals
Field-calibrated with internally generated 100MHz, 80dB signal

2,595.95

ELENCO & HITACHI & B+K
SCOPES AT
DISCOUNT PRICES

SPECIAL BUY
HITACHI V-212

20MHz $409

Hitachi Popular Series

V-525 - 50MHz, Cursors $975
V-523 - 50MHz, Delayed Sweep $949
V-522 - 50MHz, DC Offset $849
V-422 - 40MHz, DC Offset $749
V-222 - 20MHz, DC Offset $625

Hitachi Compact Series Scopes

V-660 - 60MHz, Dual Trace $1,095
V-665A - 60MHz, Dual - Trace w/cursor $1,325
V-1060 - 100MHz, Dual Trace $1,375
V-1065A - 100MHz, DC Offset $1,649
V-1085 - 100MHz, Quad Trace $1,995
V-1100A - 100MHz, Quad Trace $2,195
V-1150 - 150MHz, Quad Trace $2,695

Hitachi RSO Series

RSO's feature; roll mode, averaging, save memory, smoothing, interpolation, pretriggering, cursor measurements.

VC-6023 - 20MHz, 20MS/s $1,650
VC-6024 - 50MHz, 20MS/s $1,950
VC-6025A - 50MHz, 20MS/s $2,350
VC-6045A - 100MHz, 40MS/s Call
VC-6145 - 100MHz, 100MS/s Call

Logic Analysers

32 channels (VC-3120) or 48 channels (VC-3130)
25MHz synchronous operation on all channels
100MHz asynchronous operation (8 or 12 channels)
5ns glitch capture capability
Multi-level trigger sequencing
Non-volatile data and set-up memories
Disassembler options for popular uP's
Very low cost - Call
9 inch LCD screen

C&S SALES INC.
1245 ROSEWOOD, DEERFIELD, IL 60015
FAX: 708-520-0085 • (708) 541-0710
CALL TOLL FREE 1-800-292-7711
1-800-445-3201 (Can)
PROBES INCLUDED IN ALL SCOPES & METERS
15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY
WRITE FOR FREE CATALOG
### STEREO LOUDSPEAKER PROTECTOR

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TY-25</td>
<td>Super fast acting relay protects speaker against destructive DC voltage. Can connect directly to a power amplifier or can use a separate power supply. Has a 3 second turn-on delay to avoid turn-on thumpes. (1 lb.)</td>
<td>Kit: $15.85</td>
</tr>
</tbody>
</table>

### REGULATED DC POWER SUPPLY

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR-503</td>
<td>It is short circuit proof and has overload protection. Output voltage is variable over a range of 0.50 volts and can supply up to max of 3A. Current limit trip is adjustable. May use Mark V #002 transformer. (1 lb.)</td>
<td>Kit: $17.75</td>
</tr>
</tbody>
</table>

### FM WIRELESS MICROPHONE

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TY-35</td>
<td>It can be used anywhere within the 88 to 108 mHz FM band without a licence. It has high sensitivity sound pickup by a capacitance microphone. May be used directly for assignment or for remote wireless monitoring (1 lb.)</td>
<td>Kit: $12.50</td>
</tr>
</tbody>
</table>

### SCHOOL PROJECT CORNER

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM-328</td>
<td>It is a keyboard programmable for easy use. It allows full control of intensity and flash rate. It has 4 separate channels with a capacity of 1170 watts per channel. Total wattage capability is 4.68 killowatts. This is equivalent to 46 pcs. 100-watt light bulbs or 936 pcs. 5-watt colored bulbs and is sufficient for the largest halls and auditoriums.</td>
<td>Asm: $165.00</td>
</tr>
</tbody>
</table>

### COLOR LIGHT CONTROLLER

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM-43</td>
<td>AC/DC Voltage range: 1mV-1000V. Thermo-meter range : ±100°C. DC current range: 1 microamp - 2 amp. Capacitance range : 1pf to 2 microfarads. Frequency Counter: 10HZ-20KHZ. Max indication ±1999. Power Supply: 5-6V DC, 200mA</td>
<td>Kit: $34.50</td>
</tr>
</tbody>
</table>

### CATALOG & INFORMATION

Phone or Mail Order to: MARK V ELECTRONICS 8019 E. Slauson Avenue, Montebello, CA 90640

### DO-IT-YOURSELF ELECTRONIC KITS

HOLIDAY SALE ! Free shipping on items 3 lbs. or less. Offers must be shipped via UPS Ground only.

ORDER TOLL-FREE 1-800-521-MARK / 1-800-423-FIVE

See our catalog for more kits!

Kit skill levels are specified as:
- Beginner
- Intermediate
- Advanced
- Ready to plug in when assembled

### MARK V ELECTRONICS

Mark V has more than 60 kits available including high-fidelity audio products, laboratory equipment, power supplies, light controllers, games and numerous projects! Audio amplifiers range from 6 to 300 watts. Quality kits at unbeatable prices starting from $7! Ship within 48 hours. Dealer inquiries welcome. In business since 1985!

### 300 W MOSFET POWER MONO AMPLIFIER

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF-3 7</td>
<td>Power Output: 300W into 4 ohms RMS. 200W into 8 ohms RMS. Frequency response: 10 Hz - 20 KHz. THD: &lt; 0.03%. Signal to noise ratio: 91dB. Input Sensitivity &amp; Impedance at 1 kHz, 1V 47K. Load Impedance: 4 – 16 ohms. Power Requirement: ±55 to ±65V DC 8A. May use Mark V Model 009 Transformer. Suggested Capacitor 10,000 uf 100V Model 019. Suggested Metal Cabinet LG-1925.</td>
<td>Kit: $165.00</td>
</tr>
</tbody>
</table>

### 120 W MOSFET POWER MONO AMPLIFIER

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT-477 7</td>
<td>Power Output: 120W into 8 ohms RMS. Frequency Response: 8 Hz - 20 KHz, +0.4 dB. Sensitivity: 1V. Power Requirement: 55 VDC @ 3A. May use Mark V Model 005 or 012 Transformer. Suggested Capacitor 10,000 uf 100V Model 019. Suggested Metal Cabinet LG-1925.</td>
<td>Kit: $68.00 Asm: $85.00</td>
</tr>
</tbody>
</table>

### 120W + 120W PRE & MAIN STEREO AMPLIFIER

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT-800MK2 7</td>
<td>Power Output: 120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response: 0.2 - 20 KHz. THD: &lt; 0.1%. Tone Control Bass ±12dB, Mid ±6dB, Treble ±8dB. Sensitivity: 20mV into 47K. Line, ±0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40V DC @ 6A. May use Mark V Model 001.</td>
<td>Kit: $63.92 Asm: $73.95</td>
</tr>
</tbody>
</table>

### 80W + 80W PURE DC STEREO MAIN POWER AMPLIFIER

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT-802 7</td>
<td>Power Output: 80W per channel into 8 ohms RMS. THD: &lt; 0.05%. Frequency Response: DC to 200 KHz, -0 dB, -3dB @ 1W. Power Requirement: 30V AC × 2 @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Capacitor 8,200uf 50V Model 017. Suggested Metal Cabinet LG-1924.</td>
<td>Kit: $45.94 Asm: $59.72</td>
</tr>
</tbody>
</table>

### 30W + 30W PRE & MAIN STEREO AMPLIFIER

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT-323A 7</td>
<td>Power Output: 30W into 8 ohms RMS per channel. THD: &lt; 0.1% from 100 Hz to 10 KHz Sensitivity: 30mV @ 47K. Tuner, Tape 130mV @47K. Signal to Noise ratio: 80dB Power Requirement: 22 to 36V AC, 3A. May use Mark V Model 002 Transformer. Suggested Cabinet LG-1684.</td>
<td>Kit: $29.50 Asm: $38.50</td>
</tr>
</tbody>
</table>

### METAL CABINETS

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>LG-1273 7</td>
<td>3X12X7&quot; (4 lbs.)</td>
<td>23.85</td>
</tr>
<tr>
<td>LG-1684 7</td>
<td>4X16X8&quot; (7 lbs.)</td>
<td>28.50</td>
</tr>
<tr>
<td>LG-1924 7</td>
<td>4X9X11½&quot;(10 lbs.)</td>
<td>34.50</td>
</tr>
<tr>
<td>LG-1925 7</td>
<td>5X9X11½&quot;(10 lbs.)</td>
<td>38.50</td>
</tr>
<tr>
<td>LG-1983 7</td>
<td>2½X19X8½&quot; (7 lbs.)</td>
<td>32.50</td>
</tr>
</tbody>
</table>

Minimum order $20.00. We accept Visa, MasterCard, Money Orders, and Checks (allow 2 weeks for clearance). We ship by UPS ground inside US (min $4.00) and ship by US mail outside US. Please call our operator for orders over 3 lbs. or foreign orders.

CIRCLE 306 ON FREE INFORMATION CARD
Military 50 MHz Solid-State Oscilloscope

(USM 281 IE, Made by Dumond Oscilloscope)

You need something for a low cost, dependable, Tektronix type oscilloscope and you won’t find a better than this. The solid state, portable scope is capable of accurately displaying and measuring simple and complex waveforms. 20 MHz. Consists of the mainframe, vertical and horizontal sweep units. Vertical deflection factor 5.5 mV/div at 50 MHz in 11 calibrated areas with an accuracy of 1%. Vertical input resistance is 1 MΩ (2%L) protected by 4 kΩ in p-p. Dual channel with dual trace control, triggered and active displayable modes. Vertical (100) in provides a time base of 1.5 μs per div at 20 MHz and includes 1 x 10 dial. Vertical (1000) features include all multiple scaling of display and triggering modes. Works with 475 to 600 V power source including aircraft power. Equipped with features including front and rear connector, calibration output. 2 x 9 and 4 x 0.5. Porcelain (127 HZ.

$299

Military TV7 Tube Tester

$149

- Portable tube tester
- Built-in Mil spec. specifications and construction
- Provides feature test on a wide range of tube types
- Rear view mirror and large, natural eye.
WANTED
YOUR OLD, TIRED, OR JUST BROKEN
DIGITAL MULTIMETERS

WILL TRADE YOUR UNWANTED, BROKEN OR ???
FOR A BRAND NEW INSTEK DM-394 3 3/4 DIGITAL
MULTIMETER with TRMS FOR ONLY $79.99

PLEASE CONTACT THE DISTRIBUTORS IN YOUR AREA:

EASTERN U.S. = 800-655-6686
NORTHEAST U.S. = 716-544-4392
SOUTHERN U.S. = 800-464-4150
MID-ATLANTIC = 404-424-0447
NATION WIDE = 800-655-6686
OR 800-464-4150

CORP. Test & Measuring Instruments
1205 John Reed Court
City of Industry, CA 91745

11-Year Multi

AUSO SAVE
$58.00
REGULAR PRICE $138.00

LIMIT 2 per CUSTOMER
OFFER EXPIRES JUNE 1994
ALFA ELECTRONICS

**ALFA ELECTRONICS**

**HIGH QUALITY TEST EQUIPMENT**

**REST PRICE**

**ALFA ELECTRONICS**

DMM 2360 
**$119.95**

DMM + LCR Meter

Most Versatile DMM

Inductance 1µH-40H
Capacitance 1pF-40µF
Frequency 1Hz : 4MHz
Temperature -40 - 302°F
TTL Logic Test 20MHz
Diode, Continuity
Volt, Amp, Ohm
3199 count display
Peak Hold
Auto power off
Ruggerized case
Rugger Holster $8.00

**Fluke Multimeter**

Fluke 12  
$79.95
Fluke C-10  
$10
Fluke 70 II  
$65
Fluke 72 III  
$90
Fluke 75 II  
$127
Fluke C-70  
$15
Fluke 77 II  
$147
Fluke 79 II  
$167
Fluke 29 II  
$167
Fluke 83  
$225
Fluke 85  
$259
Fluke 87 True RMS  
$285
Fluke 97 Scope Meter $1750

**LCR Meter 814**

**$199.95**

The Best Handheld LCR

Inductance 0.1µH-200H
Capacitance 0.1pF-20,000µF
Resistance 1kΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics from test fixture
Best for high frequency RF and surface mount components
SmD and chip component test probe $25.00, Deluxe carrying case $55.00

**LCR Meter 195**

**$119.95**

Very Popular LCR

Inductance 1µH-200H
Capacitance 1pF-20µF
Resistance 0.01Ω-20MΩ
0.5% basic accuracy
10% L3%
Test frequency 1kHz
Soft carrying case $3.00
Deluxe case $5.00

**DC Power Supply**

PS-303  
**$159.00**

0-30 VDC, 0-3A output
0.05% + 3mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
PS-8200 with digital voltmeter $179.00
Also available 320V/5A, 30V/5A, 16V/10A, 30V/10A

**Audio Generator**

AG-2601A  
**$119.00**

10Hz - 1MHz in 5 ranges
Output 0-8Vrms sinewave
-10Vp-p squarewave
Synchronization: +5% of oscillation frequency
Output distortion: 0.05% 100Hz - 500kHz
0.5% 50Hz - 500kHz
Output impedance: 100 ohm

**Function Generator**

FG-2100A  
**$169.95**

0.2 Hz - 2MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5V/20V-p-p
1% distortion, DC offset ≤ 1V
VCF: 0-10kHz output frequency to 1000 1

**Function Counter**

FG-2102AD  
**$229.95**

Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output

**Sweep Generator**

**AG-2603AD**  
**$229.95**

Generates audio signal same as AG-2601A
Frequency counter 1Hz-150MHz
for internal and external sources
Sensitivity <50mV

20 MHz Oscilloscope with Delay Sweep

PS-205  
**$429.95**

Dual Trace, Component test, 8" CRT, X-Y Operation, TV Sync, Z Modulation, CH2 Output, Graticule Illum, 2 probes each has a 10:1 switch, Best price with delay sweep
PS-200 20 MHz DUAL TRACE  
$339.95
PS-400 40 MHz DUAL TRACE  
$499.95
PS-405 40 MHz DELAY SWEET  
$569.95
PS-605 60 MHz DELAY SWEET  
$769.95

**20 MHz Digital Storage Oscilloscope**

SCOPE DS-203  
**$729.95**

Switchable between digital and analog modes
2 K word per channel storage
Sampling rate: 10 MHz samples/sec
8 bit vertical resolution (25 ppm/div)
Expanded timebase 10ms/div - 50 s/div
refresh, roll, save all, save CH2, Pre-Trig, Power Control

**DC Power Supply Triple Output**

PS-8202  
**$499.95**

Two 0-30 VDC, 0.3A outputs,
One fixed 5VDC, 3A output
Capable of independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available 320V/5A triple output $549.95
30V/5A dual tracking $749.95

**EQUIPMENT, 1 YEAR WARRANTY**

January 1994, Electronics Now
INVENTORY SALE

X-10

<table>
<thead>
<tr>
<th>Product</th>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamp Module</td>
<td>DOZ</td>
<td>$110.00</td>
</tr>
<tr>
<td>Appliance Module</td>
<td>DOZ</td>
<td>$110.00</td>
</tr>
<tr>
<td>Power/S Sound Control Kit</td>
<td>44.00</td>
<td></td>
</tr>
<tr>
<td>LEVITON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wall Mounted Controller</td>
<td>57.00</td>
<td></td>
</tr>
<tr>
<td>No Dim Wall Switch 20 Aamp</td>
<td>43.00</td>
<td></td>
</tr>
<tr>
<td>2000 Watt Dimmer</td>
<td>246.00</td>
<td></td>
</tr>
<tr>
<td>Signal Test Transmitter</td>
<td>106.00</td>
<td></td>
</tr>
<tr>
<td>SIGNAL STRENGTH INDICATOR</td>
<td>106.00</td>
<td></td>
</tr>
<tr>
<td>PANASONIC HYBRID PHONE SYSTEM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SSI

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>SY30000 Dolby Prologic Decoder</td>
<td>$272.50</td>
</tr>
<tr>
<td>APMR 4000 5 Channel Amplifier</td>
<td>$306.50</td>
</tr>
<tr>
<td>LEVITON X-10 COMPATIBLE IN STOCK</td>
<td></td>
</tr>
<tr>
<td>STANLEY X-10 COMPATIBLE IN STOCK</td>
<td></td>
</tr>
<tr>
<td>Universal One For All Infrared Remotes</td>
<td></td>
</tr>
<tr>
<td>Yamaha 8 Channel 40 Watts Per Channel</td>
<td></td>
</tr>
</tbody>
</table>

FOSGATE CALL FOR DETAILS

NEW!

ES1400e ENERGY LOGIC W/ VERSION 2 SOFTWARE

CDI 220 COMPACT DISK INTERACTIVE DECK

COMPTON'S INTERACTIVE ENCYCLOPEDIA-THE MOST COMPREHENSIVE REFERENCE PROGRAM ON CDI- A $299.00 VALUE

WIN AUTOMATIC WINDOW CONTROLLER AND SKYLIGHT OPENERS

WIN

INVENTORY SALE

AD-500 VHF-FM TELEPHONE TRANSMITTER CRYSTAL

- Controlled: Operating Frequency: 130 - 145.400 MHz
- RF power output: 11 MW
- Dimensions: 1 3/4 x 1 3/4 x 3/4 (W x H x D)
- Half assembled kit
- Price: $115.00

AD-650 VHF-FM TRANSMITTER CRYSTAL

- Controlled: Operating Frequency: 135 - 145 MHz
- RF power output: 11 MW
- Dimensions: 3 x 1/8 x 1/2 (W x H x D)
- Half assembled kit
- Price: $125.00

AD-268 VHF-FM TRANSMITTER CRYSTAL

- Controlled: Operating frequency: 130 - 145 MHz
- RF power output: 200 MW
- Dimensions: 2 x 3/8 x 5/8 (W x H x D)
- Half assembled kit
- Price: $145.00

CHINON CX-102 AUDIO MINIATURE BOARD MONOCHROME SOLID STATE CHIP CAMERA WITH AUDIO FEATURE/ BUILT IN MICROPHONE: Operating range of XCVF to 14v

- Dimensions: 1.81 x 2.76 x 0.91 (W x H x D)
- Price: $240.00

CD 100 + CCD 200 MICRO MINIATURE CCD CAMERAS - SMOKE CRYSTAL DETECTOR DESIGN:

- CCD-100: 300 lines
- Resolution: $225.00
- CCD-200: 400 lines
- Resolution: $315.00

AS2000XLT RF BUG DETECTOR:

- Operating range: 5 - 2000 MHz
- Built in rechargeable battery
- Price: $552.00

CHINON CX-102 AUDIO MINIATURE BOARD

- MONOCHROME SOLID STATE CHIP CAMERA WITH AUDIO FEATURE/ BUILT IN MICROPHONE: Operating range of XCVF to 14v

- Dimensions: 1.81 x 2.76 x 0.91 (W x H x D)
- Price: $240.00

CIRCLE 201 ON FREE INFORMATION CARD

GREENLEAF ELECTRONICS

CABLE TV Converters & Descramblers

Compatible with Jerrold, Scientific Atlanta, Pioneer, Oak, & Hamlin Equipment

BRAND NEW!

90-DAY GUARANTEE

LOWEST PRICES

Volume Control & Parental Lockout Available

Greenleaf Electronics

1-800-742-2567

NO ILLINOIS SALES

It is not the intent of Greenleaf Electronics to defraud any pay television operator and we will not assist any company or individual in doing the same.

SUSUMAR ENTERPRISES

1292 MONTCLAIR DRIVE

PASADENA, MD 21122

ORDERS (800)477-4181

VISAC * MASTERCARD * AMEX

NEXT DAY DELIVERY AVAILABLE

GOOD TIMES, GOOD TIMES FOR ALL!!!

Greenleaf Electronics

126

Electronics Now, January 1994
B & S SALES

Call (313) 566-7248 • FAX (313) 566-7258 24 hrs.

Hours: Monday through Friday 8 am to 6 pm EST
51756 Van Dyke St. #330, Shelby Township, MI 48316

WE SPECIALIZE IN QUANTITY PRICING 5, 10, 20 LOTS

Make Your Best Deal!

JERROLD
DRX-3-DIC 8590
DPBB 8580
DPV-5,7 8570
8550

PIONEER
BA 6110
BA 5135

HAMLIN
CR 6600-3M
CR 6000-3M

TOCOM
5507 VIP
5503 VIP

ZENITH
1600

NEW PAN
PIONEER
GREEN E LITE
BA 5000 Series
BA 6000 Series

NEW PAN
SA-8500 SERIES
(BUT ALL BASE BAND)
The Premier

NEW PAN
JERROLD
PINK PAN

PANASONIC TZ — PC 1453G2
By far the best basic converter on the market today. 550 MHz (1 to 99)
parental control, sleep timer, remote batteries, contrast and
remote control range.
Superior to all other converters

NO MICHIGAN SALES

We are now offering a 6-month warranty. In order for warranty to be in effect, this form must be signed and returned.

FOR VCR, SECOND, THIRD, ETC. HOOK-UPS.

☐ Yes, I agree all units are to be used or resold in compliance with Federal and State laws.
Signature ____________________________ Date ____________________________

Name ____________________________ Phone No. ( ) ____________________________
Address ____________________________
City ____________________________ State ____________________________ Zip ____________________________

It is not the intent of B & S Sales to defraud any pay television operator and we will not assist any company or individual in doing the same.

CIRCLE 217 ON FREE INFORMATION CARD
Wandel & Goltermann TSA-1
Transmission System Analyzer. 100 Hz to 180 MHz, spectrum analysis, selective level, demodulation, phase jitter.

Special $2250.00
Same as above but includes network analyzer
Special $2750.00

Wandel & Goltermann System
SPM-19 Selective Level Meter, with wideband section, for level measurements 50 Hz to 25 MHz.

$3850.00

PS-19 Level Generator, 80 Hz to 25 MHz. When used in conjunction with the SPM-19 a complete measuring setup for level, gain and loss measurement is created.

$2850.00

SG-4 Storage Display Unit. For use with the above. Stationary, flickerfree image. Measurement and reference traces can be displayed separately, together or as a different curve.

$1500.00

$6000.00 for all 3 pieces as a set.

Fluke 1911A Opt. 03
Multifunction Counter, 5 Hz to 250 MHz, measures frequency, period, period average, and totalize. 15mV sensitivity, 7 digit display.

Special $250.00

Fluke 335D
DC Voltage Calibrator/Null Detector, produces output voltages from 0 to 1111V at currents of 0 to 50 mA.

$2000.00

Racal Dana 1996
Universal Systems Counter, DC to 1.3 GHz, 1 nS single shot time interval resolution, 9-digit resolution in 1 second, full GPIB, phase, slew and duty cycle measurement.

$3500.00

Tektronix 492 & TR 503
Spectrum Analyzer, 50 kHz to 21 GHz, 80 dB dynamic range, digital storage, Amplitude comparison in 0.25 dB steps, CRT readout of all important features. Tracking Generator works with all 490 series spectrum analyzers, swept frequency measurements to 1.8 GHz.

$9250.00 Special for both pieces

Tektronix 515A
Portable Calibrator, precision. 4.5 digit calibration and 5.5 digit verification where you need it. 0 to 100 VDC, .2 uV resolution, 0 to 100 VAC.

$1750.00

Fluke 335D
DC Voltage Calibrator/Null Detector, produces output voltages from 0 to 1111V at currents of 0 to 50 mA.

$2000.00

Racal Dana 1996
Universal Systems Counter, DC to 1.3 GHz, 1 nS single shot time interval resolution, 9-digit resolution in 1 second, full GPIB, phase, slew and duty cycle measurement.

$3500.00

Tektronix 492 & TR 503
Spectrum Analyzer, 50 kHz to 21 GHz, 80 dB dynamic range, digital storage, Amplitude comparison in 0.25 dB steps, CRT readout of all important features. Tracking Generator works with all 490 series spectrum analyzers, swept frequency measurements to 1.8 GHz.

$9250.00 Special for both pieces

Tektronix 515A
Portable Calibrator, precision. 4.5 digit calibration and 5.5 digit verification where you need it. 0 to 100 VDC, .2 uV resolution, 0 to 100 VAC.

$1750.00

Tektronix 24.30
Digital Oscilloscope, 150 MHz BW, 5 nS/div sweep rate, 100 ms/sample rate, 8 bit resolution over 10 division, dual channel simultaneous acquisition, envelope mode with 2 nS glitch capture, save on Delta feature.

$3500.00

Tektronix 466
Portable Storage Oscilloscope, 100 MHz BW, variable persistence, 3000 div/uS stored writing speed. Special includes 2 probes and the operation manual.

$1500.00

Special $995.00

Fluke 515A
Portable Calibrator, precision. 4.5 digit calibration and 5.5 digit verification where you need it. 0 to 100 VDC, .2 uV resolution, 0 to 100 VAC.

$1750.00

Racal Dana 9303
True RMS RF Level Meter, frequency range 10 kHz to 2 GHz and a level range of 30 uV to 3 V. Basic accuracy of 1 %.

Just Reduced $795.00

Tektronix 1240
Logic Analyzer, up to 72 acquisition channels, acquisition speeds to 100 MHz asyn., 50 MHz sync. Includes (2) 1240D1 data acquisition cards and (2) 1240D2 data acquisition cards. Comes with 6 data acquisition probes and a operators manual.

$1500.00

Special $995.00

Tektronix 466
Portable Storage Oscilloscope, 100 MHz BW, variable persistence, 3000 div/uS stored writing speed. Special includes 2 probes and the operation manual.

$1300.00

Tektronix S2
Sampling Head, DC to 4.6 GHz, 75 ps rise time, 50 ohm input.

$99.50 Special
### DANBAR SALES COMPANY
14455 N. 79th. St. Scottsdale AZ 85260
(602) 483-6202 FAX (602) 483-6403

<table>
<thead>
<tr>
<th>Hewlett-Packard 3336B</th>
<th>Hewlett-Packard 3586B</th>
<th>Hewlett-Packard 8640B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synthesized/ Level Generator is an excellent precision source from 10 Hz to 20.9 MHz, frequency resolution of .001 Hz, level accuracy within .15 dB over full range, AM and phase modulation. Fully programmable over HP-IB, harmonics down more than 5 dB. Special $650.00 Buy Both Together as a Set for $1300.00</td>
<td>Selective Level Meter, makes carrier measurements to 32.5 MHz. Voice channel measurements from 50 Hz to 100 kHz, works with 3336 Level Generator. Special $850.00</td>
<td>Signal Generator, 0.5 to 512 MHz, +19 to -145 dBm RF output, phase locking and counter. $1800.00</td>
</tr>
</tbody>
</table>

#### Digital Voltmeter, 5 full scale dc ranges from 0.1 to 1000 volts, 100 nanovolt resolution, up to 330 rdgs/s, 4.5 digit, led display. $1350.00

#### Spectrum Analyzer, 100 Hz to 22 GHz internal mixing range, synthesized frequency accuracy, resolution bw of 10 Hz to 3 MHz in a 1, 3, 10 sequence. Tunable marker with amplitude and frequency readout, store and recall. $25000.00

#### Synthesized Signal Generator, 10 kHz to 2560 MHz, AM/FM/ phase modulation/pulse in one generator, internal variable modulation oscillator. $24000.00

#### Transmission Test Set, 20 Hz to 110 kHz. 1 Hz resolution, -60 to +13 dBm, 0 to 100 dBm. $7750.00

#### Microwave Frequency Synthesizer covers the frequency range of 2.0 to 6.2 GHz in 1 kHz steps. The HP 86720A is a Frequency Extension Unit that uses a heterodyne technique to extend the frequency coverage of a 8671A to a lower limit of 10 MHz. This unit is well suited for most LQ applications that require state-of-the-art performance as well as broadband capability. $13000.00

#### Sweeper Mainframe, source for swept measurements, CW signal generation, and automatic testing HP-IB programmability. The83592A RF Plug-In covers the frequency range .01 to 20 GHz, 10mW max leveled output. Has options 002 & 004. $13500.00

#### Synthesizer/ Level Generator, 200 Hz to 81 MHz, .001 Hz resolution, high spectral purity, precision amplitude control, program storage, 11 digit display HP-IB. $2750.00 SPECIAL PRICE

---

*Includes HP-IB.*

---

*January 1994, Electronics Now*
### FREE GIFT with any order

Receive this 6-piece precision screwdriver set FREE with any order. It’s ideal for small repairs.

- While supplies last.
- Great Christmas gift.
- Place your order today.

#### VOLTAGE REGULATOR

<table>
<thead>
<tr>
<th>Part</th>
<th>Symbol</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM324</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>LM358</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>LM359</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>NE555</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>LM741</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>CD4001B</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>CD4013B</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>CD4017B</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>CD4029B</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>CD4066B</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>CD4069B</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
</tbody>
</table>

Deal ‘V1’: 26pcs (2 ea) $13

#### MORE TRANSISTORS

<table>
<thead>
<tr>
<th>Part</th>
<th>Symbol</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PN2222A</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>PN2907A</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>2N3390</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>2N3390</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>2N4401</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>2N4403</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
</tbody>
</table>

Deal ‘N8’: 60pcs (10 ea) $5

#### MORE DIODES

<table>
<thead>
<tr>
<th>Part</th>
<th>Symbol</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N914A</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>1N4148</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>1N4001</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>1N4004</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
</tbody>
</table>

Deal ‘P7’: 50pcs (10 ea) $3

#### GERMANIUM DIODES

<table>
<thead>
<tr>
<th>Part</th>
<th>Symbol</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1N344</td>
<td>...</td>
<td>1000.00</td>
<td></td>
</tr>
<tr>
<td>1N347</td>
<td>...</td>
<td>1000.00</td>
<td></td>
</tr>
</tbody>
</table>

Deal ‘M4’: 5pcs (3 ea) $7

Deal ‘G3’: 10pcs (5 ea) $2

Deal ‘JT’: 20pcs (10 ea) $7

#### RADIAL LYric C aps

<table>
<thead>
<tr>
<th>Part</th>
<th>Symbol</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1uF/600V</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>2uF/600V</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>3uF/600V</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
<tr>
<td>4uF/600V</td>
<td>...</td>
<td>800.00</td>
<td></td>
</tr>
</tbody>
</table>

Deal ‘A9’: 60pcs (5 ea) $5

Deal ‘P9’: 50pcs (10 ea) $3

#### TANTALUM CAPS

<table>
<thead>
<tr>
<th>Part</th>
<th>Symbol</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1uF/35V</td>
<td>...</td>
<td>150.00</td>
<td></td>
</tr>
<tr>
<td>2.2uF/35V</td>
<td>...</td>
<td>150.00</td>
<td></td>
</tr>
<tr>
<td>10pcs min/ea</td>
<td>...</td>
<td>150.00</td>
<td></td>
</tr>
</tbody>
</table>

Deal ‘R2’: 60pcs (5 ea) $4

Deal ‘T6’: 10pcs (5 ea) $3

#### TOGGLE SWITCHES

- Miniature size: 1/4" Panel hole
- on-on..................$0.50
- on-off..................$0.75

Deal ‘C4’: 50pcs (25 ea) $2

#### POWER CORD

- 18 AWG – 3 Conductor – 6 ft: $2.00 ea

#### VITAMIN APRODUCTS CORP.

- Tel: (305) 974-6654
- Fax: (305) 974-6818

- 1725 104th St. Margate, FL 33063

- One year warranty on parts and labor.

- C.O.D. Free technical support.

- Visit our showroom or call for more information.

- View our complete line online at: www.vyper.com

- Phone: 954-472-4242

- Fax: 954-472-4040

- Visit us at Booth 1023 at the CE Show in Las Vegas.

- Visit us at Booth 1222 at the CE Show in New York City.

- Visit us at Booth 1322 at the CE Show in Chicago.

- Visit us at Booth 1422 at the CE Show in Dallas.

- Visit us at Booth 1522 at the CE Show in Miami.

- Visit us at Booth 1622 at the CE Show in San Francisco.

- Visit us at Booth 1722 at the CE Show in Los Angeles.

- Visit us at Booth 1822 at the CE Show in Houston.

- Visit us at Booth 1922 at the CE Show in Atlanta.

- Visit us at Booth 2022 at the CE Show in Seattle.

- Visit us at Booth 2122 at the CE Show in Montreal.

- Visit us at Booth 2222 at the CE Show in Toronto.

- Visit us at Booth 2322 at the CE Show in London.

- Visit us at Booth 2422 at the CE Show in Paris.

- Visit us at Booth 2522 at the CE Show in Madrid.

- Visit us at Booth 2622 at the CE Show in Rome.

- Visit us at Booth 2722 at the CE Show in Berlin.

- Visit us at Booth 2822 at the CE Show in Tokyo.

- Visit us at Booth 2922 at the CE Show in Sydney.

- Visit us at Booth 3022 at the CE Show in Seoul.

- Visit us at Booth 3122 at the CE Show in Hong Kong.

- Visit us at Booth 3222 at the CE Show in Shanghai.

- Visit us at Booth 3322 at the CE Show in Moscow.

- Visit us at Booth 3422 at the CE Show in Buenos Aires.

- Visit us at Booth 3522 at the CE Show in Cape Town.

- Visit us at Booth 3622 at the CE Show in Sydney.

- Visit us at Booth 3722 at the CE Show in Singapore.

- Visit us at Booth 3822 at the CE Show in Moscow.

- Visit us at Booth 3922 at the CE Show in Buenos Aires.

- Visit us at Booth 4022 at the CE Show in Cape Town.

- Visit us at Booth 4122 at the CE Show in Sydney.

- Visit us at Booth 4222 at the CE Show in Singapore.

- Visit us at Booth 4322 at the CE Show in Moscow.

- Visit us at Booth 4422 at the CE Show in Buenos Aires.

- Visit us at Booth 4522 at the CE Show in Cape Town.

- Visit us at Booth 4622 at the CE Show in Sydney.

- Visit us at Booth 4722 at the CE Show in Singapore.

- Visit us at Booth 4822 at the CE Show in Moscow.

- Visit us at Booth 4922 at the CE Show in Buenos Aires.

- Visit us at Booth 5022 at the CE Show in Cape Town.

- Visit us at Booth 5122 at the CE Show in Sydney.

- Visit us at Booth 5222 at the CE Show in Singapore.

- Visit us at Booth 5322 at the CE Show in Moscow.

- Visit us at Booth 5422 at the CE Show in Buenos Aires.

- Visit us at Booth 5522 at the CE Show in Cape Town.

- Visit us at Booth 5622 at the CE Show in Sydney.

- Visit us at Booth 5722 at the CE Show in Singapore.

- Visit us at Booth 5822 at the CE Show in Moscow.

- Visit us at Booth 5922 at the CE Show in Buenos Aires.

- Visit us at Booth 6022 at the CE Show in Cape Town.

- Visit us at Booth 6122 at the CE Show in Sydney.

- Visit us at Booth 6222 at the CE Show in Singapore.

- Visit us at Booth 6322 at the CE Show in Moscow.

- Visit us at Booth 6422 at the CE Show in Buenos Aires.

- Visit us at Booth 6522 at the CE Show in Cape Town.

- Visit us at Booth 6622 at the CE Show in Sydney.

- Visit us at Booth 6722 at the CE Show in Singapore.

- Visit us at Booth 6822 at the CE Show in Moscow.

- Visit us at Booth 6922 at the CE Show in Buenos Aires.

- Visit us at Booth 7022 at the CE Show in Cape Town.

- Visit us at Booth 7122 at the CE Show in Sydney.

- Visit us at Booth 7222 at the CE Show in Singapore.

- Visit us at Booth 7322 at the CE Show in Moscow.

- Visit us at Booth 7422 at the CE Show in Buenos Aires.

- Visit us at Booth 7522 at the CE Show in Cape Town.

- Visit us at Booth 7622 at the CE Show in Sydney.

- Visit us at Booth 7722 at the CE Show in Singapore.

- Visit us at Booth 7822 at the CE Show in Moscow.

- Visit us at Booth 7922 at the CE Show in Buenos Aires.

- Visit us at Booth 8022 at the CE Show in Cape Town.

- Visit us at Booth 8122 at the CE Show in Sydney.

- Visit us at Booth 8222 at the CE Show in Singapore.

- Visit us at Booth 8322 at the CE Show in Moscow.

- Visit us at Booth 8422 at the CE Show in Buenos Aires.

- Visit us at Booth 8522 at the CE Show in Cape Town.

- Visit us at Booth 8622 at the CE Show in Sydney.

- Visit us at Booth 8722 at the CE Show in Singapore.
CAIG Electronic Chemicals
for Manufacturing, Maintenance & Service!

DON'T JUST CLEAN CONNECTIONS; DEOXIDIZE, SEAL & PROTECT THEM!

Even the finest equipment cannot guarantee noise-free/error-free operation. One "dirty" connection anywhere in the signal path can cause unwanted noise or signal loss.

ProGold and DeoxIT increase the performance and reliability of electrical components and equipment. They provide long-lasting protection, reducing the expense of repeated cleaning with expensive ozone-depleting solvents.

ProGold™
Gold Conditioner & Protector

ProGold is specifically formulated to improve conductivity and protect gold, base metals and other precious metal surfaces. Use on gold connectors and contacts for maximum performance and protection. A common problem with gold plated surfaces is that the base metals migrate to the surface due to gold's soft and porous nature (dendrite corrosion). Once exposed, base metals oxidize, adding unwanted resistance that impedes electrical performance. Since gold plated surfaces are thinly coated, they are susceptible to scratching & abrasion, further exposing the base metals.

ProGold is a one-step treatment that conditions gold connectors, contacts and other metal surfaces, enhancing the conductivity characteristics to efficiently transmit electrical signals. ProGold coats the entire contact surface and connection, providing superior protection from abrasion (insertion resistance), arcing, RFI, wear and atmospheric contamination.

DeoxIT® & PreservIT®
Deoxidizes, Seals & Protects Electrical Connections

DeoxIT, a one-step treatment, is a fast-acting, deoxidizing solution that cleans, preserves, lubricates & improves conductivity on all metal surfaces. Use as a general treatment for connectors, contacts & other metal surfaces. PreservIT seals, lubricates and preserves metal surfaces for protection from oxidation and contamination. For use on clean/new surfaces or those pre-cleaned with DeoxIT.

Both have excellent migration properties that coat the surfaces and protect them from future oxidation & contamination. These new advanced formulas contain improved deoxidizers, preservatives, conductivity enhancers, anti-tarnishing compounds, arcing & RFI inhibitors and provide extended temperature range.

OpticALL
Effectively cleans, polishes and eliminates static electricity on optical viewing surfaces. OpticALL is also recommended as a general purpose antistatic cleaner on plastic, glass and metal surfaces.

StaticALL
Neutralizes static build-up caused by friction & low humidity conditions.

DustALL
Quickly & safely removes dust, lint & particles from sensitive electronic equipment, computers, lab equip., optical grade surfaces & other mechanisms & equipment.

FreezALL
Quickly and safely cools circuits to -54°C. Locates intermittent components due to heat failure and hairline cracks on PCBs.

MechanicaLL®

ElectricALL®
Rejuvenating Solution For All Electrical Applications. Cleans, Preserves, Improves & Protects Connections, Removes Corrosion & Oxidation, Reduces Wear, Abrasion, Arcing & RFI.

DegreasaLL®
For degreasing, cleaning & de-lacquering equipment & parts. Removes oil, grease, dirt and contaminants including rosin flux from PCBs, components and metal parts. Biodegradable.

CAEON® 27
For sensitive equipment applications. For removal of oil, grease & dirt from surfaces. (Freon® TF).

CAEON® 28
Degreaser and cleaning liquid removes organic contaminants including rosin flux from PCBs, components and metal parts. (Freon® TMC).

X-10S Instrument Oil
Contains silicone. Finest quality instrument oil for use on rubber, plastics and metals. Non-gumming, rust inhibiting, long lasting lubrication.

X-10 Instrument Oil
Lubricates precision instruments, fine parts & mechanisms. Use on all metals (shafts, gears, clocks, instruments, etc.). Non-gumming, rust inhibiting, long lasting lubrication.

CAIG Products ... used by those who demand the best!

Boeing
Diebold, Inc.
Dolby Laboratories
E.I. Dupont
Federal Express
General Electric
Hewlett Packard

Honeywell
IBM
John Fluke Mfg.
McIntosh Labs
Motorola
Nakaiichi
RCA

Reconot
Switchcraft
Tektronix
Texas Instruments
Wayne-Dresser
Xerox Corp.

... and many more

CAIG LABORATORIES, INC.
16744 West Bernardo Drive
San Diego, CA 92127-1904
Phone: (619) 451-1799
FAX: (619) 451-2799

January 1994, Electronics Now 131

CIRCLE 290 ON FREE INFORMATION CARD
TOTAL COST FOR AIR MAIL OF ANY ONE, OR AS MANY OF THE FOLLOWING ITEMS IS $15

PASSIVE NIGHT VIEWER

This is a completed commercial monocular hand held night viewer. It employs an image intensifier tube with a luminous gain of 12500! The viewer is of a USSR military standard and will produce useful images in a long starlight illumination. Has adjustable light objective focus, adjustable eyepiece and is supplied with a carry case of price.
Limited supplies available at a carry price of

$549

INFRA RED TUBE AND SUPPLY

These are the key components needed for making the INFRA RED NIGHT VIEWER. The tubes will convert infra red lights into visible light on the phosphor screen. These are those type 6929 similar to type 6929. These are high focus voltage. All that is needed to make the tube operational is a low current EHT power supply, which we provide in kit form: Draws 20mA from a small built-in battery.

INCREDIBLY PRICED

$120

MINIATURE CCD CAMERA

A monochrome CCD Camera that is completely assembled in a small PCB and includes an Auto Iris lens. Overall dimensions are 24 X 54 X 120mm. The camera can work with as little as 0.1 lux (6000:1) and is IR resistant. The PCB LEDs that are included on the PCB are useful for producing good images in a totally darkness. Available in EIA or CCIR standards.

$140

OATLEY ELECTRONICS

5 LANDSOWNE PARADE, OATLEY

SOUTH SYDNEY NSW AUSTRALIA 2223

PHONE ORDERS

East Coast between 7am and 2pm

West Coast between 4pm and 11pm

011 612 579 4985

FAX ORDERS

011 612 570 7910

IF POSSIBLE INCLUDE YOUR "PHONE" OR FAX NUMBER

CIRCLE 310 ON FREE INFORMATION CARD

CIRCLE 226 ON FREE INFORMATION CARD

The R&L funds pro (n)

Radionics makes a wide range of computer hardware and software products that can improve the performance of any computer system. The R&L funds pro (n) is a complete computer hardware and software kit that will enable you to build your own computer system from scratch. The kit includes all the necessary components to build a complete computer system, including a CPU, RAM, hard drive, and keyboard. It also includes software for configuring and booting the system. Radionics makes a wide range of add-on modules for the R&L funds pro (n) that can be used to customize the system to your specific needs. These modules include disk drives, network adapters, and video monitors. Radionics also provides a wide range of technical support services to help you with any problems you may encounter while building your computer system. The R&L funds pro (n) is a great value for the money and is sure to provide you with years of reliable service. For more information about the R&L funds pro (n), please visit our website today!
Learn COMPUTERS MICROPROCESSORS AND PROGRAMMING with the AES-10 trainer

This microboard has the most advanced features available, yet is easy to use and understand by beginners. You get a learning system that is also a fully functioning embedded industrial controller with 20 key input - 2 line liquid crystal display - Intel 8052 PLCC microprocessor - 64K bytes of memory - digital and analog inputs and outputs - built in logic probe - battery or 9v converter powered - and two RS232 ports. The AES -10 operates as a stand-alone system, or connect it to your PC for high-level-language programming. Learn by doing. Machine language-Assembly language-Full Basic. Clear texts give details about how the microcontroller/computer works. Shown in easy to follow style; hex and binary numbers, digital and analog electronics, and the three levels of programming. Fully built.

EACH LEARNING SYSTEM INCLUDES:

- Microboard, manuals, primer textbook, assembler, PC connector cable, software and examples.
- Everything you need. $269 Complete. Free brochure.

Advanced Educational Systems
1407 N. Batavia St. #220 • Orange, CA 92667
(800) 730-3232
SILVER SUCCESS STORY:

SILVER PLATING ON-THE-JOB.


THE CONDUCTIVE LUBRICANT.

Demonstrating low-voltage continuity through container of Conducto-Lube.

The upstart, since 1952. An excellent lubricant which is highly conductive because it contains pure silver. Uses continue to expand—from switches and breakers to any application where a conductive lubricant is needed.

Cool-Amp Conducto-Lube Company
15834 Upper Boones Ferry Road • Lake Oswego, Oregon 97035
(503) 624-6426 • Fax (503) 624-6436 • ORDER FACTORY DIRECT
No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio, TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don't need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! GUARANTEED PASS—You get your FCC License or money refunded. Send for FREE facts now. MAIL COUPON TODAY!

EARN MORE MONEY!

Be an FCC LICENSED ELECTRONIC TECHNICIAN!

Learn at home in spare time. No previous experience needed!

No costly school. No commuting to class. The Original Home-Study course prepares you for the "FCC Commercial Radio-telephone License." This valuable license is your professional "ticket" to thousands of exciting jobs in Communications, Radio, TV, Microwave, Maritime, Radar, Avionics and more...even start your own business! You don’t need a college degree to qualify, but you do need an FCC License.

No Need to Quit Your Job or Go To School
This proven course is easy, fast and low cost! GUARANTEED PASS—You get your FCC License or money refunded. Send for FREE facts now. MAIL COUPON TODAY!

COMMAND PRODUCTIONS
FCC LICENSE TRAINING, Dept. 210
P.O. Box 2824, San Francisco, CA 94126
Please rush FREE details immediately!

NAME
ADDRESS
CITY
STATE
ZIP

TECH-SYSTEMS
QUALITY USED ELECTRONIC TEST EQUIPMENT
PH:(800)435-1516
FAX:(908)280-0111

SPECTRUM ANALYZERS
HP 182T MAINFRAME...$995.00
HP 8512A IF SECTION...$795.00
HP 8515B 0-110MHz...$795.00
HP 8515L...$795.00
HP 8515B 0-1200MHz...$1,295.00
HP 8554A...$1,995.00
HP 8554A 0-18GHz...$1,795.00
HP 8554A 20-300GHz...$895.00
HP 8559A 0.1-1500MHz...$2,995.00
Tek TL5 20Hz-5.0 MHz...$3,495.00
Tek TL12 1.0kHz-1.0GHz...$3,695.00
Tek TL13 100 kHz-1GHz...$3,995.00
Tek TL18 1.5-60GHz...$4,195.00

Dual Trace Portable
OSCILLOSCOPES
Tek 465...100MHz...$695.00
Tek 475...200MHz...$995.00
Tek 475A...250MHz...$1,095.00
Tek 2445...300MHz...$1,995.00
Tek 2465...300MHz...$2,995.00

Lab Scopes
Tek 7764A...200MHz
Tek 7643...200MHz (includes 2 ea.
Tek 7A18 & 7B3A...
Tek 7A1B dual trace vert. amp...
Tek 7A19 vertical amplifier...
Tek 7A22 differential amplifier...
Tek 7A26 dual trace amplifier...
Tek 7B3A delayed sweep time base...
Tek 7B80 delayed sweep base...
Tek 7B80 delayed sweep base...
Tek 7A13 Dual Comparator/New Board...

Transmission Impedance Test Set
HP 4938A...$1,995.00
HP 4940A...$795.00
Noretal 9651...$550.00
HP 4944A...
Haileyron 320B-500B univ test sys...$550.00
HP 4955A protocol analyzer...$950.00
Tek 834 protocol analyzer...$330.00

Power Supplies
HP 6292B 10V 50A BRAND NEW...$499.00
HP 6453A 15V 500A...$1,495.00
HP 6456B 36V 100A...$1,495.00
 Lambda 100V 50A...$995.00
Seconics DCR 200A...$3,995.00
EMCV10V 500A...$1,495.00
EMCV 20V 500A...$1,295.00

We Buy Surplus Equipment!!
Fax us a list of your excess inventory

30 Day Guarantee!
1309 HWY 71 BELMAR,NJ 07719

CIRCLE 273 ON FREE INFORMATION CARD
10" THRUSTER WOOFER
You will be amazed at the great sound of this very high quality 10" woofer that is perfect for upgrading your old system or new construction. These were made for a custom manufacturer by JBL and feature 8Ω impedance, poly foam surround, frequency response from 25Hz to 2KHz and can handle up to 60 watts. Weight 2-1/2 lbs. Brand new and at an incredible blowout price!!!

G3311 $15.95
Pair for 30.00 (Include $5.00 S&H)

THIN FILM
ULTRA-FLEXIBLE
SOLAR MODULES
These are very unique ultra flexible thin film Amorphous Silicon solar cells. They are encapsulated in a clear flexible plastic film that allows them to be wrapped even around a pop can without damage. Great for charging NI-CADS, operating portable radios, electronic kits, model planes, camping equipment, etc. NOTE: The voltage output is actually higher than shown (which allows you to place a diode in series with one of the power leads when used in charging applications).

<table>
<thead>
<tr>
<th>Stock #</th>
<th>Voltage</th>
<th>Current</th>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3974</td>
<td>1.5V</td>
<td>45ma</td>
<td>2&quot; x 3.5&quot;</td>
<td>$5.95</td>
</tr>
<tr>
<td>G3975</td>
<td>3V</td>
<td>90ma</td>
<td>3.25&quot; x 6.0&quot;</td>
<td>$11.95</td>
</tr>
<tr>
<td>G3976</td>
<td>6V</td>
<td>45ma</td>
<td>2.0&quot; x 10.5&quot;</td>
<td>$12.95</td>
</tr>
<tr>
<td>G3977</td>
<td>9V</td>
<td>45ma</td>
<td>1.85&quot; x 12.5&quot;</td>
<td>$13.95</td>
</tr>
<tr>
<td>G3978</td>
<td>12V</td>
<td>45ma</td>
<td>3.25&quot; x 10.5&quot;</td>
<td>$21.95</td>
</tr>
</tbody>
</table>

COMPUTER DRIVE SWITCHING POWER SUPPLIES
We have 3 types of these high quality switching power supplies made for computers. Each supply features output as shown and can operate from 120V AC. We don't have any schematics or other info on these but we do give you a simple hookup diagram showing where to connect 120V AC in where the output is. Blowout Price on these high quality DC supplies!

<table>
<thead>
<tr>
<th>Stock #</th>
<th>Size</th>
<th>Outputs</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>G3687</td>
<td>7 1/2&quot; x 2 1/8&quot;</td>
<td>5VDC 2 amp, 12V 1 amp</td>
<td>$4.95</td>
</tr>
<tr>
<td>G3690</td>
<td>6 1/4&quot; x 2&quot;</td>
<td>5VDC 1 amp, 12V 2 amp</td>
<td>$5.95</td>
</tr>
<tr>
<td>G3688</td>
<td>5 1/2&quot; x 3 1/4&quot;</td>
<td>5VDC .5 amp, 12V 2 amp</td>
<td>$5.50</td>
</tr>
</tbody>
</table>

MINI INFRARED MODULE
Type GP1U01 is sensitive to almost all infrared remote controllers and features high gain. Has only 3 hookup pins and operates from 5 to 9V DC (it will light a LED or close a low voltage relay from 0 to 50 ft. away). Size 9"x 3" x 4".

G3652 $1.29

NU-TONE ELECTRONIC PROGRAMMABLE TIMER
Model HST - 24 can be used for controlling all types of 120VAC loads up to 15 amps resistive (1800 watts). Features up to (4) on and (4) off settings per day (repeated daily). Wire directly into a 2 gang junction box and has 2 separate switches for Vent Lite and Nite Lite. Very easy to program and has LCD digital clock with readout. Has built in AA replaceable battery to maintain program even during a power failure. Helps protect your home against burglaries. Super Value! Overall size: 4 1/2" square (including mounting plate). Brand New!

G3641 $10.95

ULTRA-BRIGHT RED LEDS BY THE FOOT!
Super bright Jumbo (5MM) diffused lens Red LEDs by Toshiba. The reds are marked with MT4148-HR5B (the SB at the end means Supr Bright!). You won't believe the quality and the matched brightness of these beauties until you see them! Operates at about 30 ma-60ma for maximum brightness and has a good viewing angle. They are on tape and reel put up by America West taping of Riverside Calif. We noticed a little tarnish on the leads on the LEDs on the first couple of wraps on the reels but all the inside LEDs look fine (and we had no problems soldering the tarnished ones in a test we did). Brand new, Blowout Price! Hurry, these will sell fast and we only have 50,000.

G3941 1 Foot $2.50 (ABOUT 24 LEDS)  1 Reel $12.00 (1500 LEDS)

IC MASK
These are the actual glass IC Masks used in transforming silicon wafers into ICs. They are fascinating to look at with a microscope. Great for educational use or just for a conversation piece. Each varies from above illustration. Comes in a plastic holder. Size is about 5" square.

G3698 $4.00
Complete Helium Neon Laser

**SPECIFICATIONS:**
- Input Voltage: 10-14 VDC
- Power Consumption: 3 watts
- Duty Cycle: Continuous
- Dimensions: 63.2 x 2.4 inches
- Wavelength: 632 nm
- Mode: TEM00
- Polarization: Random

These self contained Modules house a He Ne Tube and high voltage power supply. Complies with C.D.R.H. regulations. Comes with a one year warranty. 1 mW typical output.

**SPECIAL!**
110 VAC to 12 VDC @ 800 mA Adaptor for above He Ne Laser.  
# APT-12 $10.00

**MINIATURE LASER MODULE**

Dimensions: 7/8" (22 mm) diameter, 2.3" (56 mm) long.

Tested 1 mW typical output used tubes. Operates on 1300 VDC @ 4.5 mA. Dimensions: 5.8" x 1.0" diameter. Specification Sheet Included.

**He Ne Laser Tube**

![Image of He Ne Laser Tube]

**Laser Diode & Heat Sink**

New Mitsubishi, 3 mW 780 nm Laser Diodes mounted in a heat sink. Specification Sheet included.

**SPECIAL!**

**HEWLETT-PACKARD 3550B**

HP-3550B CARRIER TEST SET includes
- HP-204C audio oscillator (5 Hz-1.2 MHz),
- HP-403B voltmeter (1 uV-300 Vrms),
- and HP-353A telephone patch panel (800 ohms, 1-110 DB) in carrying case. Requires 115VAC 50-60 Hz, 8.4x19.3x13.3.  

HP-3565A TEST SET, earlier version of above with 204B oscillator (5 Hz-560 KHz), light gray color. Used-repairable...

36 lbs sh. Used-reparable ........................................ $195 CHECKED ... $295

HP-3550B (USM-181B) or HP-3550A (USM-181A) Partial Repro ....................................................... $150

Manuals for HP-3550B (USM-181B) or HP-3550A (USM-181A) Partial Repro ....................................................... $12 each

**L & N GALVANOMETER**

LEEDS & NORTHRUP 11876 GALVANOMETER, indicates variations of electric current in test circuits. Scale 15-0-15 in 1 mm increments; sensitivity 0.1 ua/mm. CDX 10 khms; 500 ohms system R. 3"Hx1"Wx4"D, 1 lb.  

NEW ................................................................. $29.95

**E-V DESK MIC**

ELECTRO-VOICE 607L Lo-Z differential dynamic base station mic, noise-cancelling type; 300-3800 Hz response. Mounted on heavy-duty cast stand with lockable push-to-talk switch. Coil cord has Cannon DM9702-7P 7-pin plug. 11"H; 4 lbs. NEW ................................................................. $35

**MILITARY LANTERN LIGHT**

LANTERN FLASHLIGHT has 2.3" dia lens head which pivots from right angle to in-line position. Requires four D-cell batteries (not supplied); army green metal construction with belt clip. 8.5x3.5x1.3, 2 lbs sh. FL-21067, NEW ... $6.95

Prices F.O.B. Lima, O. • VISA, MASTERCARD Accepted. Allow for Shipping • Write for latest Catalog

**FAR RADIO SALES**

1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

**LASERS Specials**

**HEWLETT-PACKARD 3550B**

- HP-204C audio oscillator (5 Hz-1.2 MHz),
- HP-403B voltmeter (1 uV-300 Vrms),
- and HP-353A telephone patch panel (800 ohms, 1-110 DB) in carrying case. Requires 115VAC 50-60 Hz, 8.4x19.3x13.3.

HP-3565A TEST SET, earlier version of above with 204B oscillator (5 Hz-560 KHz), light gray color. Used-repairable...

- 36 lbs sh. Used-reparable ........................................ $195 CHECKED ... $295
- HP-3550B (USM-181B) or HP-3550A (USM-181A) Partial Repro ....................................................... $150
- Manuals for HP-3550B (USM-181B) or HP-3550A (USM-181A) Partial Repro ....................................................... $12 each

**L & N GALVANOMETER**

- LEEDS & NORTHRUP 11876 GALVANOMETER, indicates variations of electric current in test circuits. Scale 15-0-15 in 1 mm increments; sensitivity 0.1 ua/mm. CDX 10 khms; 500 ohms system R. 3"Hx1"Wx4"D, 1 lb. NEW ................................................................. $29.95
- E-V DESK MIC ELECTRO-VOICE 607L Lo-Z differential dynamic base station mic, noise-cancelling type; 300-3800 Hz response. Mounted on heavy-duty cast stand with lockable push-to-talk switch. Coil cord has Cannon DM9702-7P 7-pin plug. 11"H; 4 lbs. NEW ................................................................. $35
- MILITARY LANTERN LIGHT LANTERN FLASHLIGHT has 2.3" dia lens head which pivots from right angle to in-line position. Requires four D-cell batteries (not supplied); army green metal construction with belt clip. 8.5x3.5x1.3, 2 lbs sh. FL-21067, NEW ... $6.95

Prices F.O.B. Lima, O. • VISA, MASTERCARD Accepted. Allow for Shipping • Write for latest Catalog

**FAR RADIO SALES**

1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802
LIST OF LCD DISPLAYS

- OPTREX 2x16-DMC 16207H 8 Bit ASCII Input
  - Dim: 31/4 x 3/4" Char Height: 18
  - $5.99

- OPTREX 2x20-DMC 20261H 8 Bit ASCII Input
  - Dim: 4 x 3/4" Char Height: 19
  - $7.99

- OPTREX 1x16 Backlit - DMC 16187
  - 8 Bit ASCII Input: Dim: 31/4 x 3/4" Char Height: 18
  - $9.95

- OPTREX 1x20 DMC 20171H 8 Bit ASCII Input
  - Dim: 71/8 x 3/4" Char Height: 42
  - $9.95

- OPTREX 2x40 DMC 40218H 8 Bit ASCII Input
  - Dim: 71/8 x 3/4" Char Height: 19
  - $9.95

VERY EASY TO INTERFACE TO ALMOST ANY MICROPROCESSOR!!!!

STereo Audio AMP

This 20 watt per channel, open frame, stereo audio amp comes completely assembled and tested. It also includes a self contained plug-in power supply. Less than 1% distortion for real "audio buffs".

You supply the speakers and we will supply some of the cleanest audio you have heard. Unit includes volume, tone, and balance controls. Front panel measures 9" x 3".

A steal at $12.95

FANS

SANYO—BRUSHLESS
- 12 Volt DC at .07 Amps—7 Blades
- 60 MM—2 3/8" x 2 3/8" x 1"
  - $5.95

TECHIDYNE—Brushless
- 12 Volt DC at .12 Amps—7 Blades
- 60MM—3 1/8" x 3 1/8" x 1"
  - This size commonly used in Computer Power Supplies
  - $5.90

PANAFLO—Brushless—12 Volt DC at 2 Amps 5 Blades—
- 119MM—4 11/16" x 4 11/16" x 1 1/2"
  - $5.99

8000/80000

<table>
<thead>
<tr>
<th>8001</th>
<th>5.20</th>
<th>B237</th>
<th>1.90</th>
<th>8008-2</th>
<th>3.25</th>
<th>B257</th>
<th>1.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>8002</td>
<td>5.50</td>
<td>B237-5</td>
<td>2.60</td>
<td>8155</td>
<td>2.25</td>
<td>B259A</td>
<td>1.85</td>
</tr>
<tr>
<td>8100</td>
<td>4.95</td>
<td>B243</td>
<td>1.75</td>
<td>8156</td>
<td>2.25</td>
<td>B259C-5</td>
<td>2.10</td>
</tr>
<tr>
<td>8031</td>
<td>2.95</td>
<td>B250</td>
<td>2.95</td>
<td>8202A</td>
<td>8.00</td>
<td>B275</td>
<td>10.95</td>
</tr>
<tr>
<td>8032</td>
<td>3.95</td>
<td>(16450)</td>
<td>6.50</td>
<td>8212</td>
<td>1.25</td>
<td>B279</td>
<td>2.25</td>
</tr>
<tr>
<td>8035</td>
<td>1.00</td>
<td>(15550)</td>
<td>10.50</td>
<td>8214</td>
<td>2.00</td>
<td>B284</td>
<td>1.49</td>
</tr>
<tr>
<td>8036</td>
<td>4.95</td>
<td>B252</td>
<td>1.10</td>
<td>8216</td>
<td>1.25</td>
<td>B286</td>
<td>3.50</td>
</tr>
<tr>
<td>8039</td>
<td>1.00</td>
<td>B253-5</td>
<td>1.75</td>
<td>8224</td>
<td>1.25</td>
<td>B287</td>
<td>2.49</td>
</tr>
<tr>
<td>8085</td>
<td>1.55</td>
<td>B255</td>
<td>1.80</td>
<td>8228</td>
<td>1.25</td>
<td>B288</td>
<td>3.50</td>
</tr>
<tr>
<td>8086</td>
<td>1.55</td>
<td>B255-5</td>
<td>1.50</td>
<td>8303</td>
<td>3.00</td>
<td>8303</td>
<td>3.00</td>
</tr>
<tr>
<td>8088</td>
<td>2.20</td>
<td>B255-5</td>
<td>1.75</td>
<td>8308</td>
<td>3.00</td>
<td>8308</td>
<td>3.00</td>
</tr>
</tbody>
</table>

TERMS: (Unless specified elsewhere) Add $3.25 postage, we pay balance. Orders over $50.00 add 8% for Insurance. No. C.O.D. Texas residents add 6 1/2% tax. 90 Day Money Back Guarantee. All items subject to prior sale. Prices subject to change without notice. Foreign orders—15% only. We cannot ship to Mexico or Puerto Rico. Canada, add $7.50 minimum shipping and handling. Countries other than Canada, add $15.00 minimum shipping and handling.

CIRCLE 219 ON FREE INFORMATION CARD
AFFORDABLE ENGINEERING HARDWARE / SOFTWARE

Engineering Software - PC/MSDOS
- Electronic Circuit Design $49
- Schematic Drawing Program $49
- PCB Design & Circuit Drawing $169
- PC-SCOPE Oscilloscope $49

PC Bus Plug-in Cards
- 24 Bit TTL I/O, 48 Bit TTL I/O $49, 59
- 12 Bit Data Acquisition & TTL I/O $89
- 16 Bit Counters & TTL I/O $89
- More Hardware & Software is available -

Call or Write for FREE Catalog

BSOFT Software, Inc.
444 Colton Road
Columbus, OH 43207
(614) 491-0832
Fax (614) 497-9971

UNITED STATES PATENT NO. 5,055,960
A USEFUL AND WORTHWHILE TOOL for the
**PROFESSIONAL ** **STUDENT ** EXPERIMENTOR

A PRECISION MOLDED, HIGH IMPACT, CLEAR PLASTIC TOOL that replaces
the VIDEO CASSETTE WHILE DIAGNOSING THE PROBLEM. THE VCR OR
CAMCORDER WILL FUNCTION IN ALL MODES AND THE MECHANISM WILL BE
OPEN FOR INSPECTION, MEASUREMENT & ADJUSTMENT

NOTICE!!
THE ORIGINAL VHS VU-THRU TOOL WILL WORK
IN ALL VCR'S, NEW UNITS OR OLDER UNITS-
FRONT LOAD, TOP LOAD, SIDE LOAD, AND
CAMCORDERs, INCLUDING THE DISCONTINUED
"G" CHASSIS VCR's.

INSTRUCTION MANuAL
FREE
WITH ANY ORDER
1 HEAD CLEANING SWABS
1 OZ. HEAD
CLEANING FLUID
2 RUBBER
RENEWING TOOL
INSTRUCTION
MANUAL
FREE INFORMATION CARD CIRCLE 227

ANY ONE TOOL
$ 9.95 ea.
$ 3.50 S&H
$ 13.45 total

ANY TWO TOOLS
$ 19.90
WE PAY S&H

ORDER ALL FOUR
$ 29.85
WE PAY S&H

COD add $ 4.50
IL orders add 7% sales tax

FOR THE VU-THRU TOOL

INSTRUCTION
MANUAL

FREE WITH ANY ORDER
1 HEAD CLEANING SWABS
1 OZ. HEAD
CLEANING FLUID
2 RUBBER
RENEWING TOOL
INSTRUCTION
MANUAL
FREE INFORMATION CARD CIRCLE 227

ANY ONE TOOL
$ 9.95 ea.
$ 3.50 S&H
$ 13.45 total

ANY TWO TOOLS
$ 19.90
WE PAY S&H

ORDER ALL FOUR
$ 29.85
WE PAY S&H

COD add $ 4.50
IL orders add 7% sales tax

Professional Tool Case
SPECIAL $59.95
Reg. $80.00
Model ENIM5
- Two removable pallets
  hold over 60 tools
- Case top has built-in
  document holder
- Case bottom is
  partitioned into 3 areas
A handsome black case to organize and
transport your valuable tools and instruments. This is
the same quality case used by literally thousands of professional
field engineers. Case is made of high impact polypropylene,
and has snap-action key locks and a padded handle.
Size: 17¾" x 12½" x 5½"
Tools are not included.
Offer expires January 31, 1994

To order call:
1-800-225-5370
In MA: (508) 682-2000
Same Day Shipment!
Money Back Guarantee!
Terms: Visa, MC, Amex;
PO's from qualified firms accepted,
Add $6.75 for packing and delivery

FREE CONTACT EAST CATALOG
Contains thousands of products for testing, repairing & assembling
electronic equipment. To get your free catalog, call (508)682-2000.
Total Coverage Radios

AOR AR1000XLT
$389.00
AM Broadcast to Microwave
1000 Channels
500KHz to 1300MHz coverage in a programmable hand held. Ten scan banks, ten search banks. Lockout on search and scan. AM, FM, & BFO for CW/SSB. Priority bank, delay/hold and selectable search increments. Permanent memory. DC or AC with adaptors. Mtng Bkt & Antenna included. Size: 2 1/4H x 5 5/8W x 6 1/2D. Wt: 1 lb. Fax fact document #305

MVT7100
$599.00
1000 Channel
100KHz to 1300MHz

NEW AOR AR1500
$449.00
Full Coverage with SSB and 1000 Channels.
500KHz to 1300MHz. Ten scan banks, ten search banks. Search lock and store. BFO. 2 Antennas. AM/NFM/WFM. Selectable increments. Top of the line in 855. Fax facts #675

AR2500
$449.00
2016 Channels
1 to 1300MHz
Computer Control
62 Scan Banks, 16 Search Banks, 35 Channels per second. Patented Computer control for logging and spectrum display. AM, NFM, WFM, & BFO for CW/SSB. Priority bank, delay/hold and selectable search increments. Permanent memory. DC or AC with adaptors. Mtng Bkt & Antenna included. Size: 2 1/4H x 5 5/8W x 6 1/2D. Wt: 1 lb. Fax fact document #305

Get instant tech information FREE from your Fax or Computer!
You can obtain specs, freq, info, software and more from our automated services. For fax facts, call from your stand alone fax machine and follow the voice prompts. Use the BBS from your modern of fax/modern equipped computer. Dial 317-849-8683 for fax back service, or dial 317-579-2045 for our computer bulletin board service.

Antennas.
Full Coverage Ant.
Hold offers
MVT7100
5/8W
Permanent memory. DC or delay/hold WFM, & logging per second. Patented $449.00
AR2500
clip,
delay
1000 Microwaves
Bearcat 2500XLTA
hand held
Bears 8500XLTC
Mobile Scanners
899.95
1000 Channel
800 MHz

Bearcat 760XLTM
$219.95
100 Channel
800 MHz

Sangean ATS-818CS
$219.95
Sangean ATS-818
$184.95
Sangean ATS-803A
$169.95
Sangean ATS-808
$179.95
Sangean ATS-606
$149.95
Sangean ATS-606P
$169.95
Sangean ATS-800
$89.95

Hand Held Scanners
Bearcat 200XLTN
$209.95
200 Channels 800 MHz
Ten scan banks plus search. Covers 29-54, 118-174, 406-512 and 806-954MHz (with cell lock). Features scan, search, delay, 10 priorities, mem backup, lockout, Wx search, keylock. Includes NiCad & Chrgr. Size: 1 3/8 x 2 1/16 x 7/12. Wt: 3 oz. Fax Facts #450
Bearcat 100XLTN
100Ch H/L/U/Air
$139.95
Bearcat 70XLT
20Ch H/L/U/Air
$159.95
Bearcat 55XLT
10Ch H/L/U/Air
$99.95
Coverage of above hand helds is 29-54, 136-174, 406-512 except 100 which also adds 118-136 Air Band. Fax Facts #475

Continuous Coverage
Bearcat 2500XLTA
hand held
$349.95
Bearcat 8500XLTC
mobile
$389.95
Bearcat 890XLT
mobile
$259.95
25-1300MHz, 500 ohm in 850, 400 is 2500 890 has 300 ohm & 29-960MHz. All cell locked. Features include turbo scan, VFO, search and more. Fax Facts #74, 475, 476

Table Top Scanners
Bearcat 855XLT1E
50Ch w/800... $159.95
Bearcat 142XLM10Ch H/L/U/Air... $84.95
Bearcat 147XLT16Ch H/L/U/Air... $89.95
Bearcat 172XM20Ch H/L/U/Air... $124.95
Bearcat 21016Ch H/L/U/Air... $129.95
Coverage of above units is 29-54, 136-174, 406-512, plus Air in 172 and 210 and air plus 800MHz in the 855. Fax Facts #675

Mobile Scanners
Bearcat
650XLZ
$99.95
16 Channel
10 Band
Compact, digital programmable unit covers 29-54, 136-174, and 406-512MHz. Size: 7 3/8 x 2 1/2 x 1 5/8. Wt: 2.5lbs. Fax fact #660

Trident
TR-33WL
$399.00
Scan/CD, X/K,Ka, Wide & Laser

Mag Mount Mobile Ant Ma100...
$19.95
Base Ant. 25-1000MHz As300...
$59.95
Pre-Amp .1-1500MHz Gw2...
$89.00
Downconverter 800 to 400 Dc89...
$89.00
Base Discone Ant Da300...
$89.00
External Speaker Ms190/90/amp...
$19.95
Old Scanner Repair, all brands...
$CALL
Extended Warranties...
$CALL
Frequency Info Fax/Modem...
$FREE
Frequency Books...
$CALL

2 Way Radios

VHF hi band programmable mobiles as low as $299.95. Call for quotes or Fax Fact #775
CELLULAR TELEPHONES

- CELLULAR HANDBOOK $59.95
  Explains in detail how cellular phones work, reprogram phones (have multiple phones with same number) SIDH and NAM codes.

- MOTOROLA CELLULAR SOFTWARE $299.95
  How to change ESN and NAM on all Motorola phones.

- CELLULAR ACCESSORIES
  Hands-free kits, smart chargers, battery eliminators, battery packs, antennas, etc.

We also sell new reprogrammed cellular phones (car mount, bag and handheld) or send us your second telephone and we will reprogram it to your current number!

CELLULAR LINK
3500 OAK GATE DR., SUITE 3603
SAN ANTONIO, TX 78230
PHONE: (210) 697-9544. FAX on demand 1-800-422-9377
Call from your fax and follow the voice prompts to receive detailed information.
Book and software sold for Educational purposes only.

CIRCLE 291 ON FREE INFORMATION CARD

4 OHM 60 WATT FLAT SPEAKER $7.95
Full Range, 50Hz-20KHz. Under 1" thick with super-fidelity sound! Durable full range speakers feature new jet structure, and microconic foam bass magnets. Ideal for applications where space is a problem. Van walls, door panels, wherever conventional Bulky speakers just won't do.
Approximately 6-1/4" x 6-1/4" x 13/16.

SCANNERS AND SECRET FREQUENCIES $19.95
Covering a broad range of topics from where to find it to what to do with it. Scanner specs, modifications, frequencies, legal aspects, and operating information as well as inside the scoop on what is really going on in the airwaves.
Over 300 pages.

137 THERMOCOUPLES PELTIER JUNCTIONS
The peltier junction is a solid-state thermocouple device. Current applied to the device will produce heat on one side of the device and a cold surface on the other side. Water placed on the surface will freeze or boil depending on polarity of applied voltage. Ideal for applications from 3-12 VDC -- wrap up a battery and let your imagination run wild! DOCUMENTATION INCLUDED!!!
Small Peltier Junction (approximately 0.17" x 0.17" x .12") $20.00
Large Peltier Junction (approximately 1.56" x 1.56" x .15") $29.50

THERMAL CONDUCTIVE ADHESIVE $4.95
Ideal for a wide variety of repairs and projects (including diffusing your peltier junctions to hooded!!) A two-part adhesive system (0.65 fl oz adhesive net and 0.44 fl oz activator net) insures that only the parts you want bonded will be. Great for bonding beams/silks to other surfaces.

NOT-SO-BIG SOLAR PANEL $14.95
A smaller version of the popular Big Solar Panel, this 1/2" x 6-1/4" x 3/16" thin film glass solar panel is ideal for experimenters, small applications, and conservative budgeters.
21 V no load, 12 V 1.93Wm with load.

BIG SOLAR PANEL $36.50
A whopping 1' x 5' x 3/16", this thin film glass solar panel (just a tiny bit bigger) 12-14 volts @ 700-750 mA (1/4A). Imagine this as a power supply for your handheld or other projects requiring 12 VDC. *(See solar panel warranties come with prices below $39.00 for cases shipping/handling on this item."

30 pc. TAMPER-PROOF SECURITY BIT SET $16.95
Drive bits with hollowed tips designed for those security screws often found in computers and other modern equipment. This set includes 9 different sizes of Torx bits (TT-7 thru TT-40), 4 sizes of square drive bits (ISO thru S3), 7 different sizes of hex bits (5/64 to 1/4), as well as flat and phillips bits, a socket holder, a 1/4" adapter, and a magnetic tipped handle to accomodate all the bits in the set. Handle also has a storage compartment for pocket use, and the complete set comes in a sturdy plastic storage case. Ideal for the bench or toolbox.

BUSY PHONE LIGHT KIT $9.95
Prevent Junior’s familiar whine “I’m on the phone!” when you pick up the receiver. Prevent those unpleasant modern interruptions on your computer. The busy phone light LED indicator lets you know when an extension phone is being used. Return to privacy in spite of your teenagers! Easy to build. Requires 5VDC.

THE END PRINT. PRICES SUBJECT TO CHANGE WITHOUT NOTICE. COTTONERY IS NOT RESPONSIBLE FOR PRINTING ERRORS. *MASTERCARD, VISA AND DISCOVER ACCEPTED. **$10 MINIMUM ON MAIL ORDERS • SUPPLY OF SOME ITEMS IS LIMITED • PRICES DO NOT INCLUDE SHIPPING • UPS ORDERING SHIPPPING & HANDLING WITHIN THE CONTINENTAL U.S. (ITEMS REQUIRING ADDITIONAL AMOUNTS ARE NOTED). **SALES TAXES FOR THE FIRST ITEM $1.50 FOR EACH ADDITIONAL ITEM. RESTOCKING CHARGES MAY BE ISSUED ON RETURNED ITEMS. OBJECTS IN MIRROR ARE CLOSER THAN THEY APPEAR.

CIRCLE 243 ON FREE INFORMATION CARD
PUT TENMA® TO THE TEST

Tenma offers a complete line of service equipment and accessories that feature competitive prices and unsurpassed value. TENMA... your one source for test equipment.

**TENMA**

**Computer Monitor Tester**
Move into the highly profitable computer monitor repair market with this new Computer Monitor Tester by TENMA. Costs hundreds of dollars less than comparable units, and portability allows you to easily test a wide range of monitors on the bench or in the field.
- 16 scanning frequencies from 15.7-70.8KHz
- Five video patterns: Tests CGA, VGA, Super VGA, extended VGA, MDA PGA/K and high resolution monochrome monitors
- Switchable sync on green

#72-1070

**Monitor Adaptor**
Made exclusively for the TENMA Monitor Tester. Inexpensive option attaches directly to tester. Greatly increases number of compatible monitor types.
- Unique “sidecar” design
- Adaptor enables MAC II and BNC type interfaces
- Includes mounting hardware

#72-1080

**Deluxe DMM**
Dual display multimeter is loaded with high tech features found only in meters costing hundreds of dollars more.
- Measures AC/DC to 750V
- AC/DC Current to 20A
- Resistance to 40Mohm
- Frequency to 2MHz
- Capacitance to 100MFD
- Transistor, diode and audible continuity test

#72-089

#72-950

**1GHz Spectrum Analyzer**
Frequency range of 1MHz-1GHz makes this unit ideal for a wide range of RF applications.
- CRT readout with cursors
- High sensitivity
- Internal scale
- 5" high brightness CRT
- Internal calibration
- Displays waveforms without delay

#72-1085

**20MHz Oscilloscope**
The TENMA Trainer #72-905 is a basic dual trace 20MHz oscilloscope ideally suited for the student or entry level electronic applications.
- 11" high brightness CRT with internal graticule
- 2KV accelerating potential
- TV video sync filter
- Front panel electronic trace rotation

#72-905

**MCM ELECTRONICS**
850 CONGRESS PARK DR.
CENTERVILLE, OH 45459-4072
A PREMIER Company

Serving you coast to coast. Distribution Facilities in Dayton, OH and Reno, NV!

To order, or to request a FREE Catalog...Call
1-800-543-4330
To Order By Fax...Call
1-513-434-6959
ENS-10

CIRCLE 307 ON FREE INFORMATION CARD
Grill Guides
Ball and socket type grill guides for attaching speaker grill to cabinet. To use, simply drill the appropriate size holes in cabinet and grill frame. 12 pair per package.

Polydax 1" Soft Dome Tweeter
1" tweeter diaphragm features an extended profile for maximum stiffness. For fluid cooling ensures high power handling capability with smooth and transparent sound reproduction.
- Power handling: 70 watts RMS/100 watts max.
- Voice coil diameter: 1" inch
- Impedance: 8 ohms
- Frequency response: 4000-20,000 Hz
- Magnets: 34 oz. x 3/4" x 5/8"
- Mounting hardware included.
- Net weight: 1 lb.

Fluorescent Work Light
Extra bright 15 watt tube that operates on 120 VAC or 12 VDC. 15 foot power cord with wall adaptor and cigarette lighter plug. Net weight: 2 lbs.

One Farad Car Stereo Capacitor
Most car amplifiers' power supplies simply lack the capability to produce large amounts of instantaneous power. By adding the 1 Farad Car Stereo Capacitor to your system it will greatly augment the power supply of your amp and help it produce incredible bass punch and dramatically improved transient response. Includes installation instructions.
- Specifications: 1,000,000 uf. 16VDC at 85 degrees C.
- Net weight: 2 lbs.
- Year guarantee.
- Dimensions: 8-1/2" (H) x 3" (Dia.)

8" Fiberglass Cone Bass/Midrange
A premium quality driver. The woven fiberglass cone, high loss rubber surround and 29 Hz resonance, combine to offer excellent sonic definition and deep, tight bass.
- Power handling: 70 watts RMS/100 watts max.
- Voice coil diameter: 1-1/2 inches
- Impedance: 8 ohm
- Frequency response: 20-4000 Hz
- Magnets: 20 ozs.
- Fs: 29 Hz
- SPL: 89 dB @ 1W/1m
- Qts: 0.18
- Qms: 47
- Qws: 2.2
- Maxx: 17 inches
- Net weight: 5 lbs.
- Dimensions: A: 8-3/8"; B: 7-1/4"; C: 3-13/16"; D: 3-7/8"; E: 1-3/8"

Home VCR Repair Illustrated
This illustrated guide can show you how to correct the most common failures and malfunctions without expensive tools or test equipment. Written by Richard C. Wilkins and Cheryl A. Hubbard. 400 pages in paperback. Copyright: 1991.

Right Angle 1/4" Phone Plug (Mono)

The Loudspeaker Design Cookbook IV
This book describes the "science" of loudspeaker design, however applying it is an "art". Using the information in this book will yield hundreds of possible variations in speaker design, with some subtle and not-so-subtle differences. 1991 copyright, fourth edition. Author: Vance Dickason. 154 pages paperback.

Cabinet Carpet
This high quality carpet is the covering of choice for car, stage, and amplifier cabinets. Adhere with spray adhesive or latex contact cements. Sold by the linear yard. 52 ozs.
- 5-260-765 Dark Charcoal
- 5-260-767 Medium Grey
- 5-260-768 Jet Black
Per Linear Yard, 36" x 54" $4.50 (3-1/2"")

Fujifilm Alkaline AA
Premium quality super alkaline batteries from Fuji feature a 100 percent mercury free formula. Long life design rivals up to 85 percent of its life after 5 years in storage. Sold in packages of four.

12" Heavy Duty Poly Woofers
Special clear, ribbed polypropylene cone with poly foam surround.
- Power handling: 100 watts RMS/200 watts max.
- Voice coil diameter: 2 inches
- Impedance: 4 ohms
- Frequency response: 23-1500 Hz
- Magnets: 40 ozs.
- Net weight: 9 lbs.
- Dimensions: A: 12-1/8"; B: 10-7/8"; C: 5-1/2"; D: 5-1/2"; E: 1-3/4"

144 Parts Express 340 East First St. Eaton, Ohio 45320 Local: 513-222-0173 "FAX: 513-222-4644

CIRCLE 262 ON FREE INFORMATION CARD
14-3 Heavy Duty Cord
Super duty power cord, 14 ga., 3 conductor, 4 ft. length. Limited availability.
#EN-119-010 $2.15 (1-25) 

12 VAC CT, 300 mA Transformer
12VAC (6-6-6) secondary, 300 mA current capability. 2-1/2 ft. primary wires. Dimensions: 2-1/2"(W) X 1-3/8"(H) X 1-1/2"(D).
#EN-129-340 $1.45 (1-15) 

VCR Hardware Assortment
Convenient assortment of clips, washers, springs, and screws. 10 pieces each of 4 sizes of "E" clips. 10 pieces of 2 sizes of retaining rings, 10 pieces of 14 sizes of washers, 2 each of 8 sizes of tension and compression springs and 24 assorted screws. Total of 246 pieces.
#EN-430-315 $6.95 (1) $5.85 (4+)

Speaker Sealing Caulk
Special rubber compound quickly and easily seals speakers into cabinets. Eliminates vibration and air leaks. Sold in 1/4" x 36" strips.
#EN-289-300 75¢ (1) 60¢ (4+)

Klein Unibit (reg) Step-Drill Bit
For drilling multiple size holes in metal, plastic and wood up to 1/8" thick. Thirteen steps in 1/32" increments ranging from 1/8" to 1/2" holes. Diameter markings are laser etched on the flute, 1/4" shaft.
#EN-362-100 $1.95

Quality 30 Watt Iron
Economical 30 watt iron with replaceable tip. Blue plastic handle.
#EN-370-010 $3.95

Soldering Stand
Convenient soldering iron stand with cleaning sponge. Display boxed.
#EN-370-020 $4.95 (1) $4.50 (10+)

Kester Pocket Pack
Perfect tool box solder supply. The wire feeds conveniently from the handy dispenser tube. Pocket clip attaches. .031" diameter solder .5 ounce (approximately 15 feet).
#EN-370-050 $1.45 (1) 90¢ (4+)

Parts Express
340 East First St. 
Dayton, Ohio 45402
Local: 513-222-0173
FAX: 513-222-4644

Isotip Butane Soldering Iron
The ideal soldering iron for field repairs where no AC power is present. Uses standard butane (not included) available at most stores. Iron also comes with a torch attachment which easily screws on in place of the soldering tip. Limited one year warranty.
#EN-370-235 $24.95 EACH

Center Off Toggle
DPDT center off toggle switch. 6A, 125VAC. (1/2" mount.)
#EN-060-087 $1.15 (1-25) $1.25 (50+)

Monitor Power Jack
Standard computer type monitor jack. Limited quantity.
#EN-090-446 85¢ (1-49) 65¢ (50+)

Screw Type Holder
#EN-070-610 85¢ (1-15) 55¢ (4+)

Pull-Out Radio Carry Case
Super quality nylon bag storing pull out radios. Front accessory storage pocket which will hold up to 5 CD cases. Velcro closure. Inside dimensions: 7-1/2" x 2-1/2" x 8".
#EN-285-950 $10.95 (1) $9.95 (4+)

Matching Transformer
Adapts 75 ohm coax to 300 ohm twin lead (or vice-versa) at antenna or television. 5-90 MHz UHF/VHF. 3 capacitor PC board type.
#EN-180-010 49¢ (1-49) 35¢ (50+)

Deluxe F-59 Connector
(Full attached ferrule)
#EN-090-355 22¢ (1-25) 17¢ (50+)

Deluxe "F" Male For RG-6
(Full attached ferrule)
#EN-090-358 29¢ (1-9) 24¢ (4+)

Technician's Turntable
Turntable to speed repair of VCRs, TVs and more. Allows technician to easily turn unit for convenient repair. Dimensions: 20"W x 15"D x 1-1/8"H Black pecled surface. Includes 4 anti-skid adhesive feet. Weight: 9 lbs.
#EN-360-427 $26.95 EACH

Surge Protected Power Center
7 outlet power center with noise and surge protection. Surge protection on all three lines (hot, neutral, ground). Response time: less than 5 nano seconds. Noise protection on hot to neutral. 15 amp circuit breaker. Lighted power switch. UL listed.
#EN-130-212 $12.05 (10) $10.95 (6+)

Universal Video Cable
6 ft. RG-59 cable with a push-on "F" connector to a combination 75 and 300 ohm balun that is switchable between 75 and 300 ohm.
#EN-180-126 $2.25 (1-9) $2.00 (4+)

3.5mm Mini Headphone Extension
Add 6 feet to your mini headphones. Gives the user added mobility when listening to personal cassette players. Limited availability.
#EN-240-090 $1.15 (1-15) $1.05 (10+)

Triple Shielded Audio Cables
These high grade oxygen free copper cables utilize triple shielding to ensure excellent noise rejection and are terminated with high conductivity gold plated RCA's for maximum signal transfer. Flexible jacket is sapphire blue and includes a remote turn on wire.
#EN-263-650 $15.95 (3 ft.)
#EN-263-655 $17.95 (6 ft.)
#EN-263-670 $29.95 (19 ft.)

In-Line Coax Splice
Quickly splice coaxial cables with this unique and easy to use splice connector. Accepts up to RG6/U cable.
#EN-090-545 49¢ (1) 55¢ (10+)

12V, 2.3Ah Camcorder Battery
Popular battery use with Canon, Chinnon, Curtis, Mathes, G.E., Magnavox, Minolta, Olympus, Panasonic, J.C. Penny, Pentax, Phiico, Quasar, Sears, Sylvania, Teknika and other miscellaneous manufacturers. Dimensions: 7.17" (L) x 4.50" (W) x 2.42" (H).
#EN-140-541 $39.95 EACH

Carpet Spray Adhesive
Professional quality spray adhesive securely bonds lightweight materials such as flexible foams, fiberglass insulation, plastics and metal foils. 16.5 oz. aerosol.
#EN-340-095 $8.95 (1-15) $7.95 (4+)

Pressfit Speaker Terminal
Spring loaded, pushbutton speaker terminal simply drill a hole, apply glue, and press into place.
#EN-250-295 95¢ (1) 78¢ (4+)

3 Amp Power Supply
This is a fully regulated power supply perfect for testing car radios, CBs, radar detectors and other standard 12VDC items. Heavy duty steel housing with indicator lamp and binding posts. Short circuit protection. Input 120 VAC. 60 Hz. 2 year warranty. Net weight: 5 lbs. Specifications: output voltage 13.8 VDC, output current (cont) 3 amps, output current (surge) 4 amps, dimensions 4-1/2"x3"x7", net weight 4 lbs.
#EN-120-495 $24.95 (1) $23.50 (6+)

Unfinished 6x9" Cabinets
#EN-260-450 $12.95 (1) $12.50 (4+)

FREE CATALOG
January 1994, Electronics Now
CIRCLE 262 ON FREE INFORMATION CARD

CALL TOLL FREE
1-800-338-0531

FREE CATALOG
January 1994, Electronics Now
CIRCLE 262 ON FREE INFORMATION CARD

CALL TOLL FREE
1-800-338-0531
THE BEST
8085 MICROPROCESSOR TRAINING SYSTEM

No other training system we know of comes close to matching the PRIMER's features at this low price. The PRIMER teaches more and is easier to use than other comparably priced trainers. The over 100 page self instruction manual takes you from binary number systems, to processing interrupts, to interfacing temperature sensors. The 8085 based PRIMER TRAINER comes complete with Monitor Operating System software, digital I/O, A/D, D/A, timer, speaker, display and keypad.

Learn how to program and interface at the machine level with the PRIMER TRAINER. Start programming with machine language, then move on to Assembler and then continue on with multi-tasking BASIC or Forth compilers. Ideally suited for beginners as well as advanced high-level programmers and engineers.

THE PRIMER IS $99.95 QUANTITY 10 OR ONLY $119.95 QUANTITY 1 IN KIT FORM. THE PRIMER ASSEMBLED & TESTED BY EMAC IS $169.95. ORDER NOW AND RECEIVE A FREE POWER SUPPLY. PLEASE ADD $5.00 FOR SHIPPING.

FOTRONIC
QUALITY ELECTRONIC TEST EQUIPMENT
Sales • Service

• Specialists in - Fluke, Hewlett Packard, Tektronix

• NIST Traceable/Mil Spec 45662A
Calibration Available

TECHNICAL SUPPORT
Oscilloscope Specials
Tek 465 100 MHZ $449.00
Tek 465B 100 MHZ $549.00
Tek 467 200 MHZ $564.00
Tek 475A 200 MHz $649.00

ALL EQUIPMENT SOLD WITH WARRANTY

For more GREAT VALUES Call, Write, or FAX
P.O. Box 708, Medford, MA 02155
(617) 391-6858 FAX (617) 391-6903

* CIRCLE 211 ON FREE INFORMATION CARD

*THE BEST*
8085 MICROPROCESSOR TRAINING SYSTEM

No other training system we know of comes close to matching the PRIMER's features at this low price. The PRIMER teaches more and is easier to use than other comparably priced trainers. The over 100 page self instruction manual takes you from binary number systems, to processing interrupts, to interfacing temperature sensors. The 8085 based PRIMER TRAINER comes complete with Monitor Operating System software, digital I/O, A/D, D/A, timer, speaker, display and keypad. Learn how to program and interface at the machine level with the PRIMER TRAINER. Start programming with machine language, then move on to Assembler and then continue on with multi-tasking BASIC or Forth compilers. Ideally suited for beginners as well as advanced high-level programmers and engineers. THE PRIMER IS $99.95 QUANTITY 10 OR ONLY $119.95 QUANTITY 1 IN KIT FORM. THE PRIMER ASSEMBLED & TESTED BY EMAC IS $169.95. ORDER NOW AND RECEIVE A FREE POWER SUPPLY. PLEASE ADD $5.00 FOR SHIPPING.

EMAC, inc.
618-529-4525 FAX: 618-457-0110
P.O. BOX 2042 CARBONDALE, IL 62902
**Mystery Levitating Device!**

Remember War of the Worlds? Objects float in air and move to the touch. Defies gravity, amazing effect, conversation piece, magic trick or great science project.

**Laser Ray Gun**

ADVANCED PROJECT:创造出一种强大的能量，能够点燃火柴。手持的装置具有可充电电池。500毫升的液体燃料可以提供充足的燃料，或者使用适合的激光器。这是一个危险的科学项目(个人防护装备必需)。

LAGUNI Kits $20.00
LAGUNIK KIT/Plans $19.50

**Extended Play Telephone Recording System**

READY TO USE! Automatically controls and records on your X-4 extended play recorder, tapping both sides of a telephone conversation. Insured for order entry verification. Check your local laws as some states may require an alerting beeper.

TAP20X Ready to Use System $129.95

**Shocker Force Field/ Vehicle Electrifier**

Neat little device allows you to make hand and shock balls, shock wards and electronics objects, charge capacitors. Great payback for those wise guys who have wrung your necks.

SHK1K Easy to Assemble Electronic Kit $24.50

**Blaster Pulsar**

Pocket-sized wand produces 100,000 watts of power for personal defense, field and lab use, etc. BL3K Plans $10.00

**Homling / Tracking Transmitter**

Beeper device, 3 mile range.

HO1 Plans $10.00
HO1K KIT/Plans $49.50

**Listen Through Walls, Floor**

Highly sensitive stethoscope mike

STETH Plans $8.00
STETHIK KIT/Plans $44.50

**NEW! Telephone Line Grabber / Room Monitor**

ALL NEW! The Ultimate In Home or Office Security & Safety! Smile to Use! Call your home or office phone, push a secret tone on your telephone key pad to access either: A. On premises sounds and voices; or B. Existing telephone conversation with break in capability for emergency messages. CALL THIS: Before assembly c/c use, check legality with your state Attorney General's office as you may require "beeper" or other third party alerts.

TELEGRAB1 Plans Only $10.00
TELEGRAB1 KIT/Plans $99.50

**Ultrasonic Blaster**

Laboratory source of acoustical shock waves. Bow horns in metal, produces "coid" steam, atomizes liquids. Many cleaning uses for PCB boards, jewelry, etc.

ULB1 Plans $10.00
ULB1K KIT/Plans $69.50

**100,000V Intimidator / Shock Wand Module**

Build an electronic device that is affective up to 20 feet. May be oversized for handheld, portable field or laboratory applications.

ITMDKIM Easy-to-Assemble Electronic Kit $49.50
ITMD2 Plans only, creditable to kit $10.00

**Iron Ray Gun**

Projects charged ions that induce shocks in people and objects without any contact. Great science project as well as a high tech party prank.

IKG3 Plans $8.00
IKG3K KIT/Plans $69.50

**Invisible Pain Field Generator**

Shirt pocket size electronic device produces intense, variant complex shock waves of intense directional acoustic energy, capable of wounding of aggressing animals.

IPG7 Plans $8.00
IPG7K KIT/Plans $49.50
IPG70 Assembled $74.50

**SUPER GIANT SMOKE ASSORTMENT**

SPECIAL INTRODUCTORY-offer! WOW! Over 500 items - the largest smoke assortment we have! Each super giant assortment contains at least 500 pieces - enough to last you a 10 year life time. At this special price - less than 1 cent per item. Guaranteed value at least 50 percent more than you pay! SMOKES 25 $59.50

**TV & FM Joker / Jammer**

Shirt pocket device allows you to totally control and remotely disrupt TV or radio reception. Great gag to play on family or friends. Discreet required.

EZJIKM Easy to Assemble Electronic Kit $24.50

**Visible Beam Laser**

High brightness red HeNe laser visible for miles. Produce your own light show! Projects a visible beam of red light clearly visible in most circumstances. Can be used to intimidate by projection of a red dot on target subject. Also may be used to "listen in" using our laser window bounce method. ILUS1 below. Easy to build module makes a working visible laser!

LAS1KKM KIT w/1mw Laser Tube, Class II $69.50
LAS1KKM KIT w/2.5m Laser Tube, Class III $99.50

**"Laser Bounce" Listener System**

Allows you to hear sounds from an area via a light beam reflected from a window or other similar objects. System uses our ready-to-use LAT1 Laser Transmitter gun site as the transmitter. The receiver section is supplied as an easy-to-build kit, including our cushioned HS10 headband. LLST2 Plans $20.00

**Smaw Visible Red Pocket Laser**

Utilizes our touch power control.

VRLSMMX KIT/Plans $119.50

**Whirlly Wheels!**

Fantastic ALL NEW pinwheel effect for auto, motorcycle, bicycle, etc. Use one per wheel. SIMPLE TO USE! LWIMRYL $9.50

**Pocket Sized NightViewer**

Uses low level starlight to see in the dark!

Low Cost
- Ultra-High Amplification!
- Auto Brightness Control
- Limited Amount Available
- Made in the USA - Night Surveillance - Animal studies, etc.

Can be used to fly an airplane or drive a car!

PKV7 Plans $13.00
PKV7X Easy to Assemble Kit $13.95
PKV70 Ready to Use $15.95

**3 Mile FM Wireless Microphone**

Subminiature Crystal clear, ultra sensitive pickup transmits voices and sounds to FM radio. Excellent for security, monitoring of children or invalids. Become the neighborhood disc jockey, or go under cover, using our sunglasses FM radio (see catalog). FMV1 Plans $7.00
FMX1 KIT/Plans $6.50
FMX1SUGL10 Sunglasses with built-in FM Radio $29.50

**Telephone Transmitter - 3 Mi**

Automatically transmits both sides of a telephone conversation to an FM radio. - Tunable Frequency - Undetectable on phone - Easy to build and use - Up to 3 Mile Range - Only transmits during phone use.

WPMMK Plans $7.00
WPMMKX KIT/Plans $38.50

**CATALOG With many more items! Free with Order or send $1 PH**

Order by Mail or by 24 Hour Orders-Only Phone 800-221-1705

January 1984, Electronics Now
**Bizarre ELECTRICAL Books!**

**Lightning Bolt Generators!**
Electrostating! Build 'em! Also high voltage test equipment, experiments, motors and more! New paperback! Rare info! Only $8.95.

Hammarlund Shortwave Manual
Build 12 different hot shortwave receivers from this 1937 construction manual. Photos, diagrams, text! Wall-to-wall how to! Only $4.95.

**Unusual Books!**
Build a solar cell $4.95, Static Electricity $5.95, Radios that Work for Free $7.95, Wimshurst Machine $8.95, Experimental Physics $24.95, Neon Signs $12.95, Design Induction Coils $12.95, Armature Winding & Motor Repair $18.50, Lo-Jay Manual $6.95, 40,000 Volt Induction Coil $4.95, more! Sec Catalog!

**How to Order!**

**NOW! A QUALITY SATELLITE**
**SCPC AUDIO RECEIVER**

**At an Affordable Price**

**Universal SCPC-100 Audio Receiver**

**Specifications**
- Stable, Microprocessor Controlled Tuning
- Compatible with 950-1450 Block Systems
- 3 Minute Hook-Up
- Large L.E.D. Tuning Scale
- Receives C and KU Band SCPC
- Does not Disable Video When in Use

**Services on SCPC**
- Hundreds of Quality SCPC Channels on Satellites

**Introductory Price $439 + S&H**

**To Order Call: 1-800-241-8171**

**Universal Electronics, Inc.**
4555 Groves Rd., Suite 13, Columbus, OH 43232
(614) 866-4605 FAX (614) 866-1201

**Attention Cable Viewers!**

**Cable Viewers...get back to your BASIC Cable Needs**

**Call 800-577-8775**

For information regarding all of your BASIC cable needs.

- **5 Good Reasons to Buy Our Far Superior Product**
  - Price
  - Efficient Sales and Service
  - We Specialize in 5, 10 Lot Pricing
  - All Functions (SA, Jerrold, PIO, Converters, etc.)
  - Any Size Order Filled with Same Day Shipping

We handle NEW equipment ONLY - Don't trust last year's OBSOLETE and UNSOLD stock! COMPETITIVE PRICING - DEALERS WELCOME

**Hours:** Monday-Saturday 9-5 C.S.T.

It is not the intent of B.E.S.W. to defraud any pay television operator as we will not assist any company or individual in doing the same. Refer to laws prescribed for specifications.
ALL NEW -- IMPROVED STEREO FM TRANSMITTER

LOADED WITH FEATURES

* RF AMPLIFIER
* FRONT PANEL FINE TUNING
* STABLE OPERATION
* INPUT LEVEL ADJUSTMENTS
* WORKS WITH DIGITAL TUNED RADIOS
* 38KHz CRYSTAL MULTIPLEX CIRCUIT

DC'S all new FM Stereo Transmitter Kit based on the unique BA1404 Stereo Broadcaster Integrated Circuit that includes all the complex circuitry to generate the stereo signal. We've added an RF amplifier circuit to provided excellent transmit range. Additional features like electronic fine tuning, voltage regulation, 38KHz multiplex crystal, input level adjustment makes the Stereocaster the top of the line Stereo FM Transmitter.

ORDER STEREOCASTER $29.95

POWER SUPPLY KIT
PS-1 $16.99
Output of this power supply is continuously adjustable from 1.2 to 25V DC. The LM317T voltage regulator provides excellent regulation and ripple rejection. Includes a 1A transformer, PC board, LM317T, 2 binding posts, and all small parts.

MORE KITS
3 DIGIT LED DVM ONLY 3” X 3” READS 0 TO 100 V DC ORDER DVM3 $19.95
FM WIRELESS BROADCASTER FMI $ 9.95
8036 FUNCTION GEN. KIT FGI $ 9.50
SEQUENCER PROJECT SEQKIT $ 9.50

CHRISTMAS TREE PROJECT
Build this unique seasonal project and have an unusual conversation piece. Powered by two D cells, 17 LEDs flash in a seemingly random fashion. Kit includes everything except batteries. ORDER XMASKIT $18.95

MAKE CIRCUIT BOARDS
THE NEW, EASY WAY
WITH TEC-200 FILM
JUST 3 EASY STEPS:
• Copy circuit pattern on TEC-200 film using any plain paper copier
• Iron film on to copper clad board
• Peel off film and etch convenient 8½ x 11 size

ORDER TEC200-10 (10-SHEETS) $5.95

UNIVERSAL DECODER IC'S
REFER TO RADIO ELECTRONICS MAY 1990

CD22402E  7.95 CD4040  .65
LM733    .99 CD4053  .59
LM7805   .50 LM7812  .50
CA3126E  1.95 LM7905  .50
74C00    .50 3.58 MHz  1.00
NE564    2.29 18 Uh   .39

DCELECTRONICS
SEND MAIL ORDERS TO:
PO BOX 3203  SCOTTSDALE, AZ 85271

ADD $3.50 S&H

TOLL FREE ORDER
HOT LINE
1-800-423-0070
NEW!! Laser Radar Detectors $99.95

CABLE CONVERTER SPECIALS

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>5</th>
<th>10+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jerrold 400 Converter</td>
<td>59.95</td>
<td>49.95</td>
<td>45.00</td>
</tr>
<tr>
<td>Hamlin 5000 Converter</td>
<td>69.95</td>
<td>59.95</td>
<td>55.00</td>
</tr>
<tr>
<td>SA-3 Type Decoders</td>
<td>89.95</td>
<td>65.00</td>
<td>50.00</td>
</tr>
</tbody>
</table>

Jerrold 400 Converter
60 channel refurbished with new transmitter. Fine tuning HRC/STD selectable. 6 month warranty.

Hamlin 5000 Converter
64 channel w/fine tune. New transmitter. Channel O & 1 Compatible.

SA-3 Type Decoders

United Electronic Supply
P.O. Box 1206-NV
Elgin, IL 60121
708-697-0600

No Illinois Sales

Hours: Mon - Fri: 8:30 — 5:00 pm CST
24 Hour Answering Machine for orders

NOW YOU CAN "SEE" INVISIBLE FIELDS AND AVOID THEM

Most homes and offices have hot spots with strong artificial electro-magnetic fields, where chronic exposure may cause mental or physical problems. Even the EPA names these fields as suspected carcinogens. You can reduce your risk by avoiding these high-field areas.

The TriField® meter detects far more of these fields than any other electromagnetic pollution meter. It's the only one that independently reads AC electric fields, AC magnetic fields and radio/microwaves. It also reads field strengths in all directions simultaneously. Every other meter that sells for under $500 reads only magnetic and only in one direction—they can entirely miss a magnetic field unless pointed correctly and are blind to radio/microwaves and electric fields, both of which cause biological effects.

The TriField® meter reads all three types of fields numerically and with a SAFE/BORDERLINE/HIGH SCALE, weighted proportional to effect on the body. Thresholds are based on epidemiological and laboratory studies. (While no absolute hazard thresholds have been established, reduction of relative exposure is prudent.)

The TriField® meter comes ready-to-use with battery, instructions, and one-year limited warranty. The cost is $144.50 postpaid.

AlphaLab, Inc. / 1280 South Third West / Salt Lake City, UT 84101-3049
For literature and information, call (303) 621-9701

PROFESSIONAL SECURITY EQUIPMENT

Proven Quality & Reliability for Government, Industry, and the Do-It-Yourselfer

Voice Record/Playback Board
Add a Speaker and 6-12 VDC Power to Record and Playback 18 seconds of audio. On Board Micro, DRAM, 1 watt amp, Volume Control, Record & Playback Buttons. The easy way to add voice to your projects! Play Time: or repeat with continuous trigger. 15mA @ 12VDC.

18106 $99.95

How do the Pro's run wires?
...Super-Long Flexible Drills
These Super-Long Twist Drills are used by the Pro's to drill through walls, and up into attics, or down into basement.

96387 1/4" x 54" Flex Bit $49.95
96388 1/4" x 72" Flex Bit $49.95
96580 3/8" x 54" Flex Bit $37.95
96691 3/8" x 72" Flex Bit $45.00
96893 1/2" x 54" Flex Bit $39.95
96694 1/2" x 72" Flex Bit $49.95

ENFORCER®
Alarm Pager System
Add to Vehicle Alarm, or use for remote signaling. Up to 2 mile range. Contains 4 Watt Vehicle Transmitter for use with existing car antenna. Output to raise automatic antennas, both (+) and (-) Trigger inputs 12VDC, 500mA. Pager beeps and flashes LED until reset.

54974 $99.95

Talking Siren Driver - 127dB!
Panfully Loud Siren Driver Board Blasts Siren and Talks in English, Spanish, French. Separate Buroglar ("You have violated an area protected by a Security System, Leave Immediately") and Fire ("Fire! Leave Immediately") Channels. Add Bobbin-10 Watt Speaker 12VDC, 1.3 Amps.

18308 $49.95

Vantage Point Technologies
1318 East Mission Rd, Ste 376
San Marcos, CA 92069

FREE shipping to continental US. Californi Residents add Sales Tax. All items carry 1 Year warranty against defects.

FREE with your order... or send $2.00 handling fee refundable on first order.

Orders Only
1-800-272-1357
FREE Technical Help (619) 565-1863
## Unbeatable Discount Prices

**1 YEAR WARRANTY**
**15 DAY MONEY BACK GUARANTEE**

### Four Instruments in One Instrument

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function Generator</strong></td>
<td><strong>$399.00</strong></td>
</tr>
<tr>
<td>- Sine, Square, Triangle, Pulse,</td>
<td></td>
</tr>
<tr>
<td>Skewed Sine, Ramp, TTL</td>
<td></td>
</tr>
<tr>
<td>- DC to 0.2 MHz. Dual Channel</td>
<td></td>
</tr>
<tr>
<td>- 6&quot; Rectangular CRT with</td>
<td></td>
</tr>
<tr>
<td>Internal Graticule 10x3cm</td>
<td></td>
</tr>
<tr>
<td>(Phillips P31)</td>
<td></td>
</tr>
<tr>
<td>- Delayed Sweep 100ns to 1 Sec.</td>
<td></td>
</tr>
<tr>
<td>- 6&quot; Rectangular CRT with Internal</td>
<td></td>
</tr>
<tr>
<td>Graticule 10x8cm (Phillips P31)</td>
<td></td>
</tr>
<tr>
<td>- Un-calibration LED</td>
<td></td>
</tr>
<tr>
<td>- High Sensitivity 1 mV/div to</td>
<td></td>
</tr>
<tr>
<td>20V/div X-Y modes, Z Axis</td>
<td></td>
</tr>
<tr>
<td>- Rise time 14n sec. or less.</td>
<td></td>
</tr>
<tr>
<td>- Full TV Trigger for TV &amp; TV-H</td>
<td></td>
</tr>
<tr>
<td>- Acceleration Potential 2kV</td>
<td></td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td><strong>$395.00</strong></td>
</tr>
<tr>
<td>- 3-1/2 Digit LCD</td>
<td></td>
</tr>
<tr>
<td>- Triple output: 1-0.5-0.1-0.05 V,</td>
<td></td>
</tr>
<tr>
<td>0.01 V Max.</td>
<td></td>
</tr>
<tr>
<td>- 240VAC, 50/60 Hz</td>
<td></td>
</tr>
<tr>
<td>- 1A, 15V, 24V</td>
<td></td>
</tr>
<tr>
<td>- 1.5 A, 24V</td>
<td></td>
</tr>
<tr>
<td><strong>Frequency Counter</strong></td>
<td><strong>$379.00</strong></td>
</tr>
<tr>
<td>- 8 Digit LED</td>
<td></td>
</tr>
<tr>
<td>- 1 Hz - 100MHz</td>
<td></td>
</tr>
<tr>
<td>- 1 Hz + 1 digit. + Time</td>
<td></td>
</tr>
<tr>
<td><strong>Digital Multimeter</strong></td>
<td><strong>$399.00</strong></td>
</tr>
<tr>
<td>- 3-1/2 Digit LCD</td>
<td></td>
</tr>
<tr>
<td>- DCV, ACV, Ω, DCA, ACA</td>
<td></td>
</tr>
<tr>
<td>- ± (0.5% + 2 digit)</td>
<td></td>
</tr>
</tbody>
</table>

### GoldStar Oscilloscopes

<table>
<thead>
<tr>
<th>Oscilloscope</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OS-3304/3324, 25 MHz</strong></td>
<td><strong>$299.00</strong></td>
</tr>
<tr>
<td><strong>OS-3315, 40 MHz Sweep Delay</strong></td>
<td><strong>$399.00</strong></td>
</tr>
</tbody>
</table>

### Best Buy! OS'SCOPES

<table>
<thead>
<tr>
<th>Warranty</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OS-3304/3324, 25 MHz</strong></td>
<td><strong>$299.00</strong></td>
</tr>
<tr>
<td><strong>OS-3315, 40 MHz Sweep Delay</strong></td>
<td><strong>$399.00</strong></td>
</tr>
</tbody>
</table>

### RF Signal Generator, SG-310

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>100kHz - 150MHz</strong></td>
<td><strong>$199.00</strong></td>
</tr>
</tbody>
</table>

### DC Power Supply, PS-500

<table>
<thead>
<tr>
<th>Current Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0-30VDC, 0-3A</strong></td>
<td><strong>$249.00</strong></td>
</tr>
</tbody>
</table>

### Audio Generator, AG-350

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10Hz - 1MHz</strong></td>
<td><strong>$199.00</strong></td>
</tr>
</tbody>
</table>

### DC Power Supply, PS-540

<table>
<thead>
<tr>
<th>Current Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0-16VDC, 0-20A</strong></td>
<td><strong>$299.00</strong></td>
</tr>
</tbody>
</table>

### Multimeter Multi-Function w/Holster

<table>
<thead>
<tr>
<th>Current Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3-1/2 Digit</strong></td>
<td><strong>$44.00</strong></td>
</tr>
<tr>
<td><strong>1.5&quot; Big LCD</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Duty, 20A</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Capacitance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TR-NFE</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Ohms</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Low Battery Mark</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Over Range Mark</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Protective Holster</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Coil Stand</strong></td>
<td></td>
</tr>
</tbody>
</table>

### Oscilloscope Probes

<table>
<thead>
<tr>
<th>Probe Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>X1 / X10</strong></td>
<td><strong>$59.00</strong></td>
</tr>
</tbody>
</table>

### Auto Bargraph w/Holster

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3200</strong></td>
<td><strong>$59.00</strong></td>
</tr>
</tbody>
</table>

### DM3000

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3000</strong></td>
<td><strong>$44.00</strong></td>
</tr>
</tbody>
</table>

### DM3050

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3050</strong></td>
<td><strong>$54.00</strong></td>
</tr>
</tbody>
</table>

### DM3100

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3100</strong></td>
<td><strong>$54.00</strong></td>
</tr>
</tbody>
</table>

### Other Models Call for Price

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OS-3100, 100MHz &amp; Trace</strong></td>
<td><strong>$145.00</strong></td>
</tr>
</tbody>
</table>

---

**BEST BUY! O'SCOPES**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FG-150</strong></td>
<td><strong>$229.00</strong></td>
</tr>
</tbody>
</table>

### RF Signal Generator, SG-310

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>100kHz - 150MHz</strong></td>
<td><strong>$199.00</strong></td>
</tr>
</tbody>
</table>

### DC Power Supply, PS-500

<table>
<thead>
<tr>
<th>Current Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0-30VDC, 0-3A</strong></td>
<td><strong>$249.00</strong></td>
</tr>
</tbody>
</table>

### Audio Generator, AG-350

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10Hz - 1MHz</strong></td>
<td><strong>$199.00</strong></td>
</tr>
</tbody>
</table>

### DC Power Supply, PS-540

<table>
<thead>
<tr>
<th>Current Range</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0-16VDC, 0-20A</strong></td>
<td><strong>$299.00</strong></td>
</tr>
</tbody>
</table>

### Oscilloscope Probes

<table>
<thead>
<tr>
<th>Probe Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>X1 / X10</strong></td>
<td><strong>$59.00</strong></td>
</tr>
</tbody>
</table>

### Auto Bargraph w/Holster

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3200</strong></td>
<td><strong>$59.00</strong></td>
</tr>
</tbody>
</table>

### DM3000

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3000</strong></td>
<td><strong>$44.00</strong></td>
</tr>
</tbody>
</table>

### DM3050

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3050</strong></td>
<td><strong>$54.00</strong></td>
</tr>
</tbody>
</table>

### DM3100

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DM3100</strong></td>
<td><strong>$54.00</strong></td>
</tr>
</tbody>
</table>

---

**BMC**
Your Best Source for **High Standard Electronics**

[800-532-3221](tel:800-532-3221)

800-532-3221 (714) 586-2310 Fax (714) 586-3399

CIRCLE 285 ON FREE INFORMATION CARD
Miniature Transmitters and Receivers

Small, Attractive, High End Quality, 2 Channel 318 MHz Transmitter
59,049 Settable Codes, 120°-300° Range, 1-1/4” x 2” x 9/16”, Assembled

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Qty</th>
<th>1</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF300T</td>
<td>150’ Range Transmitter</td>
<td></td>
<td>24.95</td>
<td>19.95</td>
<td>15.95</td>
</tr>
<tr>
<td>RF300XT</td>
<td>300’ Range Transmitter</td>
<td></td>
<td>29.95</td>
<td>24.95</td>
<td>19.95</td>
</tr>
</tbody>
</table>

Small, High End Quality, 2 Channel Receiver for the RF300 Transmitters
1-1/4” x 3-3/4” x 9/16” PCB w/.1” spaced pads for standard connectors
Input: 8-24 vdc Output: Gated CMOS Momentary and Latching Lines

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Qty</th>
<th>1</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF300R</td>
<td>Receiver, Fully Assembled</td>
<td></td>
<td>24.95</td>
<td>20.95</td>
<td>16.95</td>
</tr>
<tr>
<td>RF300RK</td>
<td>Receiver, Complete Parts Kit</td>
<td></td>
<td>19.95</td>
<td>15.95</td>
<td>12.95</td>
</tr>
<tr>
<td>RF300PA</td>
<td>Pre-Amplifier. Doubles Range</td>
<td></td>
<td>14.95</td>
<td>11.95</td>
<td>9.95</td>
</tr>
</tbody>
</table>

Small, Economical, Single Channel Transmitter and Receiver Set
Set Code, 60’ Range, 1-7/8”x2-3/8”x7/16” (T), 2”x2-3/4”x9/16” (R)
Receiver Input: 5 vdc Output: Gated TTL Momentary Line

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Qty</th>
<th>1</th>
<th>5</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF60</td>
<td>Transmitter and Receiver Set</td>
<td></td>
<td>24.95</td>
<td>19.95</td>
<td>14.95</td>
</tr>
</tbody>
</table>

Add $4 shipping for first item + $1 for each additional item. Ca. residents add 8.25% tax
Visa, Mastercard, Money Orders Personal Checks and Cash C.O.D.s

Visitect Inc.
P.O. Box 14156 Fremont, CA. 94539 (510) 651-1425 Fax (510) 651-8454

CIRCLE 315 ON FREE INFORMATION CARD

Professional Electronic Engineering Software

"Best bargain in the country"

Linear AC/DC Circuit Analysis

Linear Transient Circuit Analysis

Active Filters Design & Analysis
Design & Analyze active LPF, BPF, HPF & All pass filters. Calculate, plot & print AC & DC voltage, current & power. More.

Control Systems Analysis
Calculate and plot Root Loci, Nyquist, Bode's of any H(s). Determine gain and phase margins, stability. More.

Mag & Phase Graphics
Calculate, plot & print magnitude & phase of H(s). More.

Function Graphics
Calculate, plot & print any of 87 common math functions as desired. More.

Data Graphics
Plot up to 400 data points in 9 formats. Linear, log, semi, etc. More.

Polynomial Operations
Calculate roots, product & coefficients.

PC XT/AT, DOS, EGA

Extremely Easy to use
Dot Matrix/Laser/Mouse Support
Outstanding Graphics & Menus
200 page User’s Manual Included
Most Powerful Package for Electronic Engineering

Introductory Offer: Complete 9-program package for $79.99
Visa/MC accepted. Add $5.95 for shipping. CA add $5.80 Tax
To order or info call (800) 645-6806 or send check or money order to:
Geoban Engineering, PO Box 856, Ridgecrest, CA 93556

100% Satisfaction Guaranteed

CIRCLE 256 ON FREE INFORMATION CARD
AMPLIFIED EXTENSION SPEAKER

2 watt amplified monitor speaker with volume control. Ideal for CB, ham or other communication applications. 4 inch 4 ohm speaker in block enclosure. 5.1" X 4.9" X 6.5" high. RCA jack input. Powered by 9 Vdc. wall transformer (included).

$ 6.75 each

AA NICKEL CADMIUM BATTERY CHARGER

SANYO NC-452 Battery charger for 2 or 4 AA nickel cadmium rechargeable batteries. Plugs into wall outlet and charges batteries in 8 to 10 hours. Can be folded for easy carrying and storage. 3.25" X 1.6" X 1.81" when folded. UL listed.

$ 2.50 each

SURFACE MOUNT LED

10 for $ 2.00
100 for $ 18.00

CARBIDE DRILL BITS (USED)

High quality, solid carbide drill bits with 1/8' shanks. Ideal for precision drilling. These bits were used in PC board manufacturing and were routinely removed from service while they still had lots of life in them. Available in the following sizes:

Size: (") CAT#
81 0.013 DRB-81
78 0.016 DRB-78
73 0.024 DRB-73
71 0.026 DRB-71
68 0.031 DRB-68
67 0.032 DRB-67
66 0.033 DRB-66
65 0.035 DRB-65
63 0.037 DRB-63
61 0.039 DRB-61
59 0.041 DRB-59
58 0.043 DRB-58
57 0.045 DRB-57
56 0.046 DRB-56
55 0.052 DRB-55
54 0.055 DRB-54
49 0.073 DRB-49

Minimum Purchase 10 Pieces Of One Size

10 of one size $ 5.00
50 of one size $ 20.00

ORDER TOLL FREE 1-800-826-5432

Minimum Order $10.00 • All Orders Can Be Charged To Visa, Mastercard Or Discovercard • Quantities Limited • California, Add Sales Tax • Shipping And Handling $4.00 For the 48 Continental United States All Others Including Alaska, Hawaii, P.R. And Canada Must Pay Full Shipping • No C.O.D. • Prices Subject to change without notice.
ASSORTED, transparency, 0.3
ASSORTED, paper, 0.7
ASSORTED, paper, 0.3
RED,
BLUE,
BLUE,
BLUE, paper,
GREEN,
GREEN,
GREEN, transparency, 0.7 mm
BLUE, paper, 0.3 mm tip
BLUE, paper, 0.7 mm tip
BLUE, transparency, 0.3 mm tip
BLUE, transparency, 0.7 mm tip
RED, paper, 0.3 mm tip
RED, paper, 0.7 mm tip
RED, transparency, 0.3 mm tip
RED, transparency, 0.7 mm tip
ASSORTED, paper, 0.3 mm tip
ASSORTED, paper, 0.7 mm tip
ASSORTED, transparency, 0.3 mm tip
ASSORTED, transparency, 0.7 mm tip

8 mm Video Camcorder Users!

We have a new supply of these popular T-120 (120 minute) Hi-8 video cassettes. These are top quality, metal oxide cassettes that were used for a short time, then bulk-erased. Each cassette has its own plastic storage box. New, they would sell for considerably more than we're asking. We've sold thousands, and our customers love them.

10 for $28.00

CAT# VCU-8

PLOTTER PENS

TI-1 style plotter pens. Assorted colors. 5 pens per pack.

For use on the following plotters:
Hewlett-Packard (all), Houston Instruments (695A & Image Maker), Roland DXY-101, DXY-800), Enter (Speaker, P600), IBM (all), and many other compatible plotters.

Two styles, paper and transparency, are interchangeable. Paper inks are lighter than transparency inks.

BLACK, transparency, 0.3 mm tip CAT# TR-38K
BLACK, transparency, 0.7 mm tip CAT# TR-75K
GREEN, paper, 0.7 mm tip CAT# PA-7G
GREEN, transparency, 0.3 mm tip CAT# TR-3G
GREEN, transparency, 0.7 mm tip CAT# TR-7G
BLUE, paper, 0.3 mm tip CAT# PA-3B
BLUE, paper, 0.7 mm tip CAT# PA-7B
BLUE, transparency, 0.3 mm tip CAT# TR-3B
BLUE, transparency, 0.7 mm tip CAT# TR-7B
RED, paper, 0.3 mm tip CAT# PA-3R
RED, paper, 0.7 mm tip CAT# PA-7R
RED, transparency, 0.3 mm tip CAT# TR-3R
RED, transparency, 0.7 mm tip CAT# TR-7R
ASSORTED 5 DIFFERENT COLORS
ASSORTED, paper, 0.3 mm tip CAT# PA-3A
ASSORTED, paper, 0.7 mm tip CAT# PA-7A
ASSORTED, transparency, 0.3 mm tip CAT# TR-3A
ASSORTED, transparency, 0.7 mm tip CAT# TR-7A

All Plotter Pens Are In Packs Of Five

FAX (818) 781-2653 • INFORMATION (818) 904-0524

Mail Orders To:
ALL ELECTRONICS CORP.
P.O. Box 567
Van Nuys, CA 91408

Visa, Mastercard, Discover, Checks, Money Orders Accepted On All Orders

RETAIL STORES LOCATED IN
Los Angeles and Van Nuys
CALIFORNIA

CIRCLE 214 ON FREE INFORMATION CARD
Serving the public since 1981
XANDI Electronics
201 E Southern #111, Tempe AZ 85282

BUY WITH CONFIDENCE FROM XANDI
- 30-DAY REFUND POLICY
- NEW TELEPHONE TECH SUPPORT NUMBER
  (602-894-0992)

Satisfaction Guaranteed!

Smalliel FM Transmitter
- anywhere
- Tunes 86-108 MHz.
- Powerful 2 stage audio amplifier.
- Sensitive, picks up sound at the level of a whisper.
- Up to 1 mile range.
XSL700 SUPER-MINIATURE FM TRANSMITTER
Worlds smallest FM voice transmitter. Use with any FM broadcast receiver. Easy to assemble. All chip (SMT) parts are pre-assembled to the circuit board.
XSL700(1-2) Kit $44.95

SUPER SENSITIVE FM TRANSMITTER
- Transmits both sides of phone conversation.
- Adjustable from 86-108MHz.
- Works with any FM broadcast receiver.
- Up to 1 mile range.
- Transmits to any FM Broadcast receiver.
XTT100 LONG RANGE PHONE TRANSMITTER
Similar to our popular XSL700, the XTT100 is battery powered for maximum range. It plugs into any phone jack and transmits all calls on that line.
XTT100(1) Kit $32.95

 Tiên Dô's Ham Shack

CIRCLE 196 ON FREE INFORMATION CARD

SATELLITE RADIO® ON YOUR SATELLITE SYSTEM
Includes Latest Complete, Quarterly Updated Satellite Radio Guide® To All Satellite Audio Services

*Satellite Radio® Shows You How To Receive
- All Sports Events
- Music - Ethnic Programs
- News Services - Talk Shows
- SCPC Broadcast Services
- Home-Town Radio Stations
- Weather Satellite Photos
- Facsimile Press Photos
- Much, Much More

Universal Electronics, Inc.
4555 Groves Road, Suite 12, Columbus, OH 43232
Phone: (614) 866-4605 Fax: (614) 866-1201

Just released with Complete Guide Section
Let This New Book Show You How

Tune To

Let'S Get More
From Your Home Satellite System!

Still GETTED

We accept Visa, MC, MO, COD
Ask for free catalog of all our products

Toll Free Order Line
1-800-336-7389

Send Mail Orders To:
XANDI Electronics
Box 25647
Tempe, AZ 85285-5647

156

CAPITAL ELECTRONICS
5451 North Broadway Ave.
Chicago, Illinois 60640
(312) 271-9510 • Fax (312) 271-9733

Printed Circuit Board Manufacturers
- Single-sided, double-sided, multi-layer(4-8 layers) and flexible PCB production
- premium delivery available
- 24 HR service on SS & DS
- 72 HR service on multi-layer
- artwork generation/editing
- photoplotting services
- 24 HR. MODM(19,200 BAUDE)

For quick & competitive pricing,
more information, please call us today!

Quality is our capital concern

Electronic News, January 1994
**3-MEG AT/Class/386/16-Bit Memory Board**

New Everex Model EV159, supports extended & expanded memory LIM 4.0, with documentation & software. Uses 256K DRAM. Will populate for $18 per meg.

**720K Mitsubishi Floppy Disk Drive**
5-1/4" ........................................... $14.95

**XT Motherboard**
8 Slots, 8 MHz, with space for 1MB RAM ........................................... $16.95

**FLOPPY DRIVE CONTROLLER**
1.44MB/1.2MB/360KB FDC (for 8088, 286, 386).
These will fit in XT as well as faster machines. They control 2 drives... $21.49

**MOS Fet N-Channel**
Part #SGSP222 50V 10A ........................................... 4/$1.00

**Controllers**
MFM, WD1002-WA2 ........................................... $19.95
SEFCO Monochrome Controller ........................................... $14.95
1/4" Streaming Tape Controller by Adaptec
SCSI to QIC-36 Model #AC8-350A (Manual add $5) ........................................... $33.95
Floppy Disk Controller Board
Dual, 350K or 720K switch selectable ........................................... $9.95
Async Cluster Adapter by AST
Multichannel board providing 4 individually addressable RS-232 serial ports on IBM PC/XT/AT. (Async Cluster Adapter Cable add $5) .... $34.95

**Cash Register System for IBM Compatible PC’s**
Complete package includes cash drawer, controller board, and free POS software...... ........................................... $199.00

**TAPE BACK-UP**
Cipher Model 540 60meg ........................................... $48.95
Cipher Model 520 20meg PC XT ........................................... $29.95

**ITERATED SYSTEMS**
Color Box Ver. 2.0 (Fractal compression program capable of compressing video 200:1) ........................................... $99.00

**LASERS**
Lasers 3-4 Mw HeNe ........................................... $24.95
Lasers 4-5 Mw HeNe ........................................... $35.95

**Laser Deck 10 Mw HeNe Laser**
Power supply, 2 beam splitters, 5 front surface mirrors, AO modulator, AO driver, polygon scanner, photo detectors, 3 special lenses, polarizer, over $5,000 worth of optical components plus documentation. Sold many of these to Fortune 500 companies, universities, and research labs. Applications include research, design and engineering. An experimenter’s dream. ........................................... $199.00

Visible Laser Diodes (visible red light)
1Mw ........................................... $15.00
2Mw ........................................... $23.95

**SOLID STATE RELAY**
Cryon D1240, input 3-32 VDC, output 120 VAC 40A ........................................... $8.95

**CCD DOCUMENT SCANNER**
Uses a 4096-element line imaging chip. Can use for robotics, astronomy, machine vision, high resolution slow scan TV, etc. Supplied with documentation. ........................................... $24.95

Monitor Board with Power Supply
High voltage, video, brightness, focus, vertical and horizontal with flyback transformer. Model 99-0420-001 rev D. ........................................... $7.95

**50-WATT SWITCHING POWER SUPPLY**
Astec Model #AC222-01 for microprocessor-based systems, disk drive systems, terminals & mixed logic. 5 VDC/5A, +12 VDC/5A, -12 VDC/5A, -5VDC/5A ........................................... $14.95

**STEP-PER MOTOR**
by Oriental Motor, Model #OHI56-A-05, high precision, 500 steps per rev., 0.72° per step ........................................... $19.95

COD, Cashier’s Check or Money Order to
ECSC
1490 W. Artesia Blvd. • Gardena, CA 90248
COD Phone orders (800) 543-0540
or FAX orders to (310) 217-0590
$20 minimum order, CA residents add 8.25% sales tax. We pay shipping on prepaid orders, you pay on COD.

Come into Our Huge L.A. Store
CIRCLE 296 ON FREE INFORMATION CARD
Testing or Fixing Floppy Drives?

Call the experts for a complete line of industry standard floppy drive test and alignment tools.

**Test Diskettes**
- Analog Alignment Diskettes (AAD™) - Traditional "Catseye" alignment disk for use with an oscilloscope or other test equipment.
- Digital Diagnostic Diskettes (DDD™) - Diagnostic disk for quick drive check.
- High Resolution Diagnostic Diskettes (HRD™) - Powerful, high resolution diagnostic disk for quick and precise checking or adjustment of floppy drives.
- Certifier Reference Diskettes (CRD™) - Reference material for calibrating media certification equipment.

**Ready-To-Run Diagnostic Packages**
- Drive Probe/MacDrive Probe - Complete Software-Based IBM PC and Macintosh Floppy Drive Diagnostic and Alignment kits.
- Drive Probe Advanced Edition - Powerful Floppy Drive Tester - Plugs into a PC slot, includes all cables and HRD Test Diskettes - Even tests Mac and Software Duplication Drives!

**CALL (408) 433-1980**  
OR  
**FAX (408) 433-1716**

231 Charcot Avenue  
San Jose, CA 95131-1107

CIRCLE 304 ON FREE INFORMATION CARD

---

**PCBoards PCB Artwork Made Easy!**

PRINTED CIRCUIT DESIGN SOFTWARE

**for**

**Layout - Autorouting - Schematic**

- Supports all Video Modes Including Super VGA
- Copper Flooding for Building Ground Areas
- Gerber and Excellon Output
- Mirror Imaging for Laser Printer Output
- Autorouter and Schematic Programs
- Circuit Simulation Software Available
- NEW! - WINDOWS™ Versions
- FREE - Heat Transfer Film with Order

Download Demos from 24hr BBS (205)933-2954

**PCBoards Layout Only** $99

**Windows™ Layout starts at** $149

Call or Write for Full Product Line, Prices & Demo Packages

PCBoards  
2110 14th Ave. South  
Birmingham, AL 35205  
(800)473-7227  
Fax (205)933-2954  
Phone (205)933-1122

---

**SOLVE YOUR AUDIO PROBLEMS**

**ADD ANOTHER MIC INPUT**

PO-41 AC POWERED SEMI-PRO MIC-LINE DRIVER  
$158.00

TRANSFORMER-BALANCED INPUT WITH PHANTOM POWER. FOR CONSUMER LEVEL OUTPUT, USE DUAL JUMPER ADJUSTABLE GAIN. AC POWERED. BROAD FREQUENCY RESPONSE. LOW DISTORTION SMALL SIZE. 47 Ohm X 4 Ohm. CAN BE RACK MOUNTED WITH POWER SUPPLY (SOLD SEPARATELY)

**FOR SPORTS REMOTES USING DIAL-UP TELCO**

PO-55 10 TO -4DBE  
$219.00

FOR CONSUMER TYPE TAPE, CD, ET C. PROD. AC POWERED, SMALL SIZE. 47 Ohm X 4 Ohm. CAN BE RACK MOUNTED WITH A FRAME (SOLD SEPARATELY)

**CONVERT YOUR CONSUMER GEAR TO PRO**

PO-55 10 TO -4DBE  
$219.00

FOR CONSUMER TYPE TAPE, CD, ET C. PROD. AC POWERED, SMALL SIZE. 47 Ohm X 4 Ohm. CAN BE RACK MOUNTED WITH A FRAME (SOLD SEPARATELY)

**ELIMINATE HUM, BUZZ, AND GROUND LOOPS IN 600Ω LINES**

IL-19 IN-LINE TRANSFORMER  
$55.00

LOW FREQUENCY RESPONSE. 20-20 KHZ LOW HUM, BUZZ. USE WITHOUT AC POWER SUPPLY.

**PREPAID ORDERS RECEIVE A 20% DISCOUNT**  
**AND FREE 2ND DAY FREIGHT**

**FREE ADDITIONAL 10% DISCOUNT**

USA AND CANADA ORDERS (800) 634-5357  
FAX ORDERS (800) 551-2749

 kisscom, inc.  
2136 MARY Dr., HENDERSON, NV 89018 USA

**MENTION THIS AD AND RECEIVE AN ADDITIONAL 10% DISCOUNT**

CALL OR WRITE FOR YOUR FREE AUDIO CATALOG OF OVER 350 PRODUCTS!
**Kelvin Electronics**

10 Hub Drive, Melville, NY 11747

Re-Engineered & Designed for 1994

---

**Kelvin 100 Basic**

- **#990067**

- AC/DC VOLTAGES
- DC CURRENT
- RESISTANCE
- CONTINUITY TEST-Buzzer & DIOCE TEST
- 3 1/2 Digit LCD
- 10M ohm INPUT IMPEDANCE

**CAPACITANCE METER**

**Kelvin 250 LE**

- **#990128**

- **$59.95**

- ACCURACY: 0.5%
- RANGES: 20mF, 20000uF, 200uF, 2uF, 20nF, 200nF, 20pF, 200pF
- Zero Adjust
- Safety Test Leads
- Test Socket for Plug-in Components

**2 Year Warranty** (Parts & Labor)

"Not only does the Kelvin 94 boast a lot of features... the features go a long way.

"If we had to run into a burning building to do some emergency trouble-shooting and we could carry only one piece of equipment, the Kelvin 94 would be it!"

Popular Electronics Review - May 1993

---

**Components**

- **Wholesale Prices**

<table>
<thead>
<tr>
<th>Stock No.</th>
<th>TYPE</th>
<th>YOUR COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>600001</td>
<td>555 DUAL TIMER</td>
<td>$1.29 ea</td>
</tr>
<tr>
<td>600029</td>
<td>555 DUAL TIMER</td>
<td>$1.40 ea</td>
</tr>
<tr>
<td>600039</td>
<td>LM566 DUAL</td>
<td>$1.60 ea</td>
</tr>
<tr>
<td>600018</td>
<td>741C OP-AMP</td>
<td>$1.80 ea</td>
</tr>
<tr>
<td>600026</td>
<td>1458 OP-AMP</td>
<td>$1.35 ea</td>
</tr>
<tr>
<td>630041</td>
<td>2N2222</td>
<td>$0.20 ea</td>
</tr>
<tr>
<td>630036</td>
<td>PNP222</td>
<td>$0.08 ea</td>
</tr>
<tr>
<td>600023</td>
<td>7805 Voltage Reg</td>
<td>$3.36 ea</td>
</tr>
<tr>
<td>600005</td>
<td>4700U &amp; COMPENSATED</td>
<td>$1.75 ea</td>
</tr>
</tbody>
</table>

**THERMISTOR** - 100 Ohm
**110097** | $1.35 ea | $1.00 ea |**20**
**THERMISTOR** - 10K Ohm
**110097** | $1.35 ea | $1.00 ea |**20**

---

**Kelvin Catalog #3**

Stock No: 650412

$19.95

- **MIC & VISA** "20 Minimum Order"

---

**Digital Trainer**

Laptop Digital Trainer comes with 100 page instruction manual, owner's manual, built-in 1 digit true halide display, two independent clocks with user adjustable frequency & duty cycles, 4 data bit switches and 4 LED displays. Assembled.

Stock No: 524060 | $99.95

**Binary Quartz Clock w/Alarm**

**Kelvin 300 LE**

- **#990125**

- **$49.95**

- Automatic Range
- ACV & DCV
- DC CURRENT
- RESISTANCE
- CONTINUITY TEST
- DIODE TEST
- 3 1/2 Digit LCD
- 10M ohm INPUT IMPEDANCE

**Instruments**

---

**Electronic Voice Pad**

An electronic note pad, able to record your message & play it later. It has a built-in photo cell & as soon as it senses your presence, it will automatically playback the message left for you. The components are PC mounted. The IC can record a message up to 20 seconds & no mechanical parts or tape - only a digital integrated circuit.

Intermediate Level Kit
Stock No: 345908 | $79.95

---

**Components**

- **Wholesale Prices**

<table>
<thead>
<tr>
<th>Stock No.</th>
<th>TYPE</th>
<th>YOUR COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>600021</td>
<td>100 Ohm Timer</td>
<td>$1.29 ea</td>
</tr>
<tr>
<td>740018</td>
<td>741C OP-AMP</td>
<td>$1.80 ea</td>
</tr>
<tr>
<td>600026</td>
<td>1458 OP-AMP</td>
<td>$1.35 ea</td>
</tr>
<tr>
<td>630041</td>
<td>2N2222</td>
<td>$0.20 ea</td>
</tr>
<tr>
<td>630036</td>
<td>PNP222</td>
<td>$0.08 ea</td>
</tr>
<tr>
<td>600023</td>
<td>7805 Voltage Reg</td>
<td>$3.36 ea</td>
</tr>
</tbody>
</table>

---

**Project Speaker**

- **$99.95**

---

**Project BUZZER**

- **$99.95**

---

**LED**

- **$99.95**

---

**Xenon Strobe Tube**

- **$295.00**

---

**Trigger Coil** for Xenon Strobe Tube

- **$295.00**

---

**Infrared LED**

- **$295.00**

---

**Neon Lamp**

- **$295.00**

---

**Photo Cell**

- **$65.00**

---

**Push Button Switch**

- **$65.00**

---

**Miniature Toggle Switch**

- **$79.00**

---

**CIRCLE 249 ON FREE INFORMATION CARD**
Call 1-800-945-8234 for ORDERS ONLY! For Technical Support and Information Call 1-315 732-5739

GMR 100--161.90
HR2310, 10 METER, 25 WATT--215
CPS
GRANT XL, SSB, PA, AM, ANL--159.99
PRO303E, REMOTE, ALL IN ONE--109.99
510XL, VOL, SQ, LED METER--49.99
PRO520XL, ANL, RF GAIN, CH9--65.99
PC122, SSB, AM, LED SIG--129.99
WASHINGTON, SSB, BASE--209.99
SCANNERS
BC65XLT HANDHELD--109.99
BC70XLT--137.99
BC100XLT--169.99
BC200XLT, 800MHZ--207.99
BC2500XLT, CONT--369.99
BC8500XLT, MOBILE, CONT--379.99
WE CARRY A FULL LINE OF ACCESSORIES
POWER SUPPLIES
ANTENNAS
AND MORE!

SAVE YOUR MONEY WITH THIS SALE!

CIRCLE 282 ON FREE INFORMATION CARD

NEW COMPUTER COMPONENTS
486 DLO/486SL213K SCA/20MATH CO--$169.99
345 DL/486SL--$99.99
395 DLE/486SL/CADE--$139.99
WE CUSTOM BUILD COMPUTERS
TO YOUR SPECs CALL FOR PRICES!

Radiotelephone - Radiotelegraph
Why Take Chances?
Discover how easy it is to pass the exams.
Study with the most current materials available. Our
Homestudy Guides, Audio, Video or PC "Q&A" disks
make it so fast, easy and inexpensive. No college or
experience needed. The new commercial FCC exams
have been revised, covering updated Aviation, Marine,
Radar, Microwave, New Rules & Regs, Digital
Circuitry & more. We feature the Popular "Complete
Electronic Career Guide". 1000's of satisfied customers
Guarantee to pass or money back. Newest Q&A pools.
Send for FREE DETAILS or call
1-800-800-7588

WPT Publications
7015 N.E. 61st Ave Dept. 10
Vancouver, WA 98661

Name
Address
City
St. Zip
1-800-800-7588

EPROM+
PROGRAMMING SYSTEM
NEEDS NO INTERNAL CARD

CONNECTS TO YOUR IBM OR COMPATIBLE DESKTOP, LAPTOP OR NOTEBOOK VIA THE
PARALLEL PRINTER PORT

EPPROMS (24, 28 and 32 pins)
27C08, 27B08, TMS2716, 2716
27C64, 27C128, 27C256, 27C512
27332/3/4232, 2764044A, FC 64
27332/124A, 2732756, 27512/215, 27512/315, 27375*CO91*
27C100, 27C1001 (1 MEG)
27C020, 27C2001 (2 MEG)
27C040, 27C6001 (4 MEG)
40 PIN EPPROMS 3.4 MEG
27C1024, 27C1048, 27C4096
27C1012, 27C220, 27C240
FLASH EPROMS
28XXX, 29XXX

EEPROMS (24 & 28 PIN)
2804, 2816A, 2816C, 2817A
2864A, 2864C, 2866C
4000, 4002, 4003, 4005
6200, 6202, 6204, 6205
SERIAL EEPROMS* (4 PIN)
2401, 2402/4, 2404, 2405, 2407/29/2
9060, 9065/06, 9070, 9070, 9070
MICRO CONTROLLERS*
74C41A, 74H400, 74H400X
74H508, 74H508X
8740, 8744, 8749, 8751
8752, 8753, 8753, 8757
8758, 8759, 8759D
BIPOLAR PROMS
2832XXX, 2845XXX (16-24 PIN)
*ADAPTOR REQUIRED

CALL 851-5791, 815-2113 FOR MORE INFORMATION OR A DATA SHEET

TO ORDER SEND CHECK, MONEY ORDER, WRITE OR CALL:
ANDROMEDA RESEARCH
501 W. THOMPSON AVE
MILFORD, OHIO 45150
(513) 831-9708
FAX (513) 831-7562
MADE IN THE U.S.A. WRITE OR CALL FOR MORE INFORMATION OR A DATA SHEET

EASY-TO-USE SYSTEM SOFTWARE

EASY-TO-USE SYSTEM SOFTWARE

- READ
- PROGRAM
- COPY
- BLANK CHECK
- BYTE SPLIT/HUFFLE
- SELECT DEVICE TYPE

PLUS AN INTEGRATED BUFFER EDITOR WITH 20 BYTE LEVEL COMMANDS

SYSTEM INCLUDES: PROGRAMMING UNIT, POWER PACK, CONVENIENT OPERATIONAL MANUAL & SOFTWARE
SOFTWARE AVAILABLE ON 3.5" 2 OR 3.5" 1 DISK (PLEASE SPECIFY)
CALL ABOUT OPTIONAL ADAPTORS - A SMALL TRAVEL CASE IS AVAILABLE FOR $19.95

$289
Now in use at over 60 major universities and leading corporations around the world.

(University of Michigan, Stanford, University of Illinois, NASA, Bell Labs... to name a few)

- Program prices start at $149.00/ea.
- University & Student Pricing Available
- Dealer Inquiries Welcome
- VISA/Mastercard Accepted

Beige Bag Software
715 Barclay Ct • Ann Arbor, MI • 48105
Ph: (313) 663-4309 • Fax: (313) 663-0725

CIRCLE 284 ON FREE INFORMATION CARD

TEST EQUIPMENT SPECIALS

TEKTRONIX MAINFRAMES
7854, 400MHz Digital, GPIB, 7A24, 7A26 D/T ver., 7B92 T/B Manual $1995
7104, 1GHz M/U with 7A29, 7A26 D/T ver., 7810, 7815 T/B T/B Manual $5850
7623, 100MHz Storage with 7A18/2 D/T ver. opc. 7853 T/B $995

PORTABLE PACKAGE DEALS
TEK 335, 33MHz MINIAC/Dc, Dual Trace, Delayed Sweep, With Manual $595
TEK 475, 200MHz, Dual Trace, Delayed Sweep, Probe & Manual $725
TEK 485, 350MHz, Dual Trace, Delayed Sweep, Probe & Manual $995
TEK 2336, 100MHz, D/T, D/S, Compact LCD readout, Probe & Manual $995

HI-TECH LAB and PROCESS EQUIPMENT
WYKO LADITE-256, Laser waveform measurement system. A turnkey system for determining the waveform quality and intensity distribution of laser sources. Operates from the visible to the infrared. A powerful HP300 series computer, includes the LADITE system provides full geometric and distortion analysis. Complete system, LIKE NEW CONDITION. Replacement cost >$75K.
LEASE/Rental available to qualified users. Purchase price $100K.

LASER TRIMMING STATION, QUANTRAD 1010X Pulsed xenon laser. Perfect for trimming resistor networks. 8 to 20 resistors, 800W peak, 1000W peak, 300ns pulse width, 4 to 6 PPS, $26 to $399 nem. with all accessories. Air cooled, adds 15WAC powered. Includes video and direct view microscope, F.D. illuminator and manual XY table. EXCELLENT CONDITION, professionally maintained, low hours. Two systems available $2500 ea.

Hi Ne Laser HEADS with AC commercial power module. Lowest price anywhere! Precision cylindrical aluminum housing with 600W power. 3-4mW, only $46, 5-6mW only $55, 3-6mW system only $95. Top of the line 6-mW system only $125 Perfect for home light show.

CIRCLE 284 ON FREE INFORMATION CARD

RESOURCES UN-LTD.
THE QUALITY YOU DESERVE AT PRICES YOU CAN AFFORD
60 DAY REPAIR OR REPLACEMENT GUARANTEE. FRIENDLY TECHNICAL SUPPORT. LARGE INVENTORY VISA,MC, AMEX or COD.
PHONE: 603-668-2499 FAX: 644-7825

CIRCLE 311 ON FREE INFORMATION CARD
DESOLDERING in the FUTURE TODAY

ESD Safe
Truly Portable
Variable Temperature Control
Quick Replacement Filter
High Vacuum Efficiency
SMD Removal Capability
Ergonomic Design
Meets MIL-Specs

The DEN-ON SC-7000 Compact Desoldering Tool
with built in Diaphragm Pump

Regular price $525.00
Our Price $395.00

Credit cards accepted:
VISA-MasterCharge, American Express-Discover & C.O.D.
Company Checks

Call Toll Free 1-800-394-1984
Fax 1-316-744-1994

Howard Electronic Instruments, Inc.
6222 N. Oliver
Wichita, Kansas 67220

SPY ON THE EARTH
See live on your PC
what satellites in orbit see

Learn how you can benefit greatly from this
exciting new technology. Send $38 check or M.O.
($45 ai; $50 overseas) for our fantastic 12 diskette set
Professional quality copyrighted programs
(IBM type) that does satellite tracking, data
acquisition, image processing, 3-D projections and
more. Diskette and information package includes
fully enabled programs (some with C language
source code), satellite views, hardware
schematics, catalog and discount certificate.

Reception guaranteed Worldwide
Absolutely legal
No satellite dish needed

For FREE information log on to our bulletin board
with your MODEM at (718) 740-3911 or call (718)
468-2720, to place an order. Buy with confidence,
We've been in business since 1956.

VANGUARD Electronic Labs
Dept. EN, 196-23 Jamaica Ave.
Hollis, NY 11423

Knight Patrol® II
Talking Security System
A high-end alarm at an affordable price!
• Stops burglars before they break-in by verbally
  warning them away
• High quality female voice with 220 word vocabulary.
• RS-232 port connects to any IBM PC compatible for
  complete customizing and status (software included).
• 24 zones monitor sensors inside and outside plus an
  auxiliary alarm and supervised fire zone
• Automatically switches intercom speakers to alarm.
• Two 12 Amp. relays for sirens and control functions.
• Complete alarm status from keypad, PC, or verbally.
• Speakers announce location of prowlers.
• Alert/Sleep monitoring modes
• Alpha-numeric LCD keypad.
• Multiple user alarm codes.
• Continuous power monitoring.
• Expandable and MORE!

 Paladin Electronics
19425-B Sisladyn Rd.
Suite 333 RES
Canyon Country, CA 91351
(805) 251-8725
Dealer inquiries invited.
BUILD YOUR OWN LASER!

Order: LASER-KIT...$99+$5 S&H

AMAZING!!!

Create thousands of fascinating patterns
Handheld Remote Control Unit
Detachable, step by step instructions
Educational & fun for kids
Requires LASER-RT Above

AMAZING HAND HELD LASER!

Hand Held Laser Light Show

Order: LASER-SHOW...$99+$5 S&H

The Real Logic Analyzer

Our popular Logic Analyzer Software has been improved! With the hundreds of satisfied customers who have turned their IBM AT or compatible computer into a fully functional digital Logic Analyzer. Stop the guess work when troubleshooting your next project and see the full picture. Just connect the optional test cable (or make your own) to the weaving telemetry port of your computer and you are ready to go. Software only: $79.95.

Optional test cable: $17.95 inc. HST
Cal/C/Fax/Email for FREE Info.

Call Now To Order!

20903 Foothill Blvd
Suite 307K
Hayward, CA 94541
(510) 886-2096

LOGIXELL

61 Piper Cr.
Kanata, Ont.
K2K 25H Canada
VISA / MC


circle 301 on free information card

CABLE TV DESCRAMBLER KITS

Universal Descrambler
Includes all the parts and an etched & Drilled PC Board. Not included is AC adaptor or enclosure...$69.00

Tri-Mode Descrambler
Includes all the parts and an etched & drilled PC board & AC adaptor. Not included is the enclosure...$49.00

SB-3 Descrambler
Includes all the parts & an etched & drilled PC board & AC adaptor. Not included is the enclosure...$29.00

Call Toll Free 1-800-258-1134

Visa, MasterCard & COD
M & G Electronics, Inc., 301 Westminster Street Providence, RI. 02903

It is not the intent of M & G Electronics, Inc. to assist any individual to defraud any pay TV operator or to violate any state or federal laws regarding the use of the descrambler kits. You must understand the kits being purchased for educational and or experimental use only.

SPEECH SECURITY KIT

Spectrum Inversion scramblers works directly with tape recorders; easily adapts to radio or phone applications (2 kits required for full-duplex). Uses DSP technology for excellent performance without calibration. Only $34.95

DECADE KITS MAKE GREAT GIFTS!

Try out ClouDMan 60W stereo power amp for your Walkman $37.95, OIL TESTER $34.95, or TWO DIGIT VOLTMETER $24.95. This DECADE 1000 ELECTRONIC CROSSOVER now includes Gold connectors at no extra cost $39.95. Kit manuals are $5.00 (refundable). MC/Visa accepted. 2-day shipment by US Priority Mail only $3.95 in USA.

Decade Engineering
2302 5th St. NE - Salem, OR 97303-6832
Voice: (503) 363-5143 Fax: (503) 399-9747

January 1984, Electronics Now 163
Design and Verify

Available for DOS, Windows and Macintosh

Analog Module includes:
- complete control over all component values
- ideal and real-world models for active components
- resistors, capacitors, inductors, transformers, relays, diodes, Zener diodes, LEDs, BJTs, opamps, bulbs, fuses, JFETs and MOSFETs
- manual, time-delay, voltage-controlled and current-controlled switches
- independent, voltage-controlled and current-controlled sources
- multimeter
- function generator (1 Hz to 1 GHz)
- dual-trace oscilloscope (1 Hz to 1 GHz)
- Bode plotter (1 mHz to 10 GHz)

Digital Module includes:
- fast simulation of ideal components
- AND, OR, XOR, NOT, NAND and NOR gates
- RS, JK and D flip-flops
- LED probes, half-adders, switches, seven-segment displays
- word generator (16 eight-bit words)
- logic analyzer (eight-channel)
- logic converter (converts among gates, truth table and Boolean representations)

Electronics Workbench®
The electronics lab in a computer™

SYSTEM REQUIREMENTS
MS-DOS version: Requires IBM AT, PS/2 or true compatible with 286 or greater, hard disk, 1 MB RAM, Microsoft-compatible mouse, EGA or VGA display adapter and DOS 3.0 or greater. Supports a math co-processor if available.
Windows version: MS-DOS 5.0 or higher, Microsoft Windows 3.1, 2 MB RAM with suitable pointing device.
Macintosh version: Macintosh Plus or higher, 2 MB RAM, System 6 or 7.

All trademarks are the property of their respective owners.
Circuits. Fast.

Electronics Workbench®

New Version 3

Features in Version 3

- new components include JFETs, MOSFETs, voltage- and current-controlled sources; manual, time-delay, voltage-controlled and current-controlled switches
- real-world models for opamps, BJTs, JFETs, MOSFETs and diodes — over 100 models available
- MS-DOS version now supports up to 16 MB of RAM for simulation of bigger circuits
- new Microsoft® Windows™ and Macintosh® versions available
- Technical support now available on CompuServe®

*30-day money back guarantee

An Ideal Test Bench

Here's why Electronics Workbench belongs on your test bench. Wires route themselves. Connections are always perfect. And the simulated components and test instruments work just like the real thing. The instruments are indestructible and the parts bin holds an unlimited supply of each component. The result: thousands of electronics professionals and hobbyists save precious time and money. Over 90% would recommend it to their friends and colleagues. Electronics Workbench: the ideal, affordable tool to design and verify your circuits before you breadboard.

Now the best is even better!

Version 3.0 simulates more and bigger circuits, and sets the standard for ease of use. Guaranteed!*

Just $299!

"Design work is faster and cheaper with Electronics Workbench."
Mark L. Weaver, Production Engineer Technician, Colorado Memory Systems, Loveland, Colorado

"Building a circuit is simple and intuitive." Jeff Holtzman, Computer Editor, Electronics Now

"I used Electronics Workbench extensively in the design of a six-meter receiver. I got surprisingly good comparison with actual breadboard and end-unit performance, even at 50 MHz. As an affordable tool for performing design tradeoffs, you can't beat it."
M. A. Chapman, Oceanside, California

Call 800 263-5552

Yes, I want Electronics Workbench in my computer!

Name: ____________________________
Address: ____________________________
City: __________________ State: ______ Zip: ______
Tel: (____) __________ Fax: (____) __________
MC _____ VISA _____ AMEX _____ # ______
Signature: ____________________________ Exp: ______

Order information: Check or Money Order payable to Interactive Image Technologies Ltd.
Call for Canadian prices. All orders add $15 shipping and handling.

INTERACTIVE IMAGE TECHNOLOGIES LTD.
908 Niagara Falls Blvd. #06B,
North Tonawanda, NY 14120-2060
Tel: (416) 361-0333 Fax: (416) 368-5799

CIRCLE 247 ON FREE INFORMATION CARD
Don’t let circuit design puzzle you!

CircuitMaker
Schematic layout and digital simulation at its best!

"CircuitMaker is much easier to use than pricier products... it really shines in the simulation phase."

Available for Windows and Macintosh - Only $199
Call Today (801)226-4470

Earn $1000
A Week While You Learn High Paying VCR Repair.
Earn While You Learn...
Secrets Revealed...
Train at Home
If you are able to work with small hand tools and possess average mechanical ability, you could earn top dollar part time or full time. Our learn by doing method teaches you how to work on VCR’s without boring unnecessary electronic basics.

For Free Information Package Send Coupon to:
Foley-Belsaw Institute, 601 Equitable Road, Kansas City, MO 64120

Check VCR or another High Paying Field
Check One Box Only

VCR Repair, Dept. 62114
Computer Repair, Dept. 64025
Advance VCR Repair, Dept. 65014
Camcorder Repair, Dept. 66022
Fax Repair, Dept. 67022
Printer Repair, Dept. 68022

Since 1926 Digital Electronics, Dept. 69022

Cable TV
ALL NAME BRANDS DESCRAMBLERS, CONVERTERS COMBOS. CALL NOW WE’LL BEAT THE COMPETITION.
UNIVERSAL SALES 800-647-2371

Invest a stamp

Save a bundle
For the price of a stamp, you can get the latest edition of the federal government’s free Consumer Information Catalog. It lists more than 200 free or low-cost publications on federal benefits, jobs, health, housing, education, cars, and more. To help you save money, make money, and spend it a little more wisely. So stamp out ignorance with our latest free Catalog. Send your name and address to:
Consumer Information Center
Department SB
Pueblo, Colorado 81009
SOLDERLESS PROTOTYPING BOARDS

If you design or build your own circuits and have never used a solderless prototyping board, then you must have just given up experimenting. Our range of prototyping boards come in three sizes: IC's plug in without sockets, no soldering is necessary and no pins fall out! This is just too easy! Most of the links in these prototyping boards are in horizontal or vertical position, for connection points and provide horizontal and vertical power buses. Two boards provide power and signal connectors which will accept banana plugs, pin plugs, "forks" or just a piece of bare wire. No sockets are necessary for most items, as Dual Inline Packages (DIP) fit directly onto the prototyping board. This is the easiest way to prototype - you concentrate on the project, not how to avoid nicking your finger or the conductor. Try one of these solderless boards, and find out for yourself how easy designing can be.

NOTE: SB630 Does not include a backplane and binding posts.

| Order # | Price  | L x W x H | Strips | Points | Rows | Price
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SB630</td>
<td>5.95</td>
<td>6.5 x 1.4 x 0.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 lbs</td>
</tr>
<tr>
<td>SB1660</td>
<td>18.50</td>
<td>8.5 x 5.1 x 1.2</td>
<td>4</td>
<td>2</td>
<td>1.630</td>
<td>3 lbs</td>
</tr>
<tr>
<td>SB3220</td>
<td>32.50</td>
<td>9.5 x 8.3 x 1.2</td>
<td>7</td>
<td>4</td>
<td>2.520</td>
<td>2 lbs</td>
</tr>
</tbody>
</table>

SOLDERLESS PROTOTYPING BOARDS

-low noise, low ripple - constant voltage and current mode over and reverse polarity protection

Order # Price Voltage Output Amps Volt. In Series Volt. In Parallel Ship
PS1850 215.00 0-18 0-3 NA NA 12 lbs
PS1850D 244.00 0-18 0-3 NA NA 12 lbs
PC3030 488.00 0-30 X 2 0-3 X 2 0-60/3A 0-60/6A 27 lbs
PC3030D 540.00 0-30 X 2 0-3 X 2 0-60/3A 0-60/6A 27 lbs

SOLDIERLESS PROTOTYPING BOARDS

PC3030 SERIES FEATURES
- Auto tracking - continuous or dynamic load
- Overload and reverse polarity
- Series and Parallel operation
- One SMD fixed output (3 Amp)

PS1850 SERIES FEATURES
- External prog. (Remote control - Continuous or dynamic load)
- Overload and reverse polarity
- Series and Parallel operation
- One SMD fixed output (3 Amp)

C.O.D. and Prepaid Orders Only

For C.O.D. services, add $5.00 to order total (C.O.D. orders only are payable by cash, cashier’s check or money order only)

CA Residents Add Your Area Sales Tax

Add Freight Charges As Follows (Continental U.S. Only)

- UPS Ground: Up to 3 lbs. $5.00
- Each Additional Pound $0.50

Other Services: Contact us for rates outside the Continental U.S.A.

30 DAY MONEY BACK GUARANTEE ON ALL PRODUCTS!

Prices subject to change without notice

Send your check or money order made payable to "Billabong Electronics" Today!!

EASY TO FABRICATE
DESIGNED FOR SMALL LOT PRODUCTION

DUAL SLOPE METAL CABINETS

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Major Use/Secondary Use</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS-1</td>
<td>4 x 6 x 8 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>59.00</td>
</tr>
<tr>
<td>DS-2</td>
<td>6 x 8 x 12 x 12 x 12 x 12 x 16</td>
<td>12 x 12 x 20</td>
<td>87.56</td>
</tr>
<tr>
<td>DS-3</td>
<td>8 x 8 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>126.25</td>
</tr>
<tr>
<td>DS-4</td>
<td>10 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>175.00</td>
</tr>
<tr>
<td>DS-6</td>
<td>12 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>216.00</td>
</tr>
<tr>
<td>DS-8</td>
<td>12 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>275.00</td>
</tr>
<tr>
<td>DS-9</td>
<td>12 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>348.00</td>
</tr>
<tr>
<td>DS-11</td>
<td>12 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>587.00</td>
</tr>
<tr>
<td>DS-12</td>
<td>12 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>759.00</td>
</tr>
<tr>
<td>DS-13</td>
<td>12 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>1056.00</td>
</tr>
<tr>
<td>DS-14</td>
<td>12 x 12 x 12 x 12 x 12 x 12 x 18.5</td>
<td>12 x 12 x 20</td>
<td>1375.00</td>
</tr>
</tbody>
</table>

VEHICLE RACK CHASSIS 1994

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>3RU7 HD</td>
<td>19 x 7 x 8.25</td>
<td>116.00</td>
</tr>
<tr>
<td>3RU10HD</td>
<td>19 x 10 x 8.25</td>
<td>121.00</td>
</tr>
<tr>
<td>3RU14HD</td>
<td>19 x 14 x 8.25</td>
<td>134.00</td>
</tr>
<tr>
<td>4RU7 HD</td>
<td>19 x 7 x 9.75</td>
<td>117.00</td>
</tr>
<tr>
<td>4RU10HD</td>
<td>19 x 10 x 9.75</td>
<td>120.00</td>
</tr>
<tr>
<td>4RU14HD</td>
<td>19 x 14 x 9.75</td>
<td>135.00</td>
</tr>
<tr>
<td>5RU7 HD</td>
<td>19 x 7 x 10.75</td>
<td>123.00</td>
</tr>
<tr>
<td>5RU10 HD</td>
<td>19 x 10 x 10.75</td>
<td>128.00</td>
</tr>
<tr>
<td>5RU14 HD</td>
<td>19 x 14 x 10.75</td>
<td>139.00</td>
</tr>
</tbody>
</table>

HEAVY DUTY RACK CHASSIS

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1RU4</td>
<td>19 x 4 x 7.25</td>
<td>56.50</td>
</tr>
<tr>
<td>1RU5</td>
<td>19 x 5 x 7.25</td>
<td>61.93</td>
</tr>
<tr>
<td>1RU6</td>
<td>19 x 6 x 7.25</td>
<td>73.00</td>
</tr>
<tr>
<td>1RU7</td>
<td>19 x 7 x 7.25</td>
<td>80.25</td>
</tr>
</tbody>
</table>

SHEET METAL PUNCHES

<table>
<thead>
<tr>
<th>Model</th>
<th>Hole Size &amp; Shape</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC-18</td>
<td>3/8&quot; round</td>
<td>4.15</td>
</tr>
<tr>
<td>PC-19</td>
<td>3/8&quot; square</td>
<td>4.15</td>
</tr>
<tr>
<td>PC-20</td>
<td>3/8&quot; round</td>
<td>4.15</td>
</tr>
<tr>
<td>PC-23</td>
<td>3/8&quot; round</td>
<td>4.15</td>
</tr>
<tr>
<td>PC-24</td>
<td>3/8&quot; round</td>
<td>5.65</td>
</tr>
<tr>
<td>PC-25</td>
<td>3/8&quot; round</td>
<td>5.00</td>
</tr>
<tr>
<td>PC-26</td>
<td>3/8&quot; round</td>
<td>4.15</td>
</tr>
<tr>
<td>PC-27</td>
<td>3/8&quot; round</td>
<td>5.75</td>
</tr>
<tr>
<td>PC-28</td>
<td>3/8&quot; round</td>
<td>4.15</td>
</tr>
</tbody>
</table>

HAND TOOLS

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Range (mm)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD-1</td>
<td>1/16&quot; - 3/32&quot;</td>
<td>0.5 - 2.3</td>
<td>10.00</td>
</tr>
<tr>
<td>MD-2</td>
<td>1/16&quot; - 3/32&quot;</td>
<td>0.5 - 2.3</td>
<td>10.00</td>
</tr>
<tr>
<td>MD-3</td>
<td>1/16&quot; - 3/32&quot;</td>
<td>0.5 - 2.3</td>
<td>10.00</td>
</tr>
<tr>
<td>MD-4</td>
<td>1/16&quot; - 3/32&quot;</td>
<td>0.5 - 2.3</td>
<td>10.00</td>
</tr>
<tr>
<td>MD-5</td>
<td>1/16&quot; - 3/32&quot;</td>
<td>0.5 - 2.3</td>
<td>10.00</td>
</tr>
<tr>
<td>AC-1</td>
<td>1/16&quot; - 3/32&quot;</td>
<td>0.5 - 2.3</td>
<td>10.00</td>
</tr>
</tbody>
</table>

NEW FOR 1994

RACKEM H'S STECKEM™ SERIES - A NEW 1/4 RACK SYSTEM WITH ITS OWNtable-top rack AVAILABLE IN CLEAR, BLACK AND GOLD FOR A GREAT PRESENTATION

ORDERS (800) 634-3457
FAX ORDERS (800) 551-2749

TECH LINE (702) 565-3803 - M-Th 8 am TO4 pm (Pacific Time)

CALL OR WRITE FOR YOUR FREE 24 PAGE CONSTRUCTION CATALOG OR PREPAID ORDERS SHIPPED GROUND AT NO CHARGE (48 STATES)
USE ELECTRONIC SHOPPER CLASSIFIEDS
READ BY MORE THAN 100,000 ELECTRONICS BUYERS AND SELLERS AND TRADERS

HOw To WriTE yOuR AD
TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO
The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES
Our classified ad rate is $1.25 per word. Minimum charge is $18.75 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT
All classified advertising in the Electronic Shopper is limited to electronics items only. All ads are subject to the publisher’s approval. We reserve the right to reject or edit all ads.

DEADLINES
Ads received by our closing date will run in the next issue. For example, ads received by April 1 will appear in the July, 1993 issue that is on sale in June 3. Shopper ads will appear Jan., Mar., May etc. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

AD RATES: $1.25 per word. Minimum $18.75.

Send your ads with payment to:
Electronic SHOPPER, 500-B Bi-County Blvd. Farmingdale, NY 11735

CATEGORIES

| 100 — Antique Electronics | 270 — Computer Equipment Wanted | 450 — Ham Gear Wanted | 630 — Repairs-Services |
| 130 — Audio-Video-Lasers | 300 — Computer Hardware | 480 — Miscellaneous Electronics For Sale | 660 — Satellite Equipment |
| 160 — Business Opportunities | 330 — Computer Software | 510 — Miscellaneous Electronics Wanted | 690 — Security |
| 190 — Cable TV | 360 — Education | 540 — Music & Accessories | 710 — Telephone |
| 210 — CB-Scanners | 390 — FAX | 570 — Plans-Kits-Schematics | 720 — Test Equipment |
| 240 — Components | 420 — Ham Gear For Sale | 600 — Publications |

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # ______

1 - $18.75 2 - $18.75 3 - $18.75 4 - $18.75
5 - $18.75 6 - $18.75 7 - $18.75 8 - $18.75
9 - $18.75 10 - $18.75 11 - $18.75 12 - $18.75
13 - $18.75 14 - $18.75 15 - $18.75 16 - $20.00
17 - $21.25 18 - $22.50 19 - $23.75 20 - $25.00
21 - $26.25 22 - $27.50 23 - $28.75 24 - $30.00
25 - $31.25 26 - $32.50 27 - $33.75 28 - $35.00
29 - $36.25 30 - $37.50 31 - $38.75 32 - $40.00
33 - $41.25 34 - $42.50 35 - $43.75 36 - $45.00
37 - $46.25 38 - $47.50 39 - $48.75 40 - $50.00

Ad No 1—Total words ________ × $1.25 per word = $ ______
All Caps words ________ × .20 per word = $ ______
Bold words ________ × .20 per word = $ ______
Bold Cap words ________ × .40 per word = $ ______
TOTAL COST OF AD No. 1 $ ______

Card # ________ ________ ________ ________ ________ ________ ________ ________ ________
Expiration Date ________ / ________
Signature ________ ________ ________ ________ ________ ________ ________ ________ ________
Phone ________ ________ ________ ________ ________ ________ ________ ________ ________
City State Zip ________ ________ ________ ________ ________ ________ ________ ________ ________

Electronic Shopper, Jan., 1994

[ ] Check [ ] MasterCharge [ ] Visa ($18.75 minimum credit card order)
You Can Master Electronics!

Vital Knowledge—Act Now!

- Choose hands-on or video based learning
- Individual courses from $49.95
- Three course, hands-on package only $339.95

Gain vital, practical skills for today's high-tech world, and have fun doing it. Demax® courses are based on experiments and demos. No hard math, no boring programmed learning! 

Mastering the Digital Multimeter, Direct Current, Alternating Current and Electromagnetics give you key knowledge, used everywhere from house wiring to space vehicles.

FREE INFORMATION
Demax Corporation, P.O. Box 946, Benton Harbor, MI 49022
(800)-79DEMAX
Fax (616) 428-7411

Robot Kits

EASY TO BUILD You do ALL electronic & mechanical assembly using 2-color Instruction Books with step-by-step, well-illustrated directions for assembly, experiments and testing. Each Robot Kit applies different electronic & robotic principles. Learn how Robots work and have fun at the same time!

606A "Scrambler" All Terrain Robot
This 6-legged Robot walks over rough terrain. Uses high-tech infrared beam to sense and avoid objects in its path. 32 page Book. $37.95

602A "Blinky" Pathfinder Robot
Follows path made with a marker pen or tape. Red/green LEDs react to steering changes, adding fun and interest. 28 page Book. Infrared emitter/detectors. $36.95

603A "Copycat" Programmable Robot
Program direction, light and sound using detachable keypad (included) or optional PC. Learn digital logic basics. 44 page Book. $57.35

601A "Scooter" Sound Controlled Robot
Backs up, changes direction, goes forward when it hears loud noise or hits an object. Florescent red. 24 page Book. Fast-paced excitement! $18.95

DEPENDABLE PRODUCTS Since 1963, Graymark's ONLY business has been producing educational electronic kits. We do one thing and we do it right. That's why Graymark has the largest selection of electronic kits. And, our "It works or we fix it" policy guarantees success for YOU!

ORDER TODAY! Phone: VISA/MasterCard
Mail: Check/Money Order, VISA/MasterCard
Add: $4.00 Shipping

CALL FOR FREE 40 PAGE CATALOG

Graymark P.O. Box 2015, Tustin, CA 92681 800-854-7393

CIRCLE 299 ON FREE INFORMATION CARD
CALL • FAX OR WRITE
FOR A FREE CATALOG

THE ULTIMATE SAVING SOURCE
Call Toll Free 1-800-325-2264 or (213) 727-0054
2733 Carrier Ave. Los Angeles, CA 90040 FAX 213-727-6032 or 888-6032
BAREBONZ BK PRECISION BARGAINS

B&K 2120
20MHz Scope
Dual Trace

Reg. $549
BAREBONZ SALE $385

ORDER TODAY!
We’ll beat ANY dealer’s advertised price on new B&K, Fluke, Leader, or Tektronix Equipment we stock.

VIEW SYNC GENERATOR

Restores Horizontal and Vertical Sync Lines from Distorted Analog Audio Video Formats

For Free Information Package on Completed Units and Pricing
• Call 219-236-5776 •
R.C. Distributing • P.O. Box 552 • South Bend, IN 46624

Prototype it........ FAST!

Phone (317) 752-5000

SAVE MONEY! A unbelievably widespread! Electronic Devices with amazing capabilities can be monitored using your telephone and room conversation? RIGHT NOW! Are you sure you’re safe? FREE CATALOG with you today! Includes the most wanted and unique items from Countersurveillance, Inc. Exciting, immensely interesting and EXTREMELY profitable. Call NOW.

1-800-752-5000

172

GENOA Group, 7334 S. Alton Way, Unit 11, Englewood, CO 80112

VIDEO SYNCH GENERATOR

BLACK AND WHITE SYNCHRGEN

Modular design allows INPLACE SYNCH GROUNDBREAKING NEW DESIGN

100% NEW PARTS

BARGAIN PRICING

90-day warranty on parts and labor

8103 Elizabeth St. • Niles, IL 60714 • 1-800-392-8415
FAX: 1-800-446-8366
DOS IN ROM!

8088 SINGLE BOARD COMPUTER

WORLD'S SMALLEST PC!!!

ROBOTS ALARMS RECORDERS DOS

THREE EASY STEPS:

1. Develop on PC
2. Download to SBC
3. Burn into EPROM

FREE SHIPPING IN U.S.
5 YEAR LIMITED WARRANTY

MVS

Box 850
Marrack, NH
(508) 782-0507

Holiday Sale on the TDD-8X
Touch Tone Decoder/Display
and ASCII Converter Board

Only $89.00
Regularly $129.00

isValided December 31, 1993

MoTron Electronics
310 Garfield Street Suite 4
Eugene, Oregon 97402

Orders: (800) 338-9058 Info: (503) 687-2118 Fax: (503) 687-2492

MoTron Electronics
310 Garfield Street Suite 4
Eugene, Oregon 97402

Orders: (800) 338-9058 Info: (503) 687-2118 Fax: (503) 687-2492

FINALLY!

UP TO 115 KBAUD SERIAL INTERFACE TO CONTROL YOUR PROJECT FROM AN RS-232 COMPUTER PORT

- Uses ASCII mnemonics from user's program or Procomm, MAC240, etc
- Bin, Hex or Dec formats
- 24 bit programmable I/O lines
- 10 X 8 bits Analog/Digital channels
- 10-10,000 Hz Pulse Width Modulation
- High & Low interrupts
- 3 EASY to use logic interfaces for stepper motors
- Measures relative resistance/capacitance and much, much more!

- I/O 232 KIT*: ONLY $65
- ASSEMBLED*: ONLY $75
Some connectors not incl

- EASY to use logic interfaces for stepper motors
- Measures relative resistance/capacitance and much, much more!

CONVERTERS and DESCRAMBLERS!

Everquest • Panasonic • Jerrold • Zenith • Pioneer
Scientific Atlanta • Oak • Eagle • Hamlin • Tocom

1 800 624-1150

FREE Catalog!
## Lake Sylvan Sales

**Orders:** 800-800-4582  
**Service:** 612-895-9944  
**FAX:** 612-895-9454  

**MONDAY thru FRIDAY**  
8:00 AM - 6:00 PM

**11986 Riverwood Drive**  
Burnsville, MN  
55337

---

### Cable TV Boxes

**CONVERTERS, DESCRAMBLERS & MORE AT WHOLESALE PRICES**  
**CALL FOR MONTHLY SPECIALS!**

#### Descramblers

<table>
<thead>
<tr>
<th>Model</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>40+</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPER 7 (Digital Impulse)</td>
<td>$109.00</td>
<td>$99.00</td>
<td>$79.00</td>
<td>CALL</td>
</tr>
<tr>
<td>TB - 3 or 2</td>
<td>$65.00</td>
<td>$50.00</td>
<td>$40.00</td>
<td>CALL</td>
</tr>
<tr>
<td>FTB - 3 or 2</td>
<td>$79.00</td>
<td>$55.00</td>
<td>$50.00</td>
<td>CALL</td>
</tr>
<tr>
<td>SA - 3B</td>
<td>$65.00</td>
<td>$45.00</td>
<td>$40.00</td>
<td>CALL</td>
</tr>
<tr>
<td>SA - 3D-F</td>
<td>$99.00</td>
<td>$94.00</td>
<td>$89.00</td>
<td>CALL</td>
</tr>
<tr>
<td>SB - 3 or 2</td>
<td>$55.00</td>
<td>$43.00</td>
<td>$38.00</td>
<td>CALL</td>
</tr>
<tr>
<td>SP-200 (Special Pio)</td>
<td>$145.00</td>
<td>$135.00</td>
<td>$39.00</td>
<td>CALL</td>
</tr>
<tr>
<td>'Oak N-12 (With VARI-Sync)</td>
<td>$54.00</td>
<td>$49.00</td>
<td>$39.00</td>
<td>CALL</td>
</tr>
<tr>
<td>'Hamlin 1200 Ch. 3</td>
<td>$65.00</td>
<td>$66.00</td>
<td>$38.00</td>
<td>CALL</td>
</tr>
</tbody>
</table>

*Refurbished as New.*

#### Converters

<table>
<thead>
<tr>
<th>Model</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>40+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panasonic TZPC 145</td>
<td>$80.00</td>
<td>$75.00</td>
<td>$70.00</td>
<td>CALL</td>
</tr>
<tr>
<td>TPS50 (550 MHz WParental)</td>
<td>$80.00</td>
<td>$75.00</td>
<td>$70.00</td>
<td>CALL</td>
</tr>
<tr>
<td>'Jerrold DQ5-5</td>
<td>$80.00</td>
<td>$70.00</td>
<td>CALL</td>
<td>CALL</td>
</tr>
<tr>
<td>'Jerrold DQ-V7 wvolume</td>
<td>$85.00</td>
<td>$75.00</td>
<td>CALL</td>
<td>CALL</td>
</tr>
<tr>
<td>'Jerrold DRZ-450</td>
<td>$59.00</td>
<td>$49.00</td>
<td>$45.00</td>
<td>CALL</td>
</tr>
<tr>
<td>'Sylvania Texscan 4040 (Ch. 2, 3 or 4)</td>
<td>$55.00</td>
<td>$45.00</td>
<td>$36.00</td>
<td>CALL</td>
</tr>
</tbody>
</table>

*Refurbished as New. Converters available in Channel 2 or 3.*

#### Combination Units

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Scientific Atlanta</td>
<td>CALL FOR AVAILABILITY AND PRICING</td>
</tr>
<tr>
<td>Zenith Models</td>
<td>CALL FOR AVAILABILITY AND PRICING</td>
</tr>
<tr>
<td>Jerrold Baseband</td>
<td>$329.00</td>
</tr>
<tr>
<td>Jerrold DPV7-212</td>
<td>$249.00</td>
</tr>
<tr>
<td>Jerrold DP5-DPV5</td>
<td>CALL</td>
</tr>
<tr>
<td>Jerrold DRX-3DIC</td>
<td>$49.00</td>
</tr>
<tr>
<td>Jerrold DRZ-3DIC</td>
<td>CALL</td>
</tr>
<tr>
<td>Sylvania Texscan 4040-DIC</td>
<td>CALL</td>
</tr>
<tr>
<td>(Ch. 2 or 3)</td>
<td>CALL</td>
</tr>
<tr>
<td>'Oak M35B (With VARI-Sync)</td>
<td>CALL</td>
</tr>
<tr>
<td>'Oak RTC56</td>
<td>CALL</td>
</tr>
</tbody>
</table>

*Refurbished as New.*

#### Other Products Available:

- Remotes: Jerrold, Panasonic, Hamlin, Tomcom, Scientific Atlanta
- Interference Filters: Channels 2 or 3 / Video Tape Enhancers

---

No Minnesota Sales  
Prices Subject to Change Without Notice!

Theft of service is a crime. Installing any device without permission may subject you to civil or criminal penalties. You must check with your local cable company and pay for all service you use. It is not the intent of Lake Sylvan Sales to defraud any television operator and we will not assist any company or individual in doing the same.
**THE BASIC STAMP**

$39 Stamp-Sized Computer Runs BASIC

The BASIC Stamp is a 1x2-inch computer that runs BASIC programs written on your PC. It has 8 I/O lines, which can easily be programmed for serial communications, potentiometer input, pulse measurement, button debounce, tone generation, PWM, etc. And all by just adding a resistor and/or capacitor, if anything. It's so simple, you'll be ecstatic!

Writing programs for the Stamp is easy. A 3-pin cable connects the Stamp to your PC's parallel port. And one piece of software is used to enter, debug, and download your programs.

For adding circuitry, the Stamp has a small prototyping area. Included are 8 I/O lines, 5-volt supply, unregulated supply, and ground.

For programming, we offer the Stamp Programming Package. The package includes software, cable, manual, application notes, and free technical support. For those who'd like to make their own, we offer the software and cable info on our BBS.

BASIC Stamps $39 • Programming Package $99 • BASIC Interpreter Chips also Available

**PIC16Cxx MICROCONTROLLERS and TOOLS**

**NEW! TrueFlight™ for PIC16C71 & PIC16C84**

You may already know about the PIC16Cxx series of 8-bit microcontrollers from Microchip Technology. They're the answer to many small controller needs, especially if price is an issue. A typical PIC is the PIC16C54-RC/P, it's an 18-pin DIP package with 12 I/O lines, 512 words of PROM, and 32 bytes of RAM, all for around $4.00.

With our programmer ($179), downloader ($299), and new TrueFlight ($349), you can develop applications for all PIC16Cxx devices (16C5x, 16C71, 16C84, and 16C64). And if you've ever written 8051 assembly language, you'll feel right at home. That's because our assembler accepts our friendly 8051-like instructions (of course, it also accepts Microchip's).

The programmer is used to program and read all PIC's (ZIF, SOIC, & SSOP adapters available). The downloader plugs in place of a PIC16C5x in your target system and allows you to run code in-circuit at 8 MHz. And the new TrueFlight programmer/downloader accomplishes both functions for the popular 16C71 and 16C84. Using a production part and an on-board flash UV eraser, TrueFlight can quickly program and erase 16C71's, allowing it to work as a 20 MHz downloader. For the EEPROM-based 16C84, the same is done with no UV time.

Parallax

3805 Atherton Road, #102 • Rocklin, CA 95765 • USA
(916) 624-8333 • Fax: 624-8003 • BBS: 624-7101

BASIC Stamp, TrueFlight, and the Parallax logo are trademarks of Parallax, Inc. PIC is a registered trademark of Microchip Technology, Inc. Features and prices subject to change without notice.

* Excellence is common, but not guaranteed. ** Prices pending (on-chip eraser not shown above).
In plastic and ceramic packages, for low-cost solutions to dozens of application requirements, select Mini-Circuits’ flatpack or surface-mount wideband monolithic amplifiers. For example, cascade three MAR-2 monolithic amplifiers and end up with a 25dB gain, 0.3 to 2000MHz amplifier for less than $4.50. Design values and circuit board layout available on request.

It’s just as easy to create an amplifier that meets other specific needs, whether it be low noise, high gain, or medium power. Select from Mini-Circuits’ wide assortment of models (see Chart), sketch a simple interconnect layout, and the design is done. Each model is characterized with S parameter data included in our 740-page RF/IF Designers’ Handbook.

All Mini-Circuits’ amplifiers feature tight unit-to-unit repeatability, high reliability, a one-year guarantee, tape and reel packaging, off-the-shelf availability, with prices starting at 99 cents.

Mini-Circuits’ monolithic amplifiers...for innovative do-it-yourself problem solvers.

**DC-2000 MHz AMPLIFIERS**

**99¢ Unit price $ (25 qty)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Plastic Flat-Pack</th>
<th><strong>VAM-3</strong></th>
<th><strong>VAM-6</strong></th>
<th><strong>VAM-7</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>MAR-1</td>
<td>1.04</td>
<td>1.45</td>
<td>1.79</td>
<td></td>
</tr>
<tr>
<td>MAV-1</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-2</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-3</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-4</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-5</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-6</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-7</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-8</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-9</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-10</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
<tr>
<td>MAV-11</td>
<td>1.15</td>
<td>1.45</td>
<td>1.65</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Frequency range DC-1500MHz
- Gain 1/2 dB less than shown

**Typical Circuit Arrangement**

**Distribution Centers**
- NORTH AMERICA 800-654-7949 417-335-5935
- EUROPE 44-252-835094 Fax 44-252-837010

 fier new ways setting higher standards

**Mini-Circuits**
- P.O. Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718) 332-4661
- NORTH AMERICA 800-654-7949 417-335-5935 Fax 417-335-5945

**CIRCLE 179 ON FREE INFORMATION CARD**