Radio-Electronics

SPECIAL ISSUE
VIDEO & HANDHELD
ELECTRONIC GAMES

$1.25 JULY 1982

uild your own
PEECH SYNTHESIZER
ith only 5 IC's

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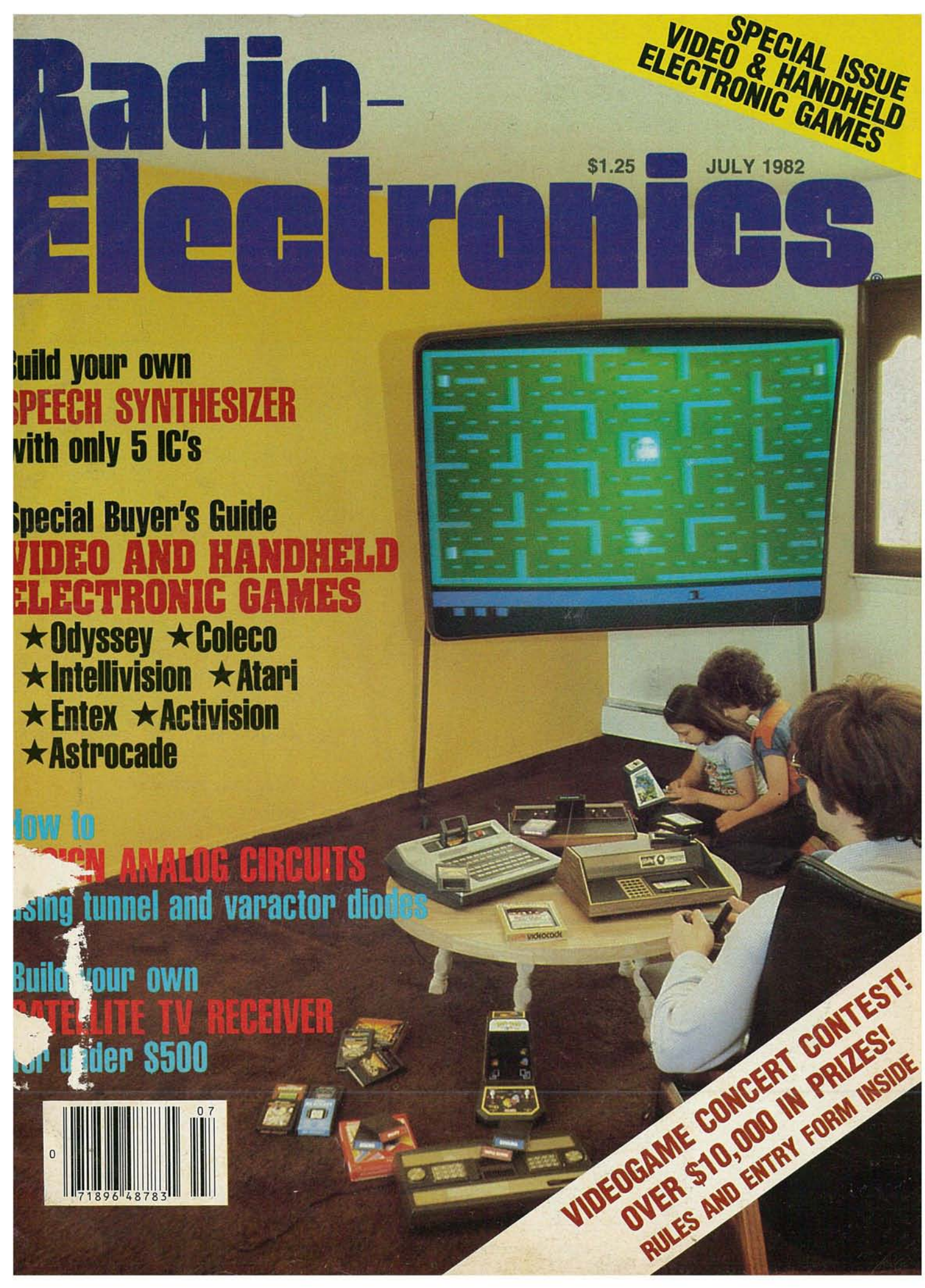
IDEO AND HANDHELD
LECTRONIC GAMES
★Odyssey ★Coleco
★Intellivision ★Atari
★Entex ★Activision
★Astrocade

ow to
SIGN ANALOG CIRCUITS
sing tunnel and varactor diodes

Build your own
SATELLITE TV RECEIVER
for under $500



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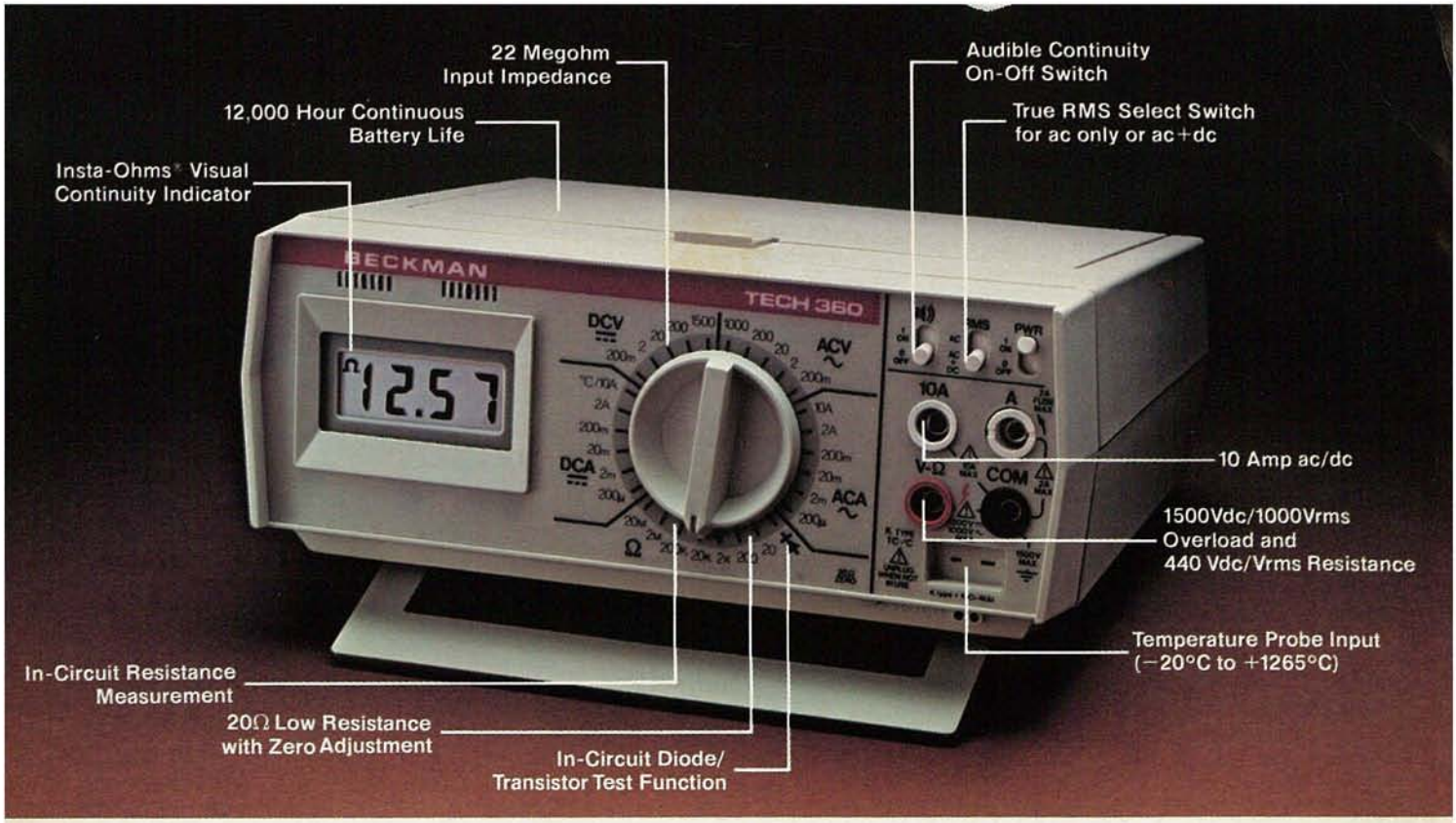

Introducing the TECH™ 360 DMM. Never has it been so easy to do so much for so little.

Beckman's TECH 360 bench/portable DMM puts unmatched capability and convenience at your fingertips.

You can select from 8 functions and 31 ranges with one turn of the single selector switch.

On or off the bench, you can accurately measure all complex waveforms with True RMS AC functions. Extend resistance measurement to 1/100 ohm resolution. Read temperatures from −20°C to 1265°C. Perform continuity checks quickly, with audible and visible indications. Measure up to 10 amps without adding special adaptors. All with 0.1% basic Vdc accuracy.

12,000 hour battery life

Designed for ultimate ease of operation, the TECH 360 delivers 12,000 hours continuous service (up to 4 years of normal use) from standard heavy-duty batteries. You'll never have to search for power outlets or contend with ground loop errors. The expense of rechargeable battery packs is eliminated.

The TECH 360 is available for just $289 (U.S. only), including batteries. The companion TECH 350 (without RMS and temperature measuring capability) is priced at $229.

For information on the complete line of Beckman DMMs and accessories, call your local distributor today. For the one nearest you call: (714) 993-8803 or write Beckman Instruments, Inc., Electro-Products Group, 210 South Ranger Street, Brea, California 92621.

Convenient storage and multiple viewing angles are featured in the new line of Beckman bench/portable DMMs.

BECKMAN

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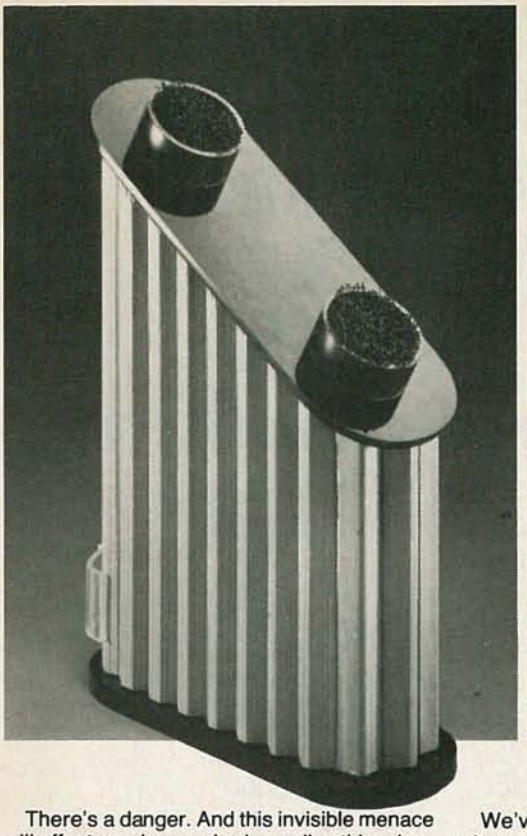

Fresh Air Bubble™

Surround your body or your work place with ion-controlled fresh air in America's first bipolar electrostatic home precipitator.

The unit measures only 2"x 4 "x 7" and its black and wood grain styling will fit into most decor.

There's a danger. And this invisible menace will affect nearly everybody reading this ad.

The danger is pollution—but not the ordinary kind. In fact, ten years ago, we didn't have this new kind of pollution. Let us explain.

Ten years ago, cars didn't have catalytic converters. Today, these catalytic converters "grind up" the car exhaust into particles so small they form micron soot, and micron soot is so fine, it can be easily absorbed into your lungs. Even the EPA has stated, "Because it is so fine, such soot particles stay longer and cause more damage in the respiratory tract."

Ten years ago, homes were able to "breathe" or exchange air between the outdoors and indoors four or five times a day. Today, with our well-insulated energy-conscious buildings our homes literally create and trap pollution that we breathe unwittingly.

OTHER PROBLEMS

There are other problems too. Add the daily soot, dust, smoke and other impurities in the air and you've created pollution problems even worse than they were ten years ago—so bad in fact that environmental groups are especially concerned over this new "time bomb" lurking in our environment.

But American ingenuity hasn't been sitting still. A rash of small devices containing charcoal filters with fans and selling for around $30 have literally flooded the market. The problem is that these devices only remove particles 5 microns or larger. Today's micron soot is one micron or smaller. Cigarette smoke for example is 2 to 3 microns or smaller.

70,000 UNITS SOLD

In 1978, JS&A introduced the negative ion generator in a national advertising campaign and sold over 70,000 units. It was a device that cleaned the air by electrostatically removing particles even smaller than one micron. Hospital burn centers soon began using commercial versions of the negative ion generator.

Removing sub micron particles from the air was very important, but there was also a surprising second benefit. The unit added negatively charged ions to the air.

We've all felt the effects of negative ions after a thunderstorm. When you take a deep breath, the air smells good and you feel good.

The opposite is true of positive ions which can be found in polluted environments, air conditioned office buildings and in automobiles. Many scientists believe that positive ions make you feel moody, depressed, irritable and restless. A negative ion generator cancels out the positive ions and fills the air with negative ions.

AN EXPERIMENT

When you blow smoke into an inverted glass bowl and put it over an ion generator, the smoke immediately vanishes. Or if you place the ion generator in an odor-filled room, the room soon smells fresh.

It was these experiments that really convinced the public that the JS&A ion generator was a valuable new home appliance. Soon the market was flooded with competitive ion generators. Many were not as efficient as JS&A's first model. Some emitted very few ions and one actually emitted dangerous levels of ozone. JS&A conducted independent laboratory tests and publicized the results which showed that JS&A's unit was indeed the best.

That's the history. But like any new technology, there's sure to be improvements. The first ion generator produced negatively charged ions which attached themselves to the pollutants and then fell to the ground. You ended up with clean, fresh air but also dirty rugs and walls.

In winter, the units created electrostatic discharges which can be uncomfortable when touching a doorknob or someone else.

CONTROLLED ION ENVIRONMENT

So American scientists created an ion generator using a bipolar emitter which emits a balanced amount of negative ions to create a controlled ion environment. One emitter produces negative ions and the other controls and shapes those ions to create an ion bubble.

The end result is a unit which leaves just the right amount of negative ions in a large room, attracts the pollution particles and deposits them on a beautiful wooden collector while keeping your floors and walls free of dirt. You're actually placed in a fresh air bubble while you work, sleep or relax and with no uncomfortable electrostatic charge. But wait, there's more.

We'll enclose with each unit, a white paper filter which you can place over the wooden collector. If the white paper is not blackened with micron soot after only ten days, please send your unit back for a full refund and we'll also refund your $4.00 postage and handling. And you can make that test anytime within 30 days after you receive your unit.

The white filter test will prove just how dirty your environment really is and it will also prove the effectiveness of the Fresh Air Bubble—the most powerful ion product sold today.

We urge you to try the Fresh Air Bubble in your home or office. Put one on your desk or in any smoke-filled room. Notice the refreshing difference in your work environment. Take it home and plug it in next to your bed. Chances are, you'll want to buy another one before our 30-day trial period ends.

When you order the unit, we'll send you the Fresh Air Bubble complete with instructions and a one year limited warranty. Then plug it in and leave it run all day and night. The cost to run the unit is only a few cents per day.

The era of the bipolar electrostatic precipitator as a home appliance is here. Order the best unit available at no obligation, today.

To order, send a check or money order to the address below or credit card holders call toll free **800 228-5000**. (In Nebraska call **800 323-6400**.) When ordering, please use the order number (shown in parenthesis) for faster service. Please add $4.00 for postage and handling and Ill. residents add 6% sales tax. Fresh Air Bubble **$89.95** (7050RE01).

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8″ DSDD Soft Sector (128 B/S, 26 Sectors)	**3115**	3.34
8″ DSDD Soft Sector (1024 B/S, 8 Sectors)	**3104**	3.34
8″ DSDD Burroughs B-80 Comp., 32 Hard Sector	**3092**	3.34
5¼″ SSSD Soft Sector (Unformatted)	**3401**	1.94
5¼″ SSDD Soft Sector w/Hub Ring	**3481**	2.34
5¼″ SSDD 10 Hard Sector w/Hub Ring	**3483**	2.34
5¼″ SSDD 16 Hard Sector w/Hub Ring	**3485**	2.34
5¼″ DSDD Soft Sector w/Hub Ring	**3491**	3.09
5¼″ DSDD 10 Hard Sector w/Hub Ring	**3493**	3.09
5¼″ DSDD 16 Hard Sector w/Hub Ring	**3495**	3.09

SSSD = Single Sided Single Density; SSDD = Single Sided Double Density
DSDD = Double Sided Double Density

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Memorex means quality products that you can depend on. Quality control at Memorex means starting with the best materials available. Continual surveillance throughout the entire manufacturing process. The benefit of Memorex's years of experience in magnetic media production, resulting, for instance, in proprietary coating formulations. The most sophisticated testing procedures you'll find anywhere in the business.

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To get the fastest delivery from **CE** of your Memorex Flexible Discs, send or phone your order directly to our Computer Products Division. Be sure to calculate your price using the **CE** prices in this ad. Michigan residents please add 4% sales tax. Written purchase orders are accepted from approved government agencies and most well rated firms at a 30% surcharge for net 30 billing. All sales are subject to availability, acceptance and verification. All sales are final. Prices, terms and specifications are subject to change without notice. Out of stock items will be placed on backorder automatically unless **CE** is instructed differently. Minimum order $50.00. International orders are invited with a $20.00 surcharge for special handling in addition to shipping charges. All shipments are F.O.B. Ann Arbor, Michigan. No COD's please. Non-certified and foreign checks require bank clearance.

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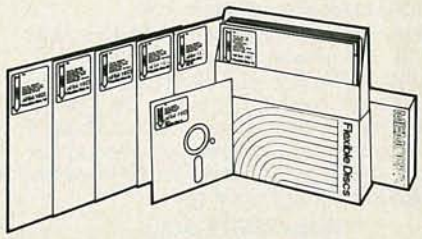

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Radio-Electronics

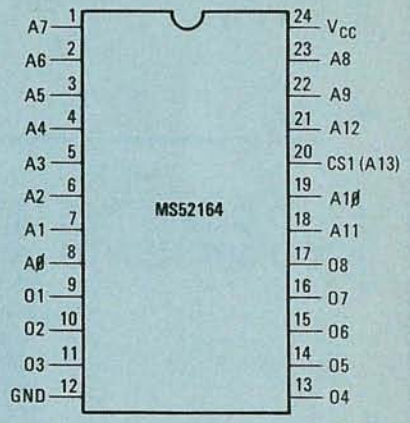
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

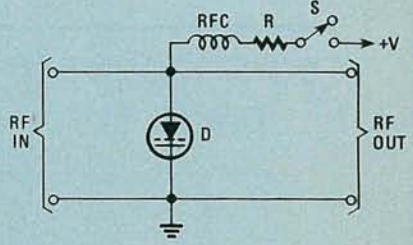
July 1982 Vol. 53 No. 7

ON THE COVER

A behind-the-scenes look at the **Radio-Electronics** Videogame Testing Laboratory. Many long hours were spent gathering data for this month's special section on video and handheld electronic games. For an overall look at what's available in video and handheld games, turn to page 49.



SPEECH SYNTHESIZER uses this ROM and 4 more IC's. For the complete construction details, turn to page 43.



PIN DIODES are just one of the many specialized diodes covered in this month's installment of the analog-design series. The story starts on page 72.

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VIDEO ELECTRONICS

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

HERE COME THE COMPONENTS

The buzzword for TV equipment this fall is going to be "component," as almost every brand is at least beginning to get involved in video components, or modular video, a field pioneered by Sony's *Profeel* series. (See left photo above.) Joining Sony in the component video field last year was Teknika, a brand handled by some department stores.

The first of the new wave of video components is being introduced by Sanyo (see right photo above) under the name "*Pro-Ponent.*" Sanyo's initial entry is a 19-inch monitor with a claimed resolution of 360 lines and a built-in 5-watt-per-channel stereo amplifier. A digital TV tuner with remote control is an accessory, as is a pair of loudspeakers. Other companion pieces include a video-component rack and a complete stereo audio-system. The Sanyo *Pro-Ponent* system carries rather high suggested retail prices—$600 for the monitor alone—but is expected to be widely discounted. Many other brands will be introducing "component video" in the next couple of months, but the term is expected to refer to a wide variety of different configurations; it will be used to describe everything from a conventional portable TV with a video jack on the back to a portable VCR outfit consisting of a recorder, tuner/timer and camera.

DON'T COUNT DISCS OUT

Pioneer Video, which bought out IBM's and MCA's interest in the optical (LaserVision) disc system, had intended to produce the discs in Japan, but ran into several snags—including the fact that the Japanese government refused admission of master tapes of not-very-racy movies which did, however, contain some nudity. Instead, Pioneer ended up buying the former IBM-MCA DiscoVision plant in Carson, Cal., which had been plagued by yield problems. Pioneer will install a "clean room" production facility there, similar to the one in its Japanese plant.

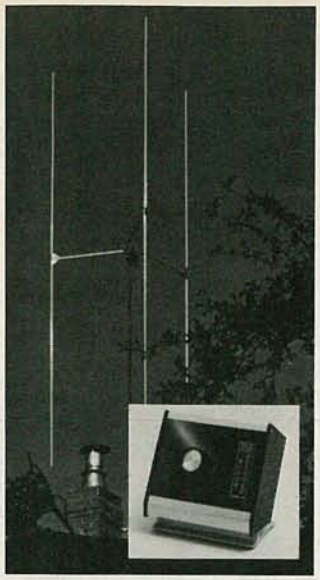
RCA, meanwhile, says that its CED *Selectavision* system has been successfully launched, and that its only mistake was in overconfident sales forecasts which weren't met. The company now says it will concentrate its efforts on introducing new titles in an attempt to convince the public that the *Selectavision* CED videodisc system is here to stay, and that it may adopt a "Preview" program, similar to the successful rental programs in the prerecorded videocassette field. Stereo-sound CED players and discs are also due to be introduced at midyear.

VCR PRICES FALL

Because of hot competition and Japanese overproduction, some of the best bargains in history are now available in videocassette recorders. Sanyo reduced the suggested list price of an electronic-tuned Beta recorder by $100 to $499.95, making it the first VCR to be offered at a list price below $500—although even such major brands as RCA and Panasonic are occasionally being advertised below $500 for low-end models. The Japanese overproduction combined with a slight recession-induced slowdown here has resulted in massive inventories at the time new models are being introduced. Thus, virtually every brand is offering dealers bargains, which largely are being passed on to consumers. Despite the sales slowdown, buying in this year's first quarter was some 40% ahead of the same period last year, and the pace is expected to accelerate in the fall. But for now, and through the summer, VCR prices are the lowest they've ever been—and possibly the lowest for quite a while. **R-E**

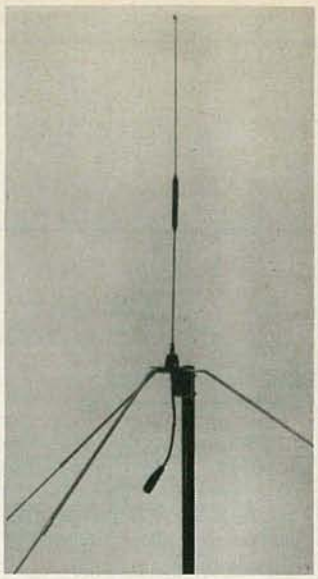
Super Scanner—the Ideal Base Antenna for Sophisticated Emergency Operations

For isolating and pinpointing the origin of emergency or commercial CB communications, there's nothing to compare with The Antenna Specialists' MS119 Super Scanner. This unique antenna is both a superb omnidirectional antenna with tremendous 5.75 dB gain and, with the twist of a knob, a high performance beam exhibiting 8.75 dB gain—like increasing your power seven times. It lets you search with the omni mode, then zero in for maximum range and clarity with the beam mode—all done instantaneously and electronically. The Super Scanner weighs just 17 pounds, is quite simple to assemble and is complete except for standard 50 ohm coax cable.



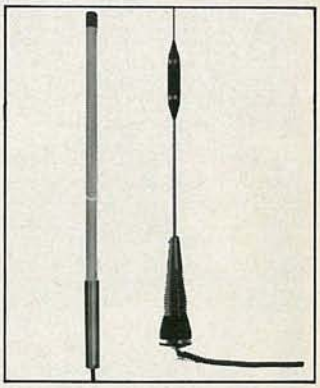
A/S Tri-Band Antenna Helps Get the Most Out of Your Scanner

Many scanner operators, especially those who have a serious purpose for their equipment, have discovered that the built-in whip antenna furnished with the radio simply cannot provide the range necessary to cover all the land mobile stations in their area that might be vitally important to their network. This is especially true in suburban and rural areas, or where portable radios are widely used. The Antenna Specialists Co. offers a wide selection of special antennas for monitor use, both base and mobile. Although some professionals and hobbyists prefer to install separate antennas for VHF and UHF coverage, most find the MONR31 triband model entirely satisfactory and very easy to handle and install. This unit is a high performance professional grade antenna that covers not only low band, high band and UHF but the "T" band as well, through 512MHz. Both the whip and 65" radials are finest stainless steel construction, and the slim, durable phasing coil is weatherproof. It comes complete with SO-239 receptacle (coax cable not furnished).



A/S Professional Antennas Just the Ticket for GMRS Applications

If you're into GMRS, you'll be interested in two models from The Antenna Specialists Company's extensive line of professional land mobile antennas that are especially suitable for typical GMRS applications. The ASP-705 Super Base Commander® is a high performance UHF collinear fiber glass unit exhibiting a minimum of 10 dB gain (RS329) and accomodating 250 Watts RF power (500 Watts with optional pigtail). Bandwith is 20 MHz (450-470 MHz). The antenna is wind rated at 128 MPH with a safety factor of 1.65. For mobile applications series ASPR660 is recommended for high performance, low profile configuration and lots of mounting options including roof, trunk lip, magnetic and cowl. Two precisely phased ⅝ wavelength collinear radiators provide 5 dB gain at the horizon.



WHAT'S NEWS

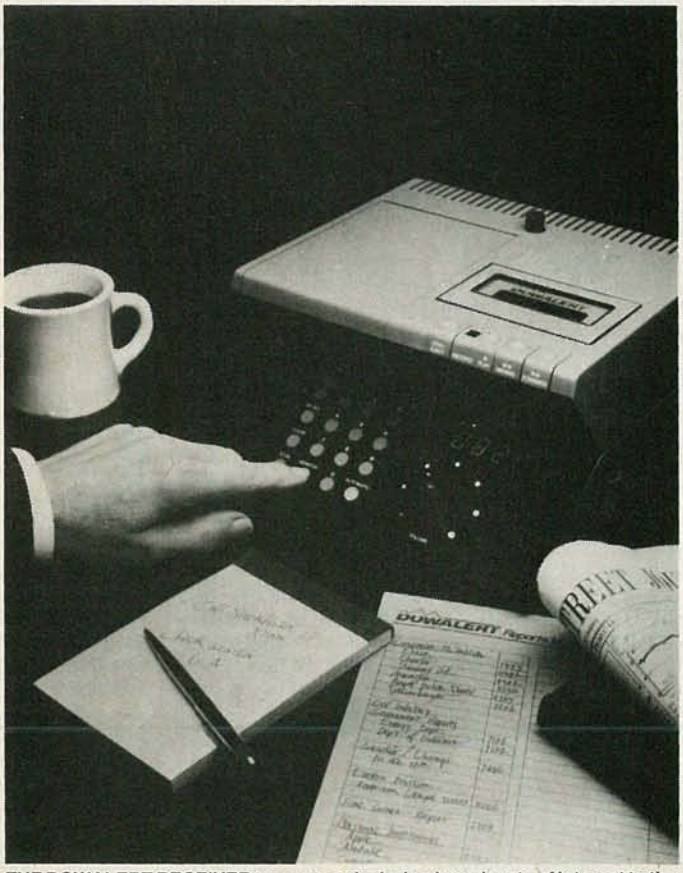
Listener-selected radio news service

A business news service, Dowalert, that permits the subscriber to select only the type of news desired is being put into service by Dow Jones Radio 2, a subsidiary of Dow Jones, Inc.

The programming originates from studios near Princeton, NJ, and is beamed by satellite to FM stations in various cities. Those stations relay the coded transmissions to specially designed, private-frequency receivers. The system was scheduled to begin last month (May), with service in the Boston and Philadelphia areas; service in other cities is also planned.

Each receiver is provided with a keypad and memory storage for up to 10,000 codes. To set up the receiver, the subscriber looks up the code for a desired topic, presses MEMORY ACCESS, the 4-digit code for the desired subject, and ENTER. The subscriber may select any number of topics.

With the control set to AUTOMATIC, the receiver will turn on when information on any of the desired topics is transmitted; it can also record the reports for playback later. On MONITOR, the receiver is always on so that the subscriber can listen continuously to everything transmitted.



THE DOWALERT RECEIVER turns on only during broadcasts of interest to the listener. A built-in recorder allows those broadcasts to be played back at a later time.

Solar generator to power new French satellite

AEG-Telefunken has announced that it is designing a solar generator system for a new French satellite, SPOT, that is scheduled to go into earth orbit in 1984. The satellite will examine the Earth's surface with two special-purpose cameras. Their object is to locate areas that would be suitable for agriculture or forestry, as well as to monitor water levels and predict crop production.

THE FRENCH SATELLITE, SPOT, will be powered by an AEG-Telefunken solar generator.

The solar generator to power the satellite will measure 16 square meters (about 19 square yards) and is made up of 2- × 4-cm (0.8- × 1.6-inch) solar cells. When completed, the generator will cost over 2 million dollars and supply one kilowatt of power.

The generator will be stowed in a narrow box during the launch, and will be extended fully as soon as the satellite reaches orbit. The solar paddles will be directed automatically toward the sun at all times.

Video sales to double within next five years

The consumer electronics industry will double its growth in both unit and dollar sales over the next five years, Jack K. Sauter, group vice president and general manager of RCA's Consumer Electronics Disivision, told a press conference early this year.

Mr. Sauter expects the principal video products of the industry—television receivers, VCR products, videodisc players, and video software—to go over $10 billion in retail sales this year, to expand beyond $15 billion in 1985, and escalate to more than $26 billion by the end of the decade. The predicted growth of the industry is due to two basic elements, according to Mr. Sauter.

One of those is the growth of the number of video sources that will be available to U.S. television households, including the videodisc, the VCR, home computers, video games, cable TV, satellite broadcasting, and others.

The other, the continued growth of the industry's basic product—color television, will be stimulated by many new technological developments. "We will see new automatic features, sophisticated remote control, new design configurations, opportunities in specialty-type television—projection TV and monitors—as well as true stereo sound," said Mr. Sauter.

QUBE cable installs computerized telephone

A computerized telephone system, designed to provide quick and efficient customer service to the 55,000 subscribers of the Warner Amex QUBE cable system of Columbus, OH, has just been installed.

"It not only allows us to handle the communications needs of our large number of subscribers more efficently," a QUBE spokesman said, "but we will also be able to analyze how we can serve them better. For instance, if we need more manpower at certain times of the month, this phone system will tell us."

To that end, the computerized system is able to analyze call volume and route traffic to customer service representatives with a minimum of delay. Diagnostic systems provide instant readouts in such vital areas as call-volume handling (including the time spent for each transaction), length of time on hold before assignment to a customer service representative, and complete statistics on abandoned calls.

Warner Amex Cable Communications operates 146 systems in 27 states, servicing more than 900,000 subscribers. It also operates three satellite networks delivering programming across the United States. **R-E**

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VISE-GRIP® 6LN* Introduced July, 1980

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(Shown Actual Size)

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Longer and even stronger jaws with more muscle for heavy-duty jobs. Plus built-in wire cutter.

Same VISE-GRIP® quality materials.

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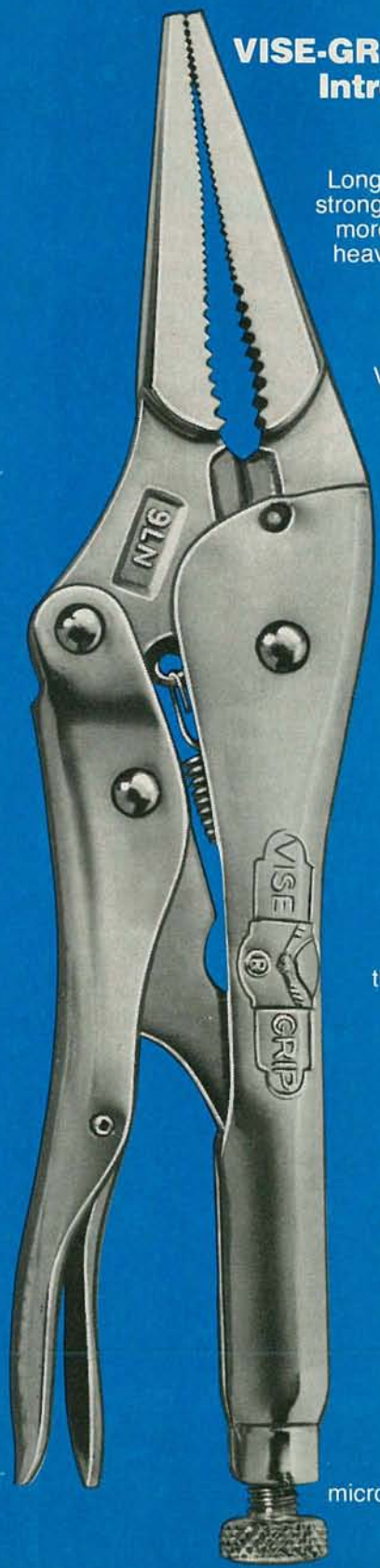

(Shown Actual Size)

Same easy release trigger and micro-adjustment screw.

They do more jobs, faster and easier, than any other long nose pliers.

VISE-GRIP®

*U.S. patent D261,096.
Other U.S. and foreign patents issued and pending.

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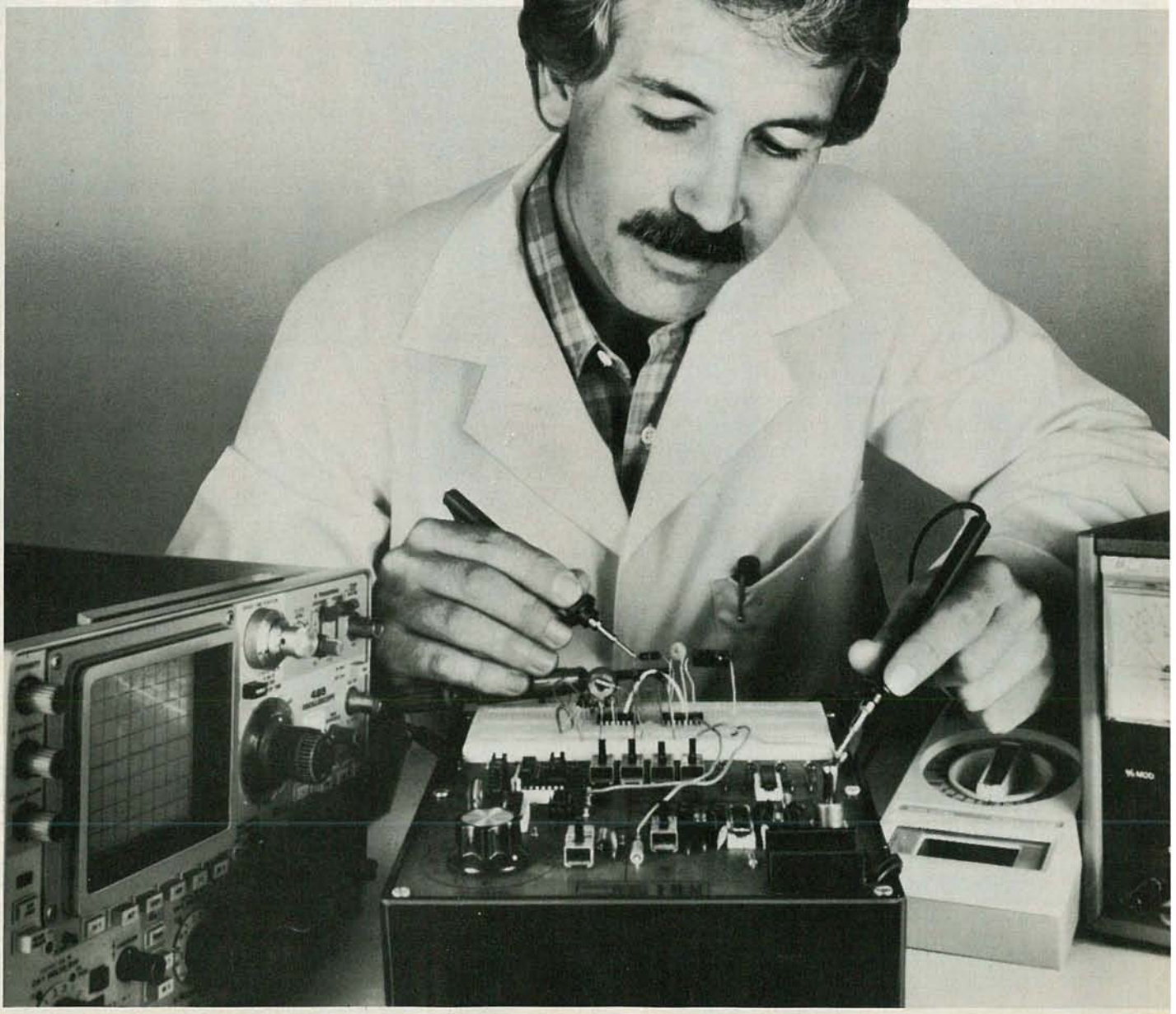

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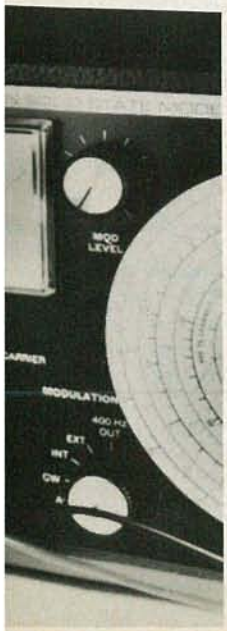

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SATELLITE/TELETEXT NEWS

GARY ARLEN
CONTRIBUTING EDITOR

MULTI-BEAM ANTENNA

Hughes Communications, the Hughes Aircraft satellite subsidiary which plans to launch several birds for cable programming, has developed a system to modify earth stations so that they could pick up simultaneous reception from two adjacent satellites. The cost for the add-on feature would be about one-third the expense of building a second earth station. It involves replacement of single antenna feeds with a dual-beam feed system. Signals from each satellite are reflected off the parabolic surface of the antenna to the dual-beam feed center, which is suspended from an adjustable support structure. That permits the earth station to pick up signals from as many as 48 transponders on two birds if the necessary receivers are in place.

The dual-reception equipment will become particularly handy by 1983, when Hughes' Galaxy I goes up; it is slated for anorbital slot of 135° West Longitude, right next to Satcom III-R, which is at 131°.

GIANT LEAP FOR DBS

The FCC has decided that it will consider eight proposals for Direct-Broadcasting Satellite systems. A total of 14 DBS proposals were submitted to the FCC last year, but the Commission ruled that six of them were "unacceptable," primarily because they didn't include sufficient technical information. In its decision to accept the eight applications, the FCC pointed out that the actual future of DBS is very unclear. There will be no decisions about which of the current eight plans will actually be permitted into operation—and the FCC stresses that it could take several more months for a set of DBS rules to be completed. After that it would probably be three years before a DBS system is built and launched.

The eight applications for DBS which were accepted for consideration came from CBS, Direct Broadcasting Satellite Corp., Graphic Scanning Corp., RCA American Communications Inc., United States Satellite Broadcasting Co., Video Satellite Systems Inc., and Western Union Telegraph Co. Part of the application by Focus Broadcast Satellite Co., which proposes to provide DBS via Western Union's Advanced Westar bird, was also accepted. Earlier the Commission had decided to consider the proposal of Satellite TV Corp., a subsidiary of Comsat; that action triggered all of the other proposals for DBS systems.

MORE TELETEXT TESTS

WGBH-TV, in Boston, will begin a teletext trial later this year, using French teletext equipment. Initially, 20 receivers will be placed in public locations (such as schools, libraries, and shopping centers) and around town. The 12-month test will involve transmission on both public-TV stations there: Channel 2 and Channel 44. The service will include captioning of public-TV shows as well as news and other community information pages.

In Seattle, KIRO-TV Channel 7 will begin an experiment using British teletext equipment. The teletext pages will include traffic conditions, stock-market data, ski-condition reports, information for hearing-impaired viewers, and other material. Test terminals are now planned for use in public locations.

AROUND THE SATELLITE CIRCUIT

New Intelsat: Intelsat V is now orbitting at 15° East Longitude, approximately over the Intelsat In-Orbit Test station operated by Telspazio, the European experimental bird. The initial position of the two-ton satellite (launched in December) is only temporary. The folks at Intelsat are still deciding whether the high-capacity satellite should be moved to a spot over the Indian Ocean at 62° East or if it should replace one of the existing Intelsat V satellites over the Atlantic Region.

Proposed Bird: American Satellite Co., which has been transmitting most of its business-oriented traffic aboard leased Westar transponders, now wants to operate its own domestic satellite. The proposed system will include three "hybrid" satellites, two in-orbit and one on-ground spare. Each hybrid bird will have the capability to operate simultaneously at C and Ku-band frequencies. The new Ku-band capacity will be used by business and government customers for private network service. ASC, which needs FCC approval before it can go ahead with its plan, hopes to launch its first satellite by October 1985. **R-E**

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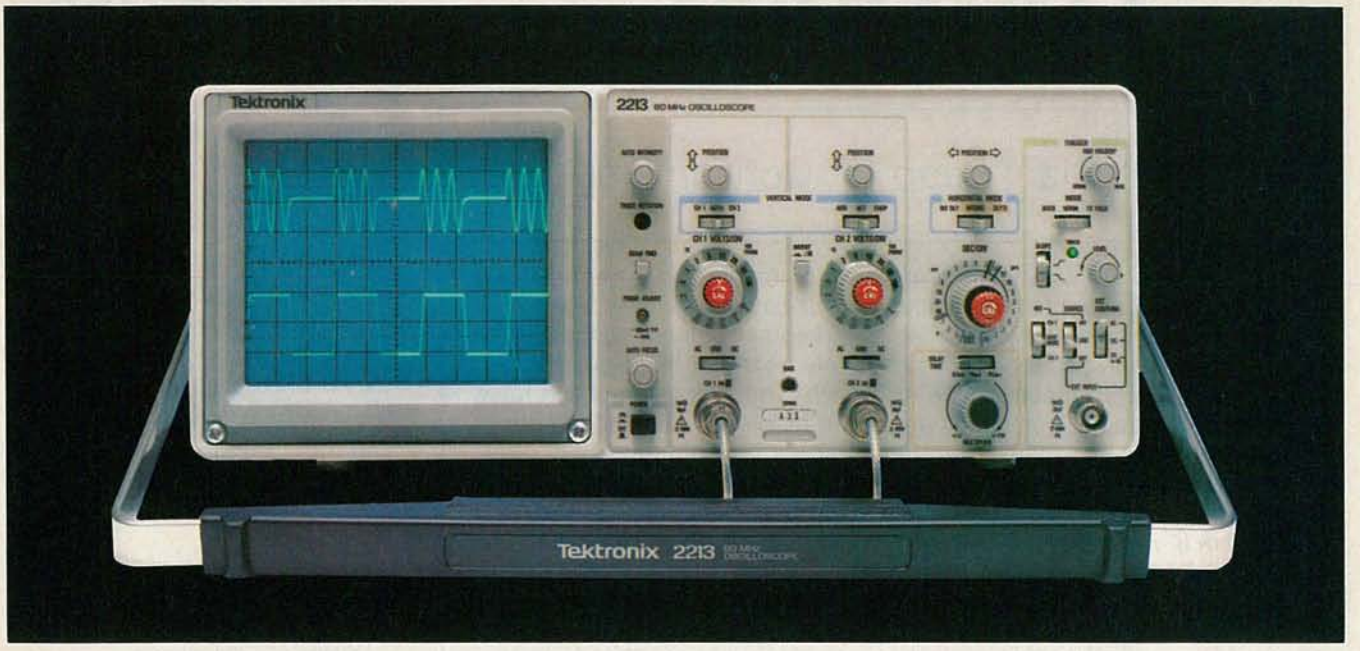

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EDITORIAL

One Giant Leap for Consumers

We live in an era when consumer-electronics products are making a continuous and ever-growing impact on our day-to-day lives. Electronics is blazing new trails in video entertainment, home computers, and even kitchen appliances. Unfortunately, many of those amazing new products are not compatible with each other. As a result, we have two different videotape systems and three different videodisc systems—to list just two major examples. Recent history makes it appear that, whenever they can, manufacturers would rather do battle with each other to win the acknowledgement that "their system" is the best, than to introduce compatible consumer products. Ultimately, we consumers are the losers in these wars.

It is tough enough for the consumer to decide simply that he wants to own a videocassette or videodisc system. But he must also agonize over which non-compatible system he should purchase. The decision would not be so difficult if it were made only on the basis of preference, but very often the consumer is betting his hard-earned dollars on the hope that the system he purchases will be around for a while.

Remember quadriphonic 4-channel audio? There were only three major competing systems. The manufacturers fought gallantly until, finally, all three systems were buried—but not before many CD-4, QS, and SQ records, decoders and systems were sold. If you own one of those systems, when was the last time you were able to buy a CD-4, SQ or QS-compatible recording?

Making the consumer the final judge of which system is to become the standard did not always exist. In times gone by, manufacturers produced and marketed compatible formats. The Philips audio cassette is just one such example. All manufacturers embraced the Philips-standard cassette. Instead of stifling competition, the single format enhanced competition and caused the demand for that new product to explode. Pre-recorded cassette tapes become widely available and the new audio product flourished in the marketplace until it toppled the then top ranking format—open reel.

Manufacturers of consumer-electronics products have not been concerned with compatibility for many years. Yet, recently, out of Japan comes a ray of hope. Engineers from Matsushita, Sony, Hitachi, JVC, and Philips have agreed on a standard for ¼-inch all-in-one VCR/camera combinations.

I could chastise those same manufacturers for not agreeing on a single standard before videodisc systems or Beta and VHS VCR's were brought to the marketplace, but that would not serve any useful purpose. Instead, let's cross our fingers and hope that the new format will flourish. Maybe, just maybe those manufacturers will re-learn the advantages of compatibility.

ART KLEIMAN
Editor

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LETTERS

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THE RC111 MODULE

In your March 1982 issue ("Hobby Corner"), "Doc" Savage did an article on the RC111 Module for use in constructing a capacitance/resistance meter (digital) using a cheap calculator. He gave the name and address of the supplier of the module: Kaltek, Box 7462, Rochester, NY 14615.

I sent for the module, which arrived very soon—much sooner, I would add, than most other mail-order goods I've bought. I constructed the circuit described in **Radio-Electronics**, but couldn't get my calculator to work with it. I wrote to Kaltek on March 21st, from Florida, seeking advice. On *March 29th* I received a handwritten letter of some two foolscap-size pages, together with circuit diagrams, describing in detail what I might try to solve my problems. It was further suggested that "if all this fails" I could return my calculator and module for testing.

To condense this as much as I can, I *did* have to return the module and my calculator. Within *four days* I received a postcard from Mr. Ben Johnson of Kaltek, stating that he had "received goods OK" and hoped to have a look at them over the weekend. On the Tuesday following that weekend, I received a small parcel. Upon opening it, I found my calculator plus module *plus*—Mr. Johnson had completely rewired same, using his *own* components—and the whole thing was in working condition. Mr. Johnson told me, in his enclosed letter, that he had accidentally shorted my calculator batteries during the wiring, and enclosed not only a replacement set but two further ones.

I can only wish that there were more like Mr. Ben Johnson in this world. He certainly deserves to get on, and I wish him all the success in the world.

Let met add that I have no connecton with either Mr. Johnson or Kaltek, and had never heard of the company before reading about them in "Doc" Savage's department.

Y. BARKER,
Key Largo, FL

CABLE TV

In response to Mr. David Wagner's letter in the April 1982 **Radio-Electronics**: We would like to suggest that perhaps Mr. Wagner should investigate further into the rules and regulations in his area regarding the installation of television cable by persons other than the company providing the service.

Here in Southern California, it is customary

continued on page 22

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LETTERS

continued from page 16

for the owner/builder to provide for cable-television pre-wiring through a private contractor. The local cable-operating company not only encourages that, but will often provide the material at no cost to the contractor.

The cable-operating company must still make the final connections to the building and the television sets.

Perhaps those regulations are the same in other areas.

AUDIO VISION COMMUNICATIONS,
Robert J. Hill, owner,
Burbank, CA

THOSE UNIQUE PROJECTS

When I started to read "Six Unique Projects for Your Car," in the April 1982 **Radio-Electronics,** my first thought was that I was reading an article by the two most incredibly naive writers in the electronics industry. But I soon discovered that the shoe was on the other foot! Hats off to Messrs. Gartman & Weinstein, the Laurel & Hardy of the electronics magazines.

TERRY WHITE,
San Antonio, TX

ROAD-INFORMATION SYSTEM

I'd like to comment on the article, "Automatic Road-Information Service" that appeared in your March, 1982, issue.

The German Blaupunkt system works, and works well; it is the solution *if* we assume that it occupies a "little-used" sub-carrier spectrum. However, SCA as an industry, although grossing millions of dollars and providing a wise venture for investment, is barely in its infancy. Do we really want to fill up the SCA bottle with traffic information?

From a technical standpoint, the use of commercial FM stations' SCA for traffic information is a bit impractical as to immediate need. Such information systems can only deliver general information on the conditions in a wide area, and cannot be used to localize data on traffic or road conditions.

I have investigated the approach thoroughly, and feel that it would have been good at the turn of the century, but that it falls far short of present and future needs.

As development is continuing on my KQ2 FM broadcast system, traffic needs have been taken care of using 10 Class-T traffic channels. Those channels are located at the top and bottom of the FM dial, below 88 MHz and above 108 MHz. The channel spacing is 71.5909 KHz. A highly compressed mono audio channel provides aural traffic information from community PR stations, or from roadside transmitters. An18-kHz pilot is used to control subcarrier information. The subcarrier information, where present, provides the automobile with digitalized information about traffic conditions. The highly directive nature of FM VHF is used productively to control only the designated areas. Two low-frequency tones amplitude-modulate the FM carrier to identify which end of the dial is being read, and can provide priority control. The KQ2 Class-T traffic system has the advantage of adapting itself immediately to existing FM radios, does not interfere with commercial FM or SCA use, and can be expanded into highly sophisticated control criteria as the technology advances.

When the KQ2 commercial FM system is finished, we will be broadcasting high-detail, full-color pictures over FM stations broadcasting on mono, stereo, and quadraphonic, and with or without SCA. That is done by amplitude-modulating the FM carrier at 57 kHz. To attempt combining that with 57-kHz ARI services poses some limitations for FM receivers at the limiting threshold.

At the present time, we just do not have sufficient working information on the peculiar combination of ARI and KQ2 picturevision to say categorically whether they will or will not be able to co-exist. Certainly, from the disastrous quality of modern FM transmitters, I tend to favor the negative.

In the past decade, we have seen the "technically" inappropriate and impossible applied to FM transmitting antennas and transmitters. The result is a significant reduction in Class B and C station coverage. Due to the wrong transmitting antenna design, the reliable fringe reception of FM stations beyond 65 miles is almost a thing of the past. Due to the wrong approach to FM transmitter design, the distortion produced by those de-

continued on page 24

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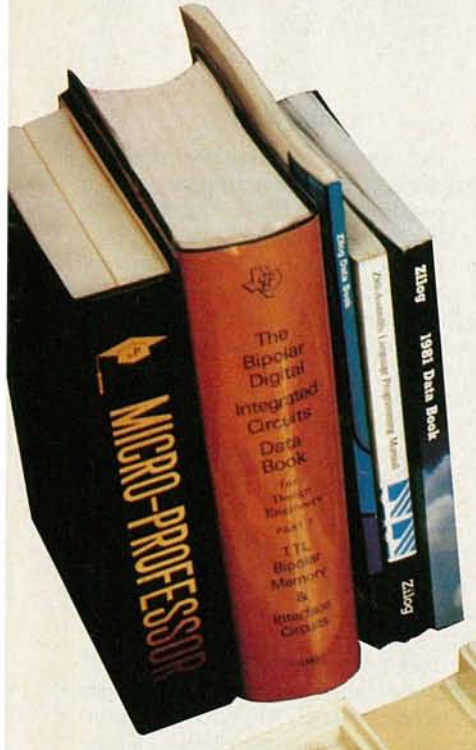
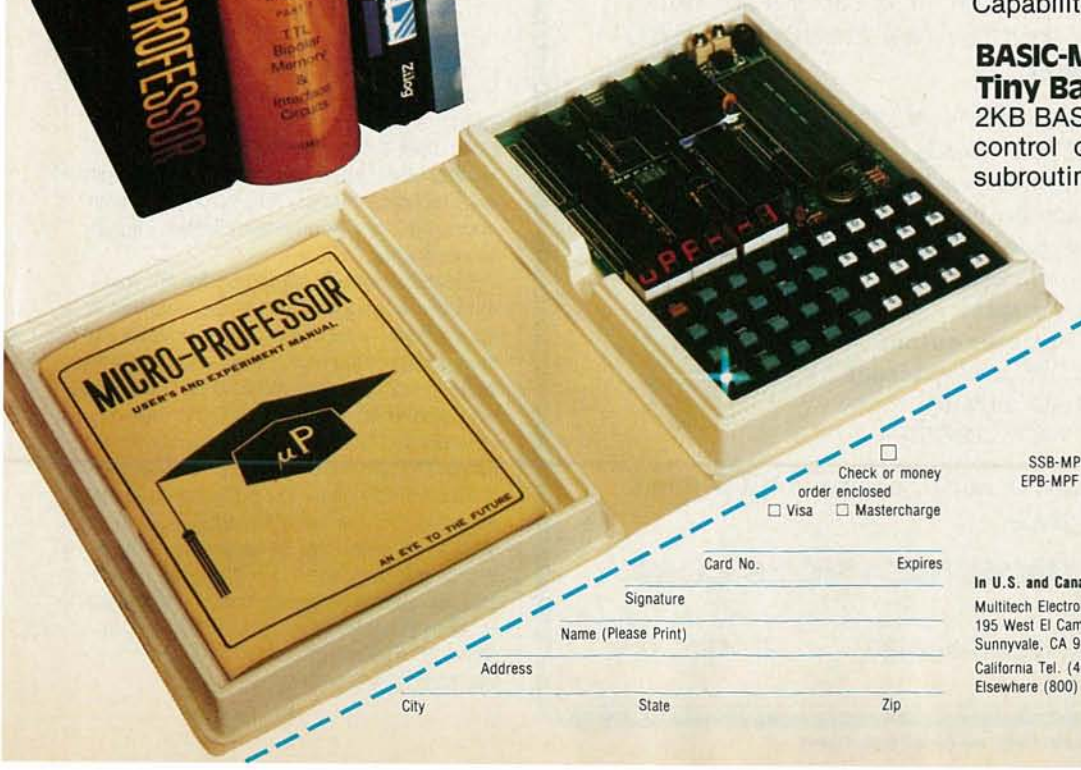
The standard 2K bytes of RAM is expandable to 4K, and the standard 2K bytes of ROM can be increased to 8K.

All this plus a built-in speaker, a cassette interface, and sockets to accept optional CTC/PIO. Bus is extendable.

As well as being an exciting learning tool, the Micro-Professor is a great low-cost board for OEM's. Call for details.

* Z80 is a trademark of Zilog Inc.





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LETTERS

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vices far exceeds the FCC's specifications. Impossible, you say! Not at all. The way distortion is measured is by the fixed-tone method, which tells you absolutely nothing about the behavior of an FM transmitting system under actual operation. In fact, if it were not for the energy-interleaving of stereo-FM sidebands, we would not be able to tolerate audibly most stereo-FM stations.

It is a common misconception that 10-watt or even 20-watt FM exciters are developed and receive an FCC certification, that the distortion and stability figures obtained will go on to become the feeding sources for RF on large transmitters, having similar distortion and stability figures. *Wrong!* The powerful RF field emanating from the transmitter permeates the exciter system. Since the FM is FM, no one can predict the feedback phase of that system during dynamic operation. One only has to compare a transmitter that is 25 years old with a brand new one to appreciate how far FM has slid.

Most of today's FM receivers selling for $300.00 up, far exceed the attainable quality of FM-transmitting systems, and many of the over-$500.00 FM receivers do not have the performance of their $300.00 counterparts, because they are based on add-on engineering, without much attention being paid to ACG or dynamic range, or even long-term stability on extremely high-gain systems. Remember the old Grundig and Telefunken tube FM receivers? Those babies can still run rings around most very expensive new receivers. Sure, the distortion may be higher, and the sensitivity may not be as great, but those sets were real performers, even with the ugly brown and ivory lacquer exeriors. It always hurts me very much when I have to put one of them asleep for bad switches.

CHARLES E. KOONTZ,
E-S-H Systems,
Fairfield, IL

ON NIKOLA TESLA

I was delighted to read Mr. Powell's tribute to Nikola Tesla in "Letters" (February 1982, **Radio-Electronics**). My regard for the man was heightened greatly by an incident on a patent application some years back. In that application, which related to a printed-circuit motor, one of the 12 claims was disallowed as having been anticipated by Tesla in 1908, in spite of its dependency on new technology for its realization! Quite a mind, quite a man.

GERALD L. BERNIER,
Nashua, NH

TELETEXT

Mr. Acton's letter about teletext in the April 1982 issue of **Radio-Electronics** needs a response. He asked to be corrected if wrong on how our current National Television System Committee (NTSC) color-television standard was adopted. He is correct in noting that the FCC standard resulted from a committee effort and was not "handed down from on high by the FCC."

What I think that Mr. Acton fails to appreciate is that it was the adoption of the NTSC recommendations into a uniform, nationwide standard that made color television prosper in this country.

The FCC is mandated by the Administrative Procedures Act to request and consider public and industry comments. That is done in the form of Notice of Inquiries (NOI's) and Notice of Proposed Rule Makings (NPRM's). I don' think that anyone at the FCC has ever felt that he or she had some privileged insight on a technical matter. The FCC has always encouraged and sometimes pleaded for public comments.

Establishment of standards for RF transmissions is a logical and proper function of government. I submit that color television, FM stereo, captioning for the deaf, and other services would not have thrived if the FCC had not established standards for those services. I predict that the lack of such standards will hamper the growth of teletext and AM stereo.

Yes, it is difficult for the FCC to choose one standard. But the benefits of having a standard so outweigh the disadvantages of having no standard, that I say that even a decision by lottery between closely competing systems is preferable to no decision at all.

DANE E. ERICKSEN,
Alameda, CA

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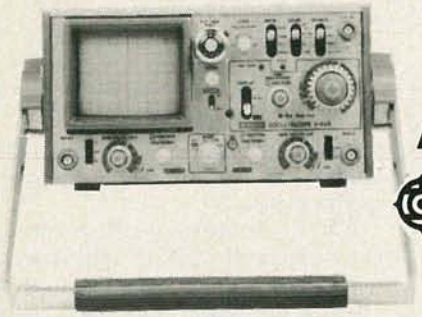

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A/D Converter: Dual slope converter, autozero, autopolarity.

Conversion: TRMS, AC coupled

Display Annunciators: BT, low battery indication.

REL, relative reference mode activated. [8060A: **(k)Hz,** frequency function activated. **dB,** dB function activated.] ⟶⟵ continuity activated.))), continuity tone activated.—,continuity detected indicator.

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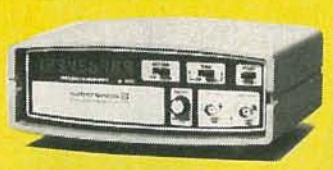
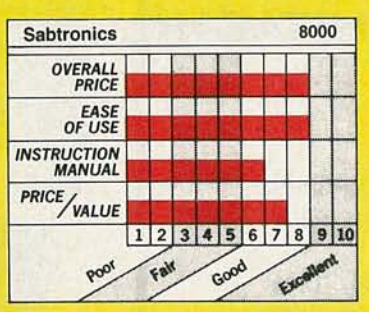
Sabtronics Model 8000 Frequency Counter





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FOR SOME YEARS, IF YOU OWNED A 600-MHZ frequency counter, it was good enough for the vast majority of communications servicing. Although the 450-512 MHz UHF mobile band is still considered the highest frequency range for most users, recent FCC frequency-block releases in the 806-960 MHz range have created a need for counters with a higher top frequency.

One such counter, especially recommended for those on a limited budget, is the Sabronics *model 8000*. That 9-digit counter has a frequency range of 10 Hz to 1 GHz, and there are some other rather impressive specifications.

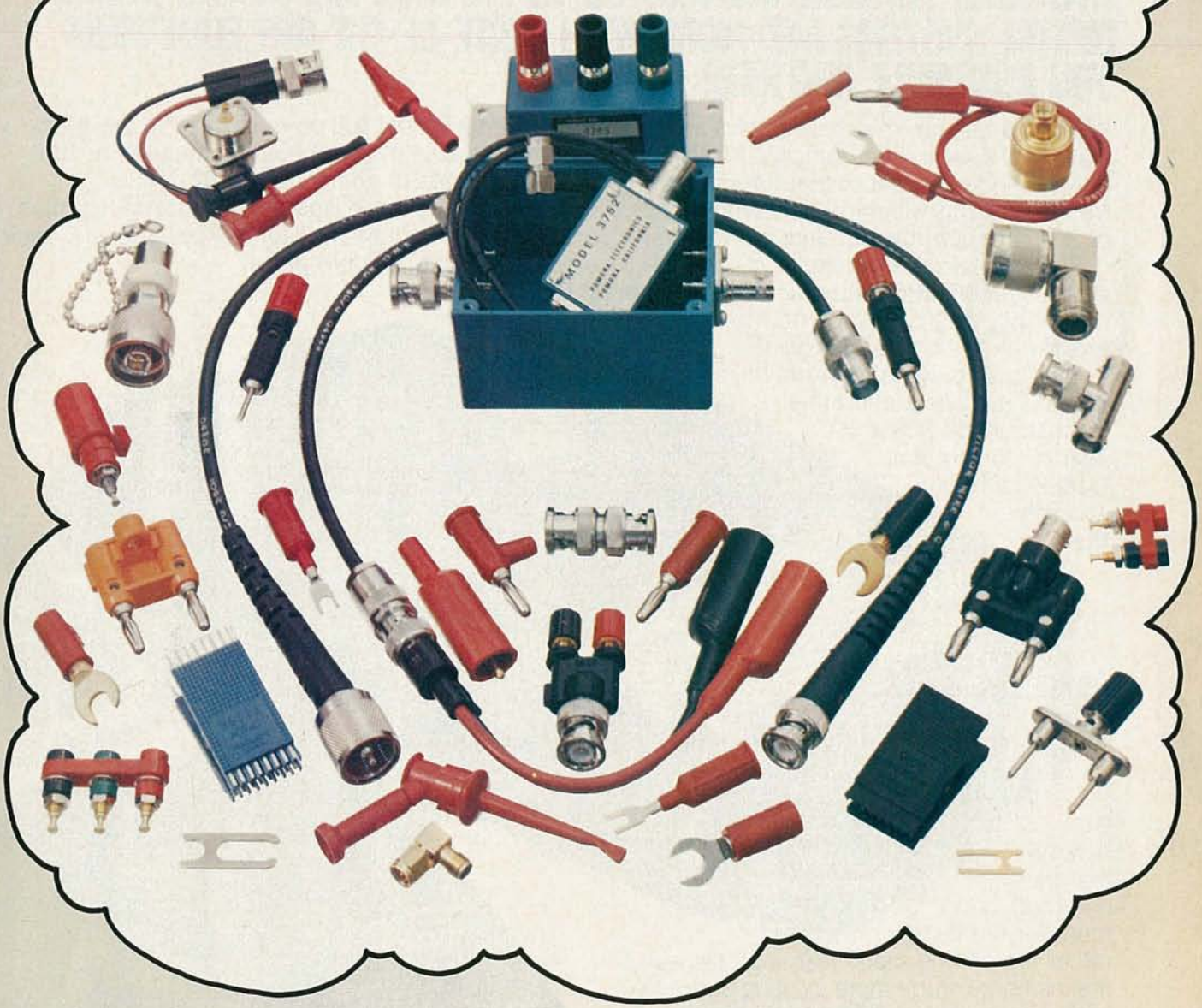
While it is common for the sensitivity of many counters to fall off with increasing frequency, that unit boasts 35-millivolt sensitivity at the top end of its range. For high resolution, three gate times, 0.1, 1, and 10 seconds, are switch-selectable. Normally, the timebase would be derived from a 10-MHz quartz crystal; our test sample, however, was supplied with an optional temperature-compensated crystal oscillator. (TCXO).

A front-panel sensitivity control allows the user to adjust the threshold for accurate counting. Separate BNC connectors are used for 10 Hz-100 MHz and 10 MHz–1 GHz inputs.

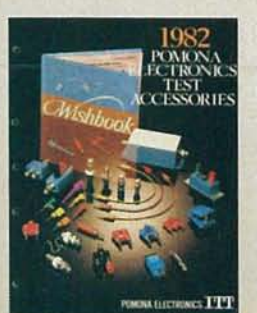
The nine-digit display features 0.4-inch

continued on page 32

I WISH I HAD...



OUR WISH BOOK CATALOG HAS IT.



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3. **The NTS/Heath HN-89A Microcomputer** features floppy disk storage, "smart" video terminal, two Z80 microprocessors, with 32K RAM Memory, expandable to 64K on board. 4. **The NTS/Heath GR 2001 Digital Color TV (25" diagonal)** features specialized AGC-SYNC muting, filtered color and new solid-state high voltage tripler rectifier.

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EQUIPMENT REPORTS

continued from page 26

LED characters and automatic decimal point positioning. Under most circumstances, the display can be easily read from anywhere near the test bench. Resolution (10-second gate time) is 0.1 Hz at 10 MHz, 1 Hz at 100 MHz, and 10 Hz, at 600-1000 MHz. Gating is indicated by a blinking LED.

The manufacturer's specification for sensitivity is better than 20-millivolts RMS at the lower frequencies, gradually increasing to 35 millivolts at 1 GHz. Input impedance is 1 megohm (100 picofarads) on the lower ranges, and 50 ohms from 10-1000 MHz. The temperature stability of the crystal oscillator is ±1 part-per-million (0-40°C), with a setability of ±2 parts-per-million. Among the available accessories are an AC adapter/charger, a probe, and a telescoping antenna.

Our test

Opening up the unit, we found an exceptionally clean layout designed around a wave-soldered glass/epoxy PC board. The temperature-compensated crystal oscillator supplied with our unit was a metal-enclosed, hermetically sealed module, rigidly mounted on a metal standoff.

Sensitivity was checked with a Hewlett-Packard laboratory generator and confirmed the manufacturer's claims. A few peaks and valleys were apparent in the sensitivity curve, but average sensitivity was well within the manufacturer's stated specifications. Jitter suppression appeared to be good; the last character does not continually "bounce around" as is found on many competitive digital instruments.

While 10 seconds may seem like a long time to wait for a display to sample, it is well worth the time for the extra accuracy.

Although it is possible that some interference to the instrument might occur as the result of its unshielded plastic cabinet, if a shielded cable probe is used, that should not be a problem in most applications.

If you are in the market for a 1-GHz frequency counter, and especially if you've got to watch your budget, be sure to check out the *model 8000* from Sabtronics International Inc. (5709 North 50th Street, Tampa, FL 33610); it will be well worth your time. It sells for $239.00. **R-E**

OVER THE LAST FIVE YEARS, THE TREND IN the microcomputer market has been toward putting more power in the hands of the desktop computer user. One of the biggest reasons for that has been the shrinking cost of memory and the increasing sophistication of microcomputer hardware. But the cost involved in setting up a reasonably powerful system is still considerable. It isn't unreasonable to spend $3,000 to $5,000 for a system consisting of a couple of disk drives, a video monitor, the keyboard, and the computer electronics, including 64K of *R*andom *A*ccess *M*emory (RAM), itself. It *is* possible, however, to get all of that, and more, and still spend less than $2000; and one way you can do that is to purchase Osborne

continued on page 36

Hitachi V-202 and V-352 Dual Trace Oscilloscopes

When you get exceptional capability per dollar, that's superior cost-performance. And that's the 35 MHz Hitachi V-352 and the 20 MHz Hitachi V-202 dual trace oscilloscopes.

Proof? Just skim these features, then note the price. For starters, both scopes have a 2-year limited warranty. And then there are features like square CRT's with internal graticules, vertical sensitivity of 1 mV/division, and a wide dynamic range for vertical amplifier of 8 divisions or more. Each scope features front panel X-Y operation, 10X sweep magnification, 3% vertical deflection and sweep accuracy, and low vertical drift. For ease of operation, functionally related controls are grouped into 3 color-coded front panel blocks.

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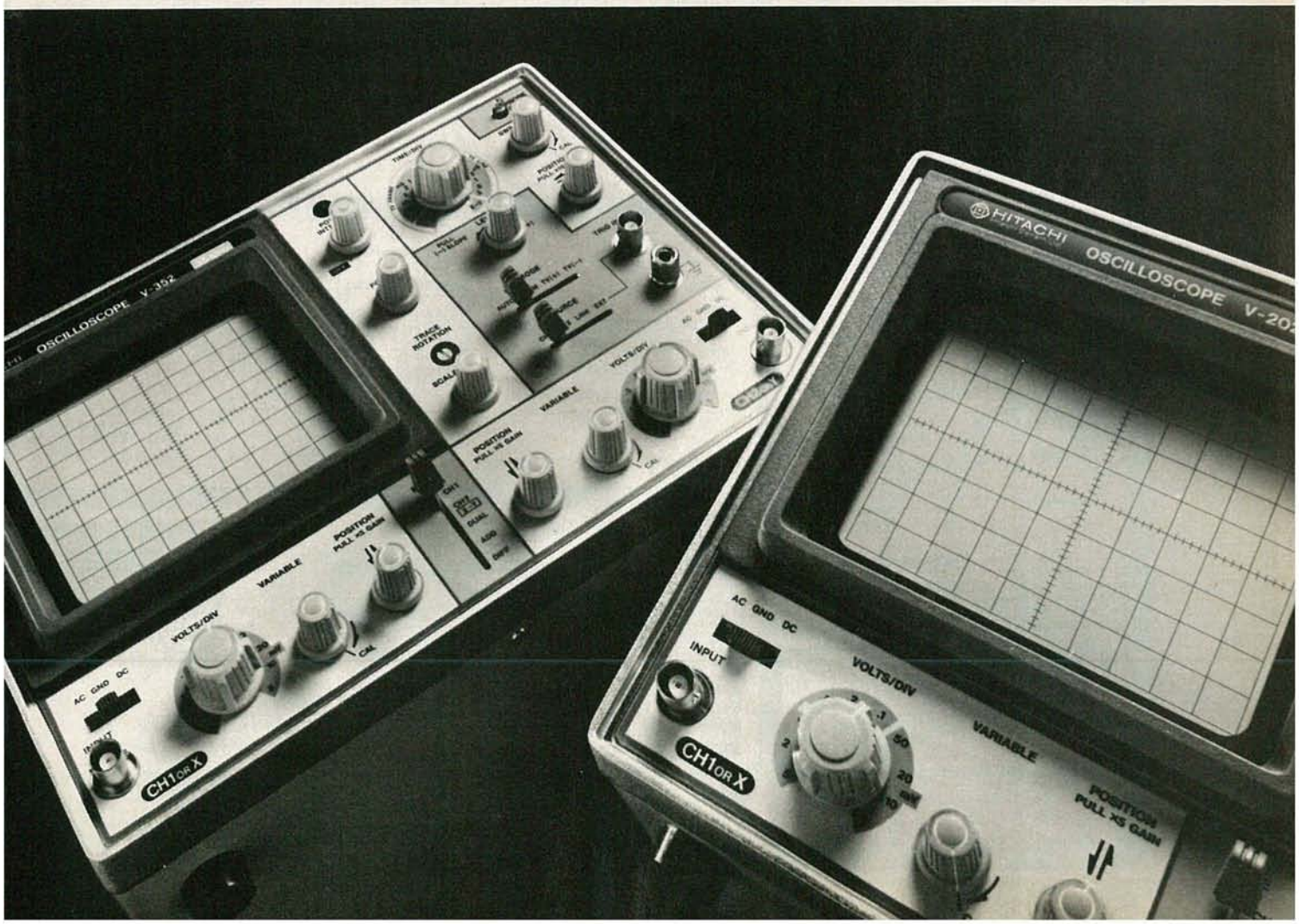

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● Frequency: 0.005 Hz to 5 mHz in 7 ranges. ● Outputs: Sine, square, triangle or haversine. ● Variable Amplitude: 20 V p-p, open circuit; 10 V p-p, into 50 ohms. ● Accuracy: ±5% F.S.

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● Frequency: 0.001 Hz to 5 mHz in 8 ranges. ● Outputs: Sine, square, triangle, pos/neg square, pos/neg ramp. ● Variable Amplitude: 20 V p-p, open circuit; 10 V p-p, into 50 ohms. ● Accuracy: ±(1.5% setting +1% F.S.), 0.001 Hz to 1 mHz; ±(2% setting +2% F.S.), 1 mHz to 5 mHz.

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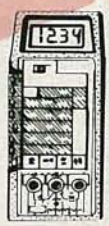

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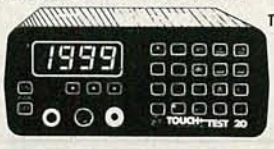

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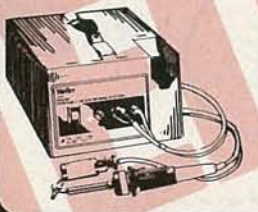

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EQUIPMENT REPORTS

continued from page 32

Computer Corporation's (26500 Corporate Ave., Hayward, CA 94545) new *Osborne 1* computer.

If the Osborne name sounds familiar, it is. The founder of the corporation is Adam Osborne, the author and publisher of many computer books and articles. With that system, he is staking a claim to the low end of the full-featured microcomputer market.

The *Osborne 1* is a turnkey system aimed at the business user or advanced hobbyist. It is also the first truly portable desktop computer. Weighing just 23 pounds, the unit resembles a small, 20½ × 13 × 9-inch suitcase, complete with carry handle and latches, when closed up. It opens to reveal two 5¼-inch disk drives, a mini-CRT, and a keyboard.

What is even more impressive, however, is the software package that the purchaser gets with system at no extra cost. It includes a *CP/M* disk-operating system, along with a *CP/M* utility package; a *WordStar* word processing system, complete with *MailMerge*; a *SuperCalc* financial planning package, and the *CBASIC* and *MBASIC* programming languages. It has been estimated that the cost of that software, would run between $800 and $1,500, if it were purchased separately. The software alone makes it an attractive package for the small business user.

That single-board computer is built around a Z80A microprocessor; the I/O ports interface directly with the board. Those include an RS-232C interface for connecting printers, modems, etc., and an IEEE-488 instrumentation bus. The keyboard connects to the main unit through a 10-inch long, detachable, ribbon cable. A connection is also provided for an external monitor (more on that later).

The 81-key keyboard is sloped, which would normally make it ideal for word-processing applications. There is one problem here, however. The "feel" of the keys is such that it would take extra effort for an experienced touch typist to use that keyboard. The keyboard also includes a 12-key keypad, with 10 user-programmable keys.

There are two other potential problems with the keyboard, or, more precisely, with its connecting cable. First, the ribbon cable is much more susceptible to wear than are other types. Second, the 10-inch length limits you somewhat in setting up the unit.

Starting up this unit is as quick as plugging in the three-pronged plug and flipping on the rear-mounted rocker switch. As for ease of operation, a series of screen prompts helps you out in loading the system and program software.

One major problem with the built-in video monitor is its size—it measures just 5 inches diagonally. For occasional field use, that monitor should be adequate. But if the unit is used on a continuous basis, a large monitor is almost mandatory. For those situations, a larger, 12-inch monitor is available as an accessory. The display system is memory mapped and offers full scrolling. That scrolling is especially useful for such things as word processing. The standard display size is 24 lines by 52 characters, but the width of the display can be adjusted.

A potentially serious limitation of the system is that it appears that no provisions have been made for future expansion. If a user needs a third or fourth drive, or wants to add an eight-inch drive for greater mass storage, he is out of luck.

The unit also tends to run on the warm side. An internal thermal cutoff opens when the temperature exceeds 150 degrees, but, for a greater margin of safety, I would have preferred a cooling fan. The power supply shuts down under overload conditions.

But there is one factor, despite the limitations we've pointed out, that makes this unit an outstanding value—that is its price. How else can one obtain a powerful Z80A-based computer system with 64K of RAM, complete with keyboard, video monitor, two disk drives, and a comprehensive systems- and applications-program package—all at a suggested list price of $1795.00? The *Osborne 1* is also recommended for those who need a truly portable computer for field work. **R-E**

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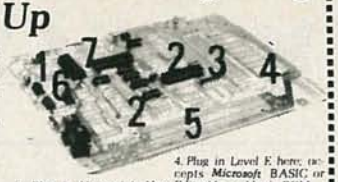
☐ Level A kit (Hex Keypad/Display Version) . . . **$129.95** plus $3 P&I.*



1. Plug in Netronics's Hex Keypad/Display
2. Add Level B to convert to S100
3. Add 4k RAM
4. Plug in Level E here; accepts *Microsoft BASIC* or *Editor/Assembler* in ROM
5. Add two S100 boards
6. Add you own custom circuits (prototyping area)
7. Connect terminal

LEVEL B — This "building block" converts the motherboard into a two-slot S100 bus (industry standard) computer. Now you can plug in any of the hundreds of S100 cards available.

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Level D kit: (CHECK ONE) . . . ☐ 4k on-board . . . **$49.95** plus $2 P&I.*; ☐ 16k S100 "JAWS" . . . **$149.95** plus $2 P&I.*; ☐ 32k S100 "JAWS" . . . **$199.95** plus $2 P&I.*; ☐ 48k S100 "JAWS" . . . **$249.95** plus $2 P&I.*; ☐ 64k S100 "JAWS" . . . **$299.95** plus $2 P&I.*.

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☐ 8k cassette version of Microsoft BASIC: (requires Level B and 12k of RAM minimum; we suggest a 16k S100 "JAWS" — see above) . . . **$64.95** postpaid.
☐ 8k ROM version of Microsoft BASIC: (requires Level B & Level E and 4k RAM; just plug into your Level E sockets. We suggest either the 4k Level D RAM expansion or a 16k S100 "JAWS.") . . . **$99.95** plus $2 P&I.*
☐ Disk version of Microsoft BASIC: (requires Level B, 32k of RAM, floppy disk controller, 8" floppy disk drive) . . . **$325** postpaid.

TEXT EDITOR/ASSEMBLER — The editor/assembler is a software tool (a program) designed to simplify the task of writing programs. As your programs become longer and more complex, the assembler can save you many hours of programming time. This software includes an editor program that enters the programs you write, makes changes, and saves the programs on cassettes. The assembler performs the clerical task of translating symbolic code into the computer-readable object code. The editor/assembler program is available either in cassette or a ROM version.

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JULY 1982

COMMUNICATIONS CORNER

A new design for a high-selectivity audio filter

HERB FRIEDMAN, COMMUNICATIONS EDITOR

MY INTRODUCTION TO THE USE OF AUDIO filters in communications was through an old National receiver with a "Select-o-ject," an audio-frequency device with very sharp tunable filters that allowed the user to boost or attenuate signals, or to attenuate annoying heterodyne-interference. That feature, though, never made much headway against crystal and mechanical filters.

Tunable filters did have some limited success as aftermarket devices, but the idea fell dormant for many years until the introduction of integrated circuits, which made it possible to manufacture a very effective peak/notch audio filter at a budget price—a particularly attractive package for low-cost receivers with no built-in filter.

Although the audio filters were often touted as "a new breakthrough in the state of the art," they were essentially just op-amp bandpass filters straight out of the textbook. One version worked just about as well as any other. At least, that's the way things appeared until recently, when I came across what can truly be described as a "new concept" ... though I'm certain that some reader will write in to tell me that he used the same idea 40 years ago.

Actually, the "concept" is that of using an active device, such as a transistor or integrated circuit, to simulate a variable resistor in an amplifier's gain loop. I first ran across it in a spectrum analyzer add-on for the Radio Shack *TRS-80* computer that used the impedance of an active circuit—an amplifier—in the feedback loop of an op-amp to control the op-amp's gain. That gain was determined by a DC bias applied to the active feedback-controller, rather than by fixed resistors. It was a cute and effective idea, and I wondered why I hadn't seen it before in consumer or service equipment.

As it turned out, other people must have had the idea at the same time, for that same week I was loaned a Bencher *XZ-2* audio filter (from Bencher, Inc., 333 W. Lake St., Chicago, IL 60606) for communications receivers that uses essentially the same principle to deliver what is almost unbelievable performance. The unit is shown in Fig. 1.

FIG. 1

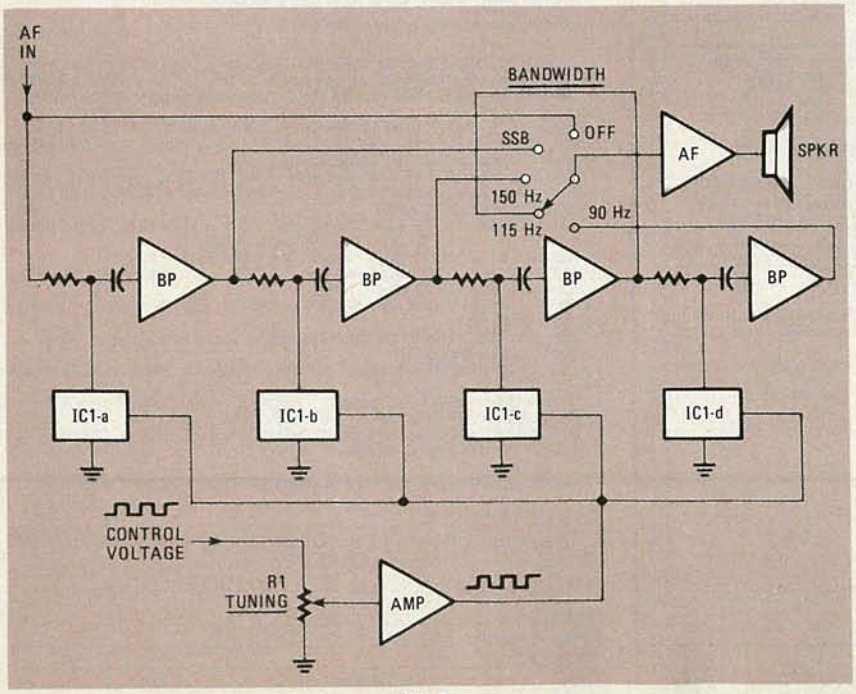


FIG. 2

The design of the device starts off like that of many other audio filters intended for shortwave listening, in that it uses multiple bandpass (BP) filters in series to provide a very narrow audio bandpass. But, unlike most other units that have two filter stages, this one has four cascaded stages of bandpass filtering, with each stage's output tapped (by a selector switch) to provide filter bandwidths of 90 Hz, 115 Hz and 150 Hz for CW, and 2500 Hz for SSB. There is also an OUT position on the switch that bypasses the filters. The filter's output is fed to an LM380 audio amplifier IC that provides approximately 1 watt of output for headphones or a speaker. The input is taken from the speaker terminals or headphone jack.

What makes that audio filter different from the others? The way it's tuned. Normally, a 4-gang potentimeter would be required to tune the four cascaded filter-stages; the Bencher unit uses just a single pot to do the job, as we'll see shortly. It's very difficult to get each section of a 4-gang pot to track the others precisely. And, if they don't, the overall performance of the filter is reduced. For that reason, audio filters for communications receivers often use two high-Q dual-stage filter sections. When a very narrow bandpass is needed, it's usually attained by cascading the two filters, each with its own tuning control (potentiometer).

Those of you familiar with high-Q filters are also familiar with the "ringing" they cause. The Bencher device, though, has almost no ringing because its filters are relatively low-Q; it depends on very precise filter-tracking for its selectivity.

Figure 2 shows how it's done. The feedback-filter network for each bandpass filter is represented by the resistor and capacitor at each input and by the impedance represented by a sector of IC1, which is a quad switching-integrator IC. The tuning control, R1, determines the pulse width of a square wave fed to the switching integrator. The effective impedance of the integrator, and hence the tuned frequency of each filter, is determined by that pulse width. Since the four sections of the switching integrator are matched, they track precisely when the control-voltage pulse train is applied to the integrated circuit.

With the tracking optimized, it's no longer necessary to design for a high-Q in order to secure a sharp passband, so a low-Q filter-design can be used to reduce (or eliminate) ringing. **R-E**

NEW IDEAS

Meter adaptor

MOST WORKBENCH-TYPE VOM'S HAVE A sensitivity of 20,000- to 30,000-ohms-per-volt and a reasonably high input-resistance on the higher voltage ranges. On the lower voltage ranges, however, the meter itself often loads the circuit heavily, and good accuracy on those ranges is a problem. The simple project described here can greatly reduce that problem. It increases the meter's input impedance considerably, and can be used with meters having sensitivities as low as 1000-ohms-per-volt.

The heart of the unit is an LF13741 op-amp. That op-amp is a low-cost device (usually less than a dollar) that has a J-FET input circuit. When it is connected as a voltage follower, the gain of the op-amp is almost exactly one, but its input impedance at room temperature is nearly a million megohms and its output impedance is less than one ohm.

The complete circuit is shown in Fig. 1. When two 9-volt batteries are used for the power supply, input voltages to ±8 volts can be applied; the input-voltage range can be increased up to ±18 volts, the maximum rating of the op-amp, if four batteries (two batteries in series instead of one as shown) are used. Since the current drawn by the circuit is only about 2 milliamps, good battery life can be obtained using even standard-duty batteries.

As the offset voltage of the LF13741 is only about 5 millivolts, no offset trimmer is required; the offset terminals (pins 1 and 5) are left floating. Resistor R1 and switch S1 are optional. If they are included, you will be able to switch from the op-amp's high-impedance input to a standard 10-megohm input simply by closing the switch; there is no need to disconnect the adapter from the meter. To keep things as simple as possible, the circuit has no input-over-voltage protection; be sure to keep the input voltage below the supply voltage of the op-amp.

The adapter can be built by using any technique. The prototype was built on perforated construction-board; the op-amp was mounted in an 8-pin DIP socket. If you can't get (or don't want to use) the LF13741 op-amp, a standard 741 can be used. In that case, the input impedance will typically be only 50 megohms, but that is still much better than the meter itself. The 741 can be substituted directly for the LF13741, provided that the 8-pin DIP version of the device is used. Other J-FET input or standard op-amps can be used, but some changes in the circuit may be needed.

One thing that I did, that you may find interesting, was to build the adaptor so that it could be mounted directly onto the meter. To do that, use plugs that match the input jacks on the meter as the adaptor's output terminals. Space them on the perforated board (or whatever else you used) so that they line up with the meter's input jacks. That will allow you to simply plug the adaptor into the meter, eliminating extra leads between the two for a much neater appearance. The test leads plug into the adaptor's input jacks.—*H.E. Fellhauer*

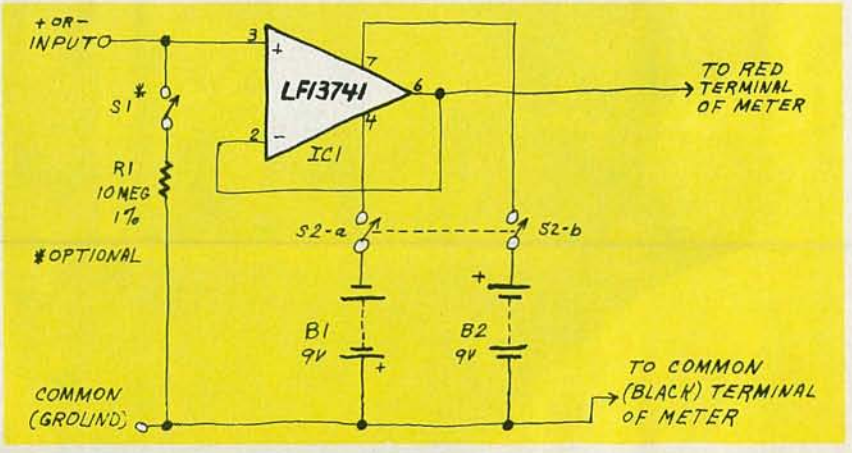
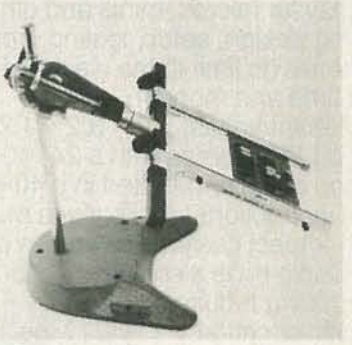


FIG. 1

NEW IDEAS

This column is devoted to new ideas, circuits, device applications, construction techniques, helpful hints, etc.

All published entries, upon publication, will earn $25. In addition, Panavise will donate their *model 333*—The Rapid Assembly Circuit Board Holder, having a retail price of $39.95. It features an eight-position rotating adjustment, indexing at 45-degree increments, and six positive lock positions in the vertical plane, giving you a full ten-inch height adjustment for comfortable working. (See photo below.)



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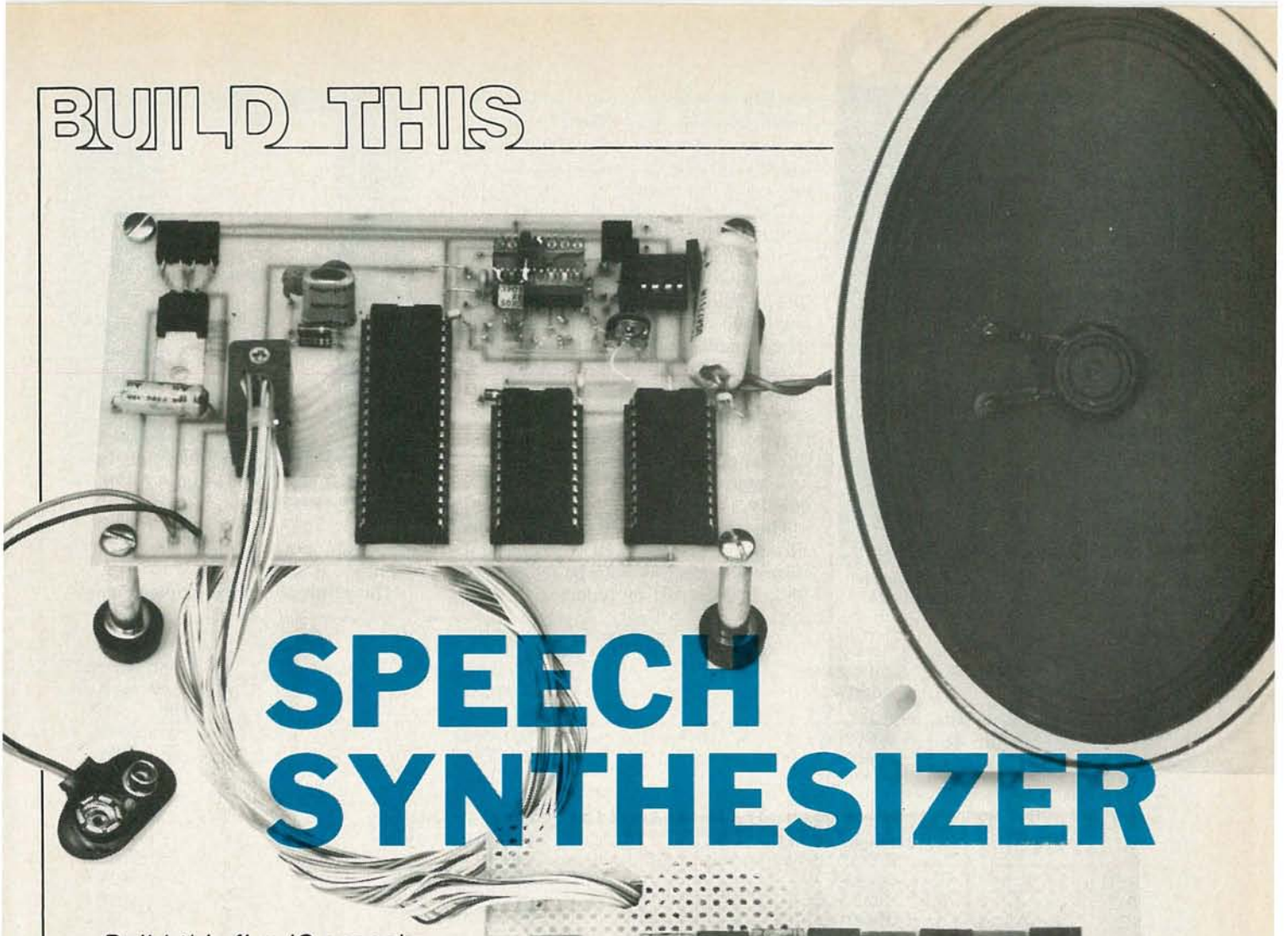

SPEECH SYNTHESIZER

Build this five-IC speech synthesizer and let your fingers do the talking.

L. STEVEN CHEAIRS

WHETHER THEY'RE USED FOR INSTRUmentation or for practical applications, many electronic devices provide us with visual readouts. Those can range from simple indicator lights to complex LED or LCD arrays, up to and including alphanumeric displays.

Frequently, though, it would be useful to have the information without having to look at the device. There are already DMM's that provide an audible continuity-test function using a tone, but wouldn't it be convenient if the meter could tell you what voltage was being measured so you wouldn't have to take your eyes off your work? Or, how about your own talking clock—one that *really* "tells time?"

What's required for devices of that sort is speech synthesis. And while speech synthesizers have been with us for a while, it is only recently that they have been reduced to a couple of IC's and their cost come down to a reasonable level. One such speech-synthesis system is the *Digitalker* from National Semiconductor.

About the circuit

The *Digitalker* system consists of three N-channel MOS integrated circuits. The main IC is referred to as the *S*peech-*P*rocessor *C*hip, or SPC; its pinout is shown in Fig. 1. The other two IC's (see Fig. 2) are ROM's containing the speech data that is processed by the SPC to produce words or phrases. Add a power supply, clock network, filter, and an audio amplifier to the *Digitalker* IC's and you will have a system that produces high-quality speech. That synthesized (actually, reconstructed) speech has the natural inflection and emphasis of the original speech. Male, female, and children's voices can be reproduced easily. (Some other speech-synthesis systems have had difficulties in reproducing the higher frequencies required for other than male voices.)

The *Digitalker's* ROM's store only those speech elements that the ear needs to hear. (The vocal tract also generates sounds that do not convey any intelligible information.) The techniques used by National to process a speech waveform are broken into two basic categories: digitization and compression.

Recordings of actual speech are sampled for digitization (turning analog values into binary numbers) at a rate at least twice that of the highest frequency in the waveform's pattern. If the highest frequency to be used were 3000 Hz, the sampling frequency would have to be at least 6000 Hz. That sampling frequency is called the Nyquist rate.

To minimize the storage space needed for the speech information, Dr. Forrest S. Mozer developed four compression schemes. The first removes all redundant (unnecessarily repeated) pitch

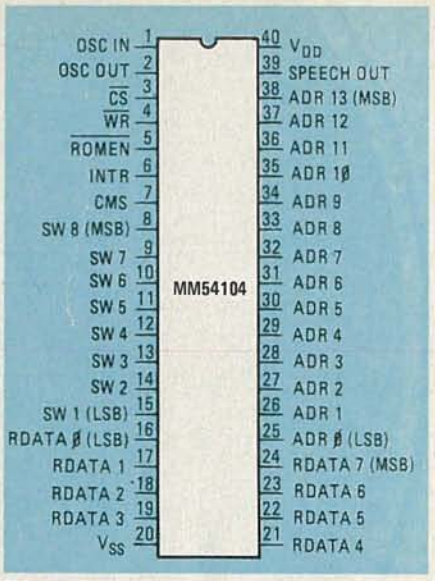

FIG. 1—THE HEART OF THE SPEECH synthesizer is National Semiconductor's MM54104.

periods and portions of certain other pitch periods. Redundant phonemes (individual sounds that, when strung together, make up speech) are also removed at this stage.

The second stage of compression, adaptive delta-modulation, involves storing the arithmetic differences of successive wave-amplitudes. By using that technique, rather than storing the amplitude values themselves, storage requirements are further minimized.

The third compression technique removes the direction component of the speech waveform. That is done by a process called phase-angle adjustment. The ear doesn't use that component, so its removal will not affect speech quality.

The last compression technique allows the amount of ROM required to store the speech data to be reduced by 50%. It does that by reducing the low-amplitude portion of a waveform to silence.

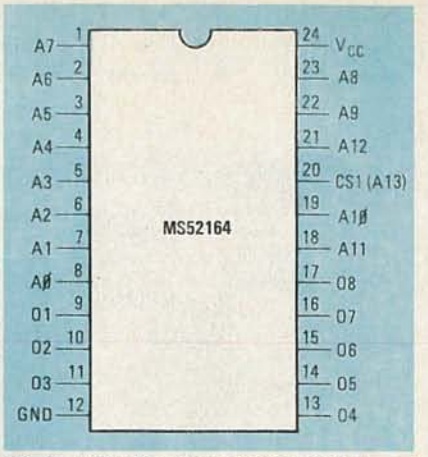

FIG. 2—THE MM52164 is a 8192 × 8 ROM used to contain speech data.

The result of using multiple compres-

TABLE 1

Word	8-bit binary address S8 S1		8-bit binary address S8 S1		8-bit binary address S8 S1
THIS IS DIGITALKER	00000000	Q	00110000	IS	01100000
ONE	00000001	R	00110001	IT	01100001
TWO	00000010	S	00110010	KILO	01100010
THREE	00000011	T	00110011	LEFT	01100011
FOUR	00000100	U	00110100	LESS	01100100
FIVE	00000101	V	00110101	LESSER	01100101
SIX	00000110	W	00110110	LIMIT	01100110
SEVEN	00000111	X	00110111	LOW	01100111
EIGHT	00001000	Y	00111000	LOWER	01101000
NINE	00001001	Z	00111001	MARK	01101001
TEN	00001010	AGAIN	00111010	METER	01101010
ELEVEN	00001011	AMPERE	00111011	MILE	01101011
TWELVE	00001100	AND	00111100	MILLI	01101100
THIRTEEN	00001101	AT	00111101	MINUS	01101101
FOURTEEN	00001110	CANCEL	00111110	MINUTE	01101110
FIFTEEN	00001111	CASE	00111111	NEAR	01101111
SIXTEEN	00010000	CENT	01000000	NUMBER	01110000
SEVENTEEN	00010001	400HERTZ TONE	01000001	OF	01110001
EIGHTEEN	00010010	80HERTZ TONE	01000010	OFF	01110010
NINETEEN	00010011	20MS SILENCE	01000011	ON	01110011
TWENTY	00010100	40MS SILENCE	01000100	OUT	01110100
THIRTY	00010101	80MS SILENCE	01000101	OVER	01110101
FORTY	00010110	160MS SILENCE	01000110	PARENTHESIS	01110110
FIFTY	00010111	320MS SILENCE	01000111	PERCENT	01110111
SIXTY	00011000	CENTI	01001000	PLEASE	01111000
SEVENTY	00011001	CHECK	01001001	PLUS	01111001
EIGHTY	00011010	COMMA	01001010	POINT	01111010
NINETY	00011011	CONTROL	01001011	POUND	01111011
HUNDRED	00011100	DANGER	01001100	PULSES	01111100
THOUSAND	00011101	DEGREE	01001101	RATE	01111101
MILLION	00011110	DOLLAR	01001110	RE	01111110
ZERO	00011111	DOWN	01001111	READY	01111111
A	00100000	EQUAL	01010000	RIGHT	10000000
B	00100001	ERROR	01010001	SS	10000001
C	00100010	FEET	01010010	SECOND	10000010
D	00100011	FLOW	01010011	SET	10000011
E	00100100	FUEL	01010100	SPACE	10000100
F	00100101	GALLON	01010101	SPEED	10000101
G	00100110	GO	01010110	STAR	10000110
H	00100111	GRAM	01010111	START	10000111
I	00101000	GREAT	01011000	STOP	10001000
J	00101001	GREATER	01011001	THAN	10001001
K	00101010	HAVE	01011010	THE	10001010
L	00101011	HIGH	01011011	TIME	10001011
M	00101100	HIGHER	01011100	TRY	10001100
N	00101101	HOUR	01011101	UP	10001101
O	00101110	IN	01011110	VOLT	10001110
P	00101111	INCHES	01011111	WEIGHT	10001111

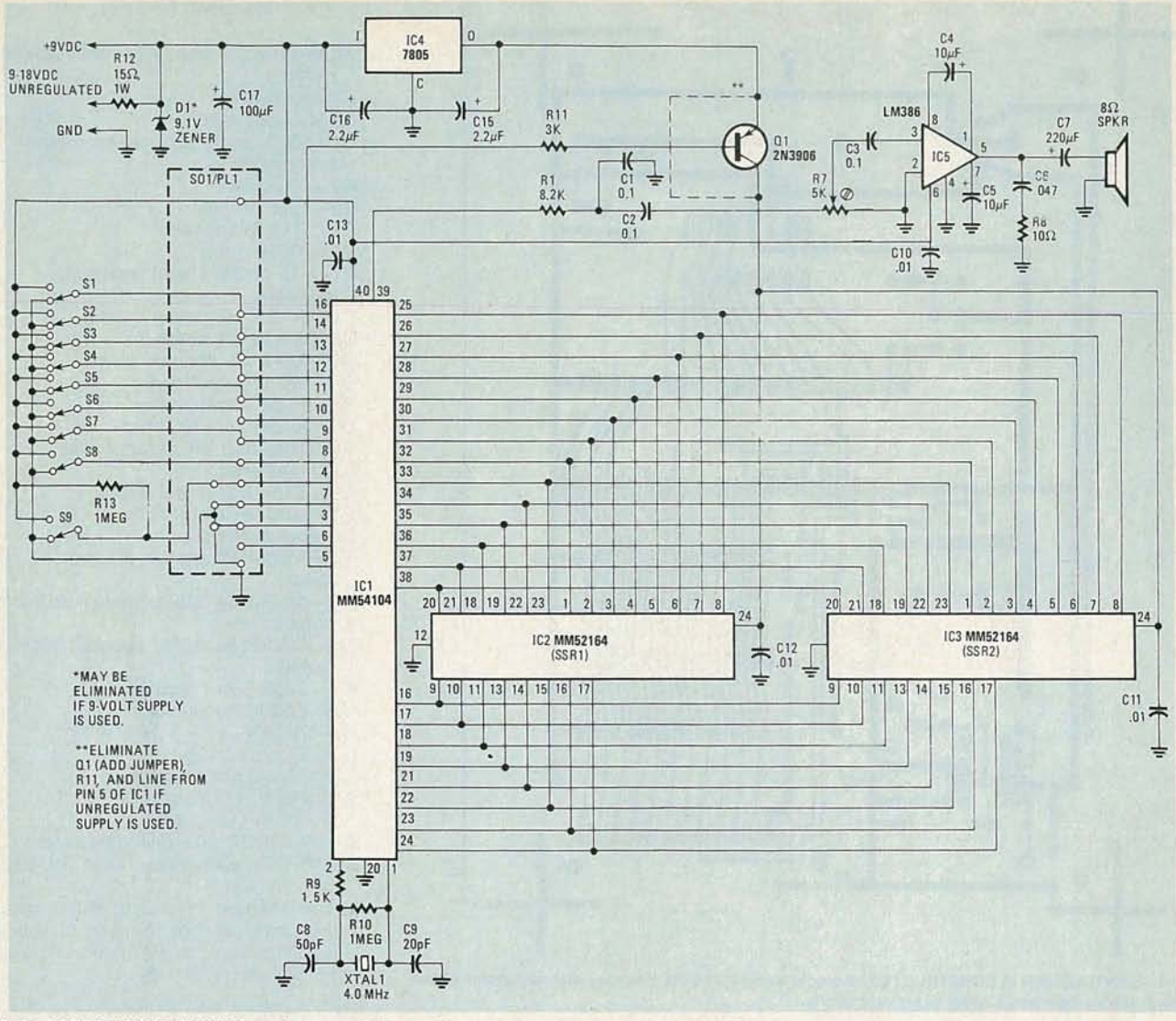

FIG. 3—SPEECH SYNTHESIZER can be operated from either a 9-volt battery or an unregulated DC-supply. See text for more details.

sion-techniques is a system capable of storing and reconstructing a word or phrase with high quality.

How it works

The complete speech-synthesizer circuit consists of the speech processor IC (SPC), plus the speech ROM's, power supply, filter, and audio amplifier. The speech data is mask-programmed into the ROM's by National Semiconductor, starting from an ordinary analog tape containing the words and phrases required.

The speech waveforms are time-domain compressed, eliminating a great deal of the number-crunching required by other techniques to reconstruct the digitized word. Because of that, the SPC can operate at lower clock-frequencies, and the speech-reconstruction circuit becomes simpler to build. Inside the SPC there is a programmable frequency-generator and a variable-gain D/A converter. Together, they produce the intonation and inflection that make for realistic-sounding speech.

The ROM set specified in the Parts List is programmed with a vocabulary (see Table 1) consisting of 136 words, one complete phrase, two tones, and five different silence durations. The words are in a male voice and the phrase is in a female voice. Each word or phrase to be synthesized is assigned an 8-bit address. Address 81H (the "H" indicates that the number is hexadecimal) is the "ss" hissing sound; it is used after a word to make it plural. All addresses higher than 8FH are invalid and will result in garbled sounds.

The circuit, shown in Fig. 3, is quite simple to build. It can be powered either by a 9-volt transistor battery connected to the REGULATED DC input or from 9 to 18-volts DC applied to UNREGULATED input. Resistor R12 and Zener diode D1 are used to obtain 9-volts if an unregulated source is used; they may be omitted if a 9-volt battery is used. The 9-volts is used by the SPC and the audio amplifier.

Power for the ROM's (5-volts) is derived from the 9-volt supply by IC4, a 7805 5-volt regulator. That power can be switched on or off by the SPC's ROMEN line using resistor R11 and transistor Q1, a useful feature for extending battery life. If an unregulated supply derived from a transformer is used you can omit R11 and Q1 and add a jumper between the pads for what would have been Q1's collector and emitter.

A clock network—resistors R9 and R10, capacitors C8 and C9, and XTAL1—is used with active components inside the SPC IC form a 4-MHz clock. The remaining circuits are the filter and audio amplifier.

The filter is a simple passive R-C circuit whose component values are chosen for a 200-Hz rolloff frequency. The output of the filter is supplied to a voltage divider, which acts as a volume control. The signal is then amplified by IC5, which drives a 8-ohm speaker. (Use a fairly large speaker—small 2¼-

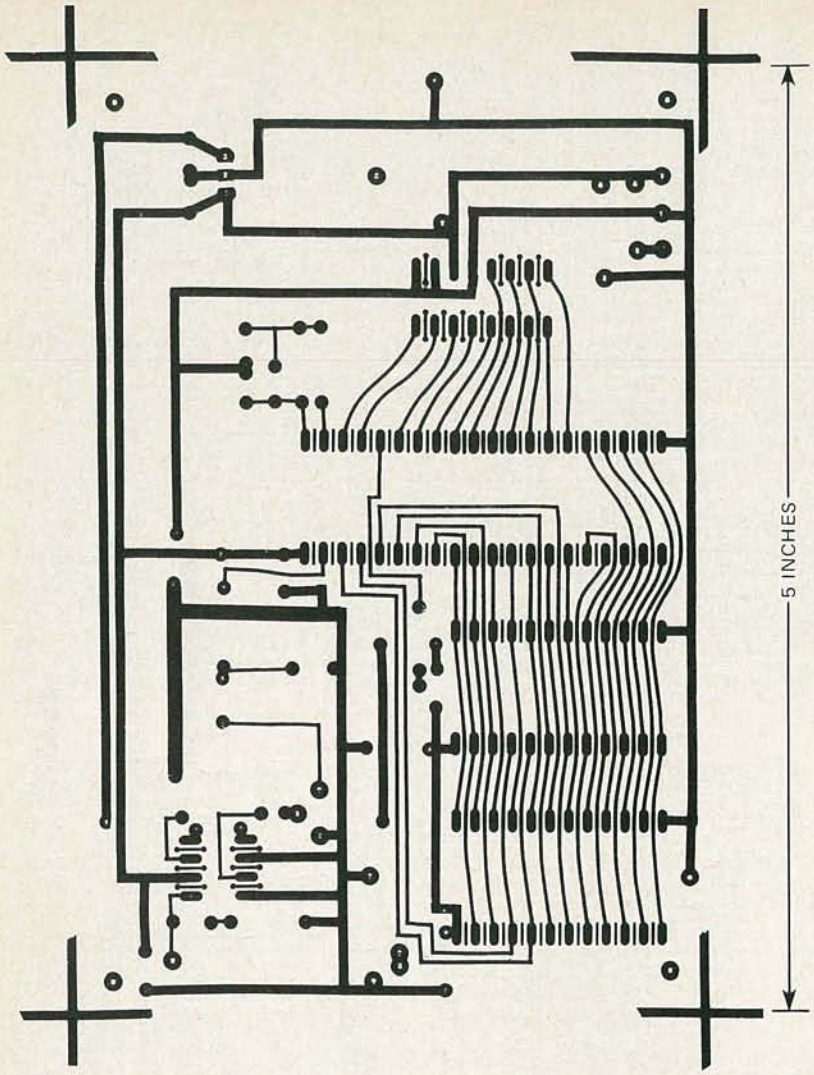

FIG. 4—SYNTHESIZER IS CONSTRUCTED on single-sided PC board. You may wish to eliminate feed-through traces between IC pins to prevent shorts.

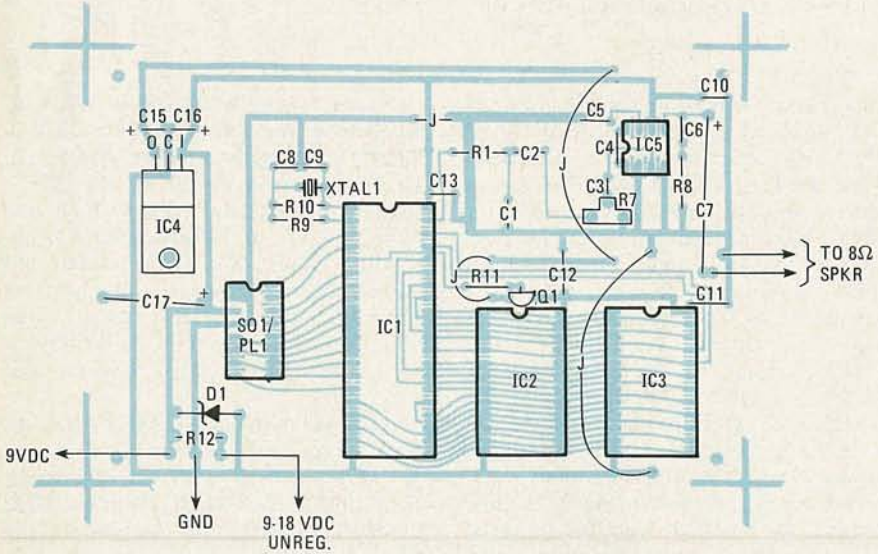

FIG. 5—PARTS-PLACEMENT DIAGRAM shows board with components for both 9-volt battery and unregulated-DC operation. Refer to text for information on which parts can be eliminated.

inch ones tend to distort the sound.)

Construction

A foil pattern for the circuit board is provided in Fig. 4. An already etched-and-drilled board is also available; see the Parts List. Install the IC sockets, together with the jumpers required for your configuration, as shown in Fig. 5. Then install and solder the resistors, capacitors, and crystal. Finally, install the diode, transistor, and IC4. You are now ready to test the synthesizer.

Before inserting the rest of the IC's in their sockets, apply power to the board. The sockets for IC1 and IC5 should have 9-volts at their V_{CC} pins (pins 40 and 6, respectively). Pin 3 of IC4—its output—should read 5 volts. If you used Q1, pin 24 (V_{CC}) of IC2 and IC3 will be at ground potential. If you ground pin 5 of the SPC (IC1) socket, 5-volts should appear on pin 24 of the two IC's. If everything checks out, disconnect power and discharge the filter capacitors.

Connect the speaker and install all the IC's in their sockets. Connect the switches as shown in the schematic

continued on page 110

PARTS LIST

All resistors ¼ watt, 5% unless otherwise noted
R1—8200 ohms
R2-R6—not used
R7—5000 ohms, PC-mount trimmer potentiometer
R8—10 ohms
R9—1500 ohms
R10, R13—1 megohm
R11—3000 ohms
R12—15 ohms, 1 watt (see text)
Capacitors
C1-C3—0.1 μF, ceramic disc
C4, C5—10 μF, tantalum
C6—0.047 μF, ceramic disc
C7—220 μF, electrolytic
C8—50 pF, ceramic disc
C9—20 pF, ceramic disc
C10-C13—0.01 μF, ceramic disc
C14—not used
C15, C16—2.2 μF, tantalum
C17—100 μF, electrolytic
Semiconductors
IC1—MM54104 speech processor IC (National)
IC2—MM52164 SSR1 speech ROM (National)
IC3—MM52164 SSR2 speech ROM (National)
IC4—7805 5-volt regulator
IC5—LM386 audio amp
Q1—2N3906
D1—9.1-volt Zener
XTAL1—4.0 MHz crystal
SO1—16-pin DIP socket
PL1—16-pin DIP header
S1-S8—SPDT slide or toggle switch
S9—SPDT momentary slide or toggle switch
Miscellaneous: PC board, switch-mounting board, 8-ohm speaker, IC sockets, 9-volt battery, or 9–18-volt DC power supply, etc.

The following are available from Quest-Star Electronics, 2820 Howard Dr., Las Vegas, NV 89107: IC1-IC3, $105.00; PC board, $12.95; kit of all parts, $149.95. Add $1.75 for shipping and handling; NV residents please add tax. Allow 6-8 weeks for delivery. For information on other speech-ROM sets, send an SASE to Quest-Star Electronics.

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1. Composition must not be less than 2 minutes in length and must not exceed 5 minutes. (Total playing time.)

2. Entry must be recorded on a standard cassette tape. It will be played back on a standard deck; no noise reduction (such as Dolby) will be used.

3. Each entry must be accompanied by a complete, signed, official entry form. Entries that do not have official forms attached or have forms that are not completed or signed, will be disqualified. Entry forms can be found in every copy of the July 1982 and August 1982 issues of Radio-Electronics. No copies or facsimiles will be accepted. In the event that you cannot locate an issue locally, these issues are available directly from Radio-Electronics. The cost is $1.25 plus $1.00 for first class postage. Payment must include your order, and must be payable in US funds.

4. All entries must be postmarked no later than August 30, 1982 and must be received no later than September 15, 1982.

5. Only one entry per individual in each category. An individual can enter all four categories (once in each category). You cannot enter the same category more than once.

6. All entries must be original compositions of the entrant.

7. All entries become the property of Radio-Electronics. By submitting an entry and in return for Radio-Electronics considering your entry, the entrant transfers all copyright rights to the submitted materials to Radio-Electronics.

8. No entries can be acknowledged or returned.

9. The decision of the judges is final.

10. Winners will be announced in the December 1982 issue of Radio-Electronics. If you wish to receive a list of the winners send a stamped self-addressed envelope to: Videogame Contest Winners, Radio-Electronics, 200 Park Ave. South, New York, NY 10003.

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Category of entry:

☐ Atari ☐ Mattel (Intellivision)
☐ Magnavox (Odyssey)
☐ Other Videogame incl. personal computer (Type)_____

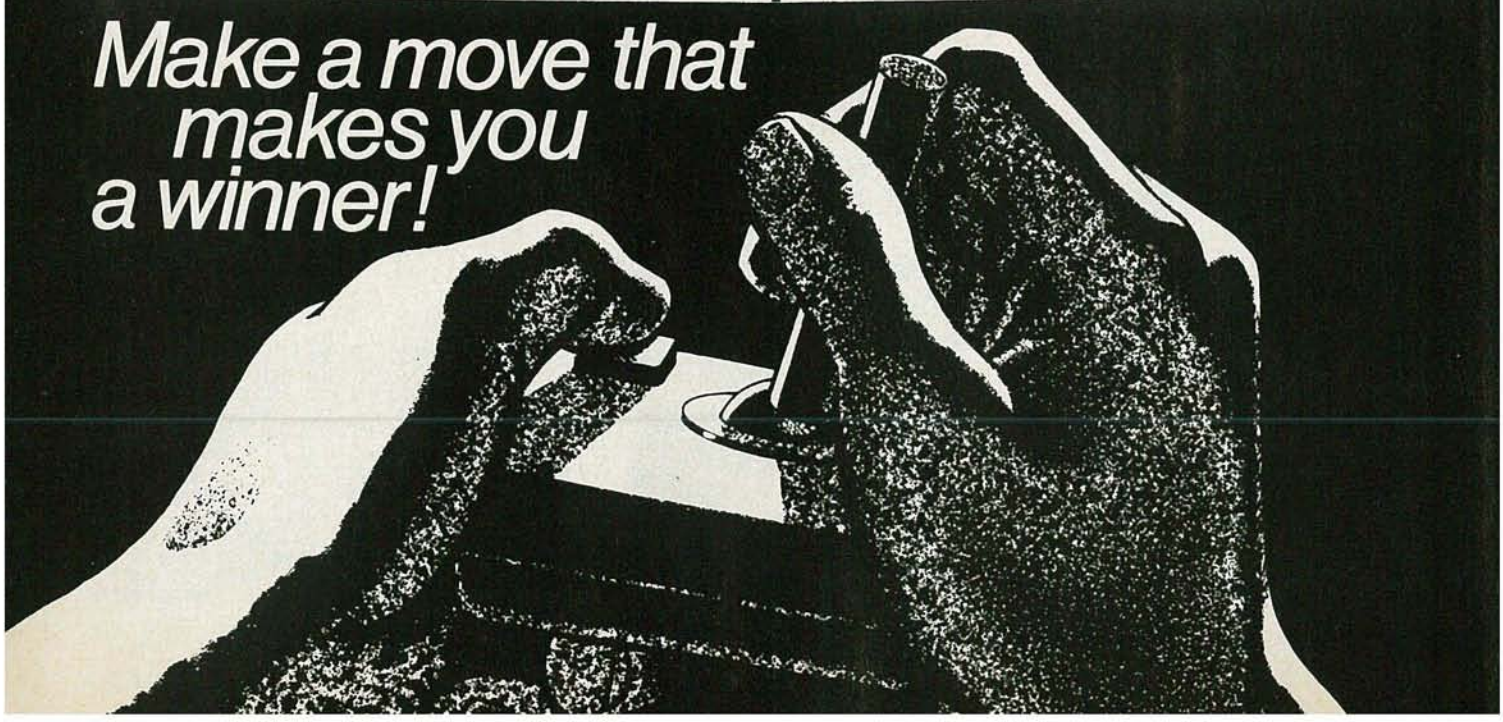
Listing of game cartridges or computer software used to form this composition. Cartridges are listed in the same order—and each time—that their sounds appear in this entry. I have listed the name of the cartridge or computer software and the name of the manufacturer. (You may continued this list on a separate sheet if it's too long to fit here.)

I have submitted this entry to the Radio-Electronics Videogame Concert Contest and will abide by the decision of the judges. I understand that in return for R-E considering my entry that I hereby transfer all copyright rights of the material submitted to Radio-Electronics and certify that all materials are original developments of mine.

Signature_____ Date_____

Age_____

If you are a minor, one of your parents or legal guardian must also sign this form.



Radio-Electronics

VIDEOGAMES

VIDEO GAMES

Mattel Intellivision
Astrocade
Magnavox Odyssey
Atari
Handheld/Tabletop Games

Videogame History

Videogames today are going strong, but their road to popularity has had its ups and downs. This is what it was like in the beginning.

JERRY and ERIC EIMBINDER

IN THE EARLY 1950'S A SMALL MANUFACTURER OF MILITARY systems gave one of its young engineers an unusual assignment. Since it was seeking to penetrate the consumer-electronics marketplace, the company asked the engineer to design the world's best television receiver.

A paramount requirement for the engineer was to include features that were so advanced and desirable that the public would gladly pay whatever premium prices might be asked.

The engineer went to work and, about a year later, completed an initial design on paper. Next came a company review and, ultimately, the decision that the price being projected for the TV receiver was well above what the public would accept. The project was abandoned.

Many years passed. By 1966, the engineer had moved to Manchester, New Hampshire, and had advanced to the position of division manager for the equipment design division of Sanders Associates. His name was Ralph Baer.

Supervising a staff of nearly 500 engineers and technicians, Baer was now in a position to authorize work involving many different electronics disciplines. But as Baer studied possible developmental projects, he recalled one of the features he had suggested, more than ten years earlier, for the never-completed world's best TV receiver. It was the use of the TV screen as a playing field on which two opposing players would match their skills.

Baer discoverd that there wasn't a single TV raster-scan-related project being conducted at Sanders Associates and only a few engineers with knowledge of TV. "I decided to build my own breadboard and check out my ideas for generating player spots and moving them around a broadcast-TV receiver screen under manual control," remembers Baer. Working after hours, he built a couple of symbol generators and soon had two spots chasing each other around the screen of a black-and-white TV set. "I had a very strong feeling that I was holding a tiger by the tail," Baer relates.

Next, Baer met with Herbert Campman, Director of Research and Development at Sanders Associates, and Louis Etlinger, Corporate Director of Patents, and work on the project was officially sanctioned. Two engineers, Bill Harrison and Bill Rusch, received the assignment to bring into existence the world's first TV game.

The first paddle game

By the following year, remarkable progress had been made. Baer, Harrison, and Rusch built a multiple-player hockey game in which the puck moved at a velocity proportional to how hard it was hit; it also moved at the same angle at which it was hit. A player could skate with the puck, hand it off to a teammate, or shoot. The puck bounced off all four walls and an adjustment changed the condition of the ice from fast to sloppy (to give beginers a better chance).

Selling the concept to a licensee turned out to be much harder than developing the game. Demonstrations to potential customers began in mid-1967 and continued through 1969. A number of discussions took place with RCA but a deal that might have changed videogame history fell through at the last minute.

However, an ex-RCA executive, employed by Magnavox, told Magnavox officials about the incredible game he had seen demonstrated and a dialog between Baer and Magnavox began. Magnavox assembled a number of units, by hand, and after a successful market-test program in 1971, obtained exclusive license rights to the Sanders' patents, including rights to sublicense the patents to others.

Magnavox moved quickly. The first model of *Odyssey* was announced in May, 1972, and the production line was running by summer. In spite of confusing advertising that created the impression that the Odyssey game could only be played on Magnavox TV sets, nearly 100,000 Odyssey games were sold during the Fall/Winter 1972 season. Until Atari entered the marketplace in 1975, *Odyssey* was the only video game that could be played on home TV-sets.

Pong arrives on the scene

Atari could have reached the home-entertainment market sooner. It had opted, instead, to pursue the coin-operated electronic-game marketplace when the company was founded in 1972. Atari finally entered the home marketplace in 1975, only after reaching an agreement with Sears and Roebuck to distribute a consumer version of *Pong*, its first arcade product.

Nolan Bushnell, Atari's founder, had worked as an attendant in a penny arcade while going to college and his attention centered on developing electronically controlled arcade games.

Bushnell envisioned *Pong* as an arcade alternative to the pinball machine. After developing and building the first model, he demonstrated it to a major manufacturer of pinball machines located in Chicago. The company wasn't interested.

Bushnell brought the unit back to Sunnyvale, CA, and persuaded the owner of Andy Capp's, a neighborhood tavern, to give *Pong* a short trial. Two days later, Bushnell received a phone message to service the machine. Thinking that something was wrong with the transistor-transistor logic, he rushed over with his repair kit. Instead, he found that the machine wasn't working because its coin

VIDEO GAMES

box was jammed to capacity.

Although Atari became only the second company to enter the home-videogame market when it introduced the consumer version of *Pong* in mid-1975, a short 12 months later, the videogame fever had reached frenzied proportions; the number of companies making TV games ballooned to 70. The competition for the 1976 holiday-season videogame business promised to be awesome. Atari needed capital, and ownership passed to Warner Communications in a $28 million deal. The change in ownership helped Atari survive the hard times that were about to hit the videogame industry.

A sensible question that one might ask is, "How could the number of videogame manufacturers swell from two to 70 in one year?" There is a logical answer.

The first videogame IC

In early 1976, General Instrument introduced a product that made it possible for anyone with a knowledge of simple assembly-line work to get into the videogame business; a background in electronics was totally irrelevant.

The product, an integrated circuit designated the AY3-8500, contained virtually all the circuitry needed for a videogame in a single IC. The IC provided six different games: tennis, soccer, squash, practice (one-player handball), and two rifle-shooting games.

The IC provided automatic scoring and character generation for displaying the scores of two players from zero to 15 on the screen. Bat sizes were selectable externally, using switches. Angles (steep or shallow) and the speed of the ball were also selectable externally. Ball service after a score was manual or automatic as desired by the players.

AN EARLY PROGRAMMABLE VIDEOGAME, the Fairchild *Channel F* has recently been re-introduced by Zircon International, Inc.

TANK II, one of the first non-programmable videogames from Atari. Note that the hand controllers closely resemble those used in the VCS.

Not only was the IC easy to use, but if the customer wasn't up in electronics knowhow, General Instrument would also supply all the necessary design information. Customers were given the external circuitry needed to use the IC and told which oscillators, speaker drivers, and modulators to use.

Development of the IC had been initiated at General Instruments Glenrothes, the Scotland plant, in 1975 at the request of Salora OY in Finland for use in a TV set. Interest spread and additional orders were received from Telefunken GmbH and Loewa-Opta GmbH in West Germany, and Vangard S.A. in Spain.

"The circuit was not the result of brilliant market forecasting or product planning," recalls a former General Instrument executive. "It was one of more than a dozen projects involving custom LSI's that were underway at that time."

The IC was designed for use in the 625-line, 50 frames-per-second PAL TV system used in Europe. After the European engineering group reached the breadboarding stage, General Instrument decided to mount a parallel effort in Hicksville, NY, to develop a 525-line, 60 frames-per-second NTSC-system version for the U.S. market.

Fifteen engineers were put on the project, and when the design was complete, a p-channel wafer-production facility that had been used to fabricate metal-oxide-semiconductor (MOS) calculator wafers was converted to produce the faster n-channel MOS chips called for by the design. The cost of the IC was $5 to $6 depending on the quantity being ordered.

Delivery of samples of the IC began in February, 1976, and by summer, more than a million IC's had been shipped. The seven-

THREE GENERATIONS of the Magnavox *Odyssey*. Lack of programmability was a major drawback of those units—the first that could be played on a home TV set. The eventual introduction of the programmable videogames—such as the *Odyssey*^{2}—solved that problem.

millionth one was shipped in January, 1977, and later, that year, factory production increased to between 1 and 1.2 million game IC's per month.

The race was on

As the first General Instrument game IC's reached the game manufacturers, National Semiconductor and Fairchild Semiconductor were racing to develop products for the 1976 holiday season. Both, however, had decided to market complete game systems not just IC's.

Despite their haste to move from development to production, both companies realized that game systems could quickly become obsolete if a competitor developed a superior IC. They decided to meet that potential threat in different ways.

National came up with a concept that could be construed as a compromise between a dedicated (fixed) and a programmable design. To change a set of games in the National game, called *Adversary*, all that was required was the substitution of one master IC for another.

Adversary was introduced in the fall of 1976; it offered three games—hockey, tennis, and handball, in full color. More than 200,000 *Adversary* games had been sold by the end of the year and, in late 1976, National pushed ahead with the development of a direct-replacement IC, scheduled for availability in 1977. The new IC would offer the same three games plus soccer, pinball, and wipeout. (In wipeout, 256 target dots would appear on the screen; points were scored by hitting each target with a ball. As the ball hit the target dot, it would disappear from the screen; hence the name "wipeout.")

National's plan was to switch to the use of the new IC as soon as it was ready. Purchasers of games with the original IC would be able to upgrade their systems by substituting the new IC, either by buying the new IC and installing it themselves, or by returning their present unit to National Semiconductor for modification at a nominal fee.

The first programmable TV game

Fairchild was the first manufacturer of a truly programmable home-TV game system. Its *Video Entertainment System*, available in limited quantities in August, 1976, was designed to accept interchangeable cartridges. Each cartridge contains a semiconductor memory, programmed to reproduce specific games on a television screen in full color. The system contained two resident games—hockey and tennis.

The heart of the system is a Fairchild F8 microprocessor and four random-access semiconductor memories. The unit uses eight-position hand controls. The controllers can be pushed forward, pulled back, pulled left or right, twisted left or right, and pulled up or pushed down. For many games, the score and elapsed playing time are continuously displayed at the bottom of the screen.

When Fairchild introduced the system, it also announced plans to bring out a new cartridge every month—a very ambitious undertaking. Unexpected delays in getting approval for the system from the Federal Communications Commission soon wrecked the entire timetable. Only a small supply of systems and three different cartridges were available for the Christmas 1976 season. The cartridges included a four-game combination of Tic-Tac-Toe (player pits his X's against computer's O's), Shooting Gallery (rifle vs. flying ducks), Doodle (drawing diagrams on the screen), and space Quadra-Doodle (computer creates color kaleidoscope). Also offered were a two-game cartridge containing Desert Fox (mine and tank warfare) and Shooting Gallery (angle of shot varies after hit) and a cartridge with two variations of Blackjack. (In one, Las Vegas rules were followed; in the other, two players opposed the house.)

Despite the delays, Fairchild remained optimistic as it announced the availability of three more cartridges in January, 1977. Those were Spitfire (a dogfight on the screen), Space War (a flying saucer duel using lasers), and Math Quiz (math basics for youngsters). Eventually, Fairchild dropped out of the videogame business, but not before it had sold many of its game systems. Recently, a company called Zircon International (475 Vandell Way, Campbell, CA 95008) started selling the original Fairchild videogame, and many of the original game cartridges. Zircon is also selling several new cartridges of its own.

RCA had revealed in September, 1976, that it also had a programmable game system in development, and, in March, 1977, it demonstrated the unit. The RCA system used its 1802 microprocessor and used a keyboard to control action. The system came

VIDEO GAMES

LACK OF A COLOR DISPLAY was among the factors that led to the early failure of the *Studio II* videogame from RCA.

with five built-in game programs; additional programs were available in plug-in semiconductor-memory cartridges.

The RCA system was the first TV game unit to offer bowling. The alley was presented on the screen with the foul line running along the bottom from left to right. The ball was released when it was in the desired position by touching a key on the keyboard. Other keys provided "curve-up," "curve-down," or "no-curve" as desired by the player. The pins didn't ricochet off each other; instead, if they were in the path of the ball, they merely disappeared. The console also provided a version of Etch-a-Sketch, controlled by pushing appropriate keys to change the direction of the traveling etch on the screen.

The RCA system had one glaring drawback that many felt doomed it to failure; unlike the competitive game systems available that displayed color on the TV screen, it was a black-and-white only game.

Both Fairchild and RCA had missed the 1976 Christmas season. But other manufacturers, many using the General Instrument AY3-8500 IC, had sold every game system they could produce. TV game sales for 1976 were estimated at $187,000,000; the number of actual units sold was about 3,390,000.

The figures could have been higher. The demands for the GI IC's far exceeded the supply. Many areas of the country ran out of videogames long before Christmas.

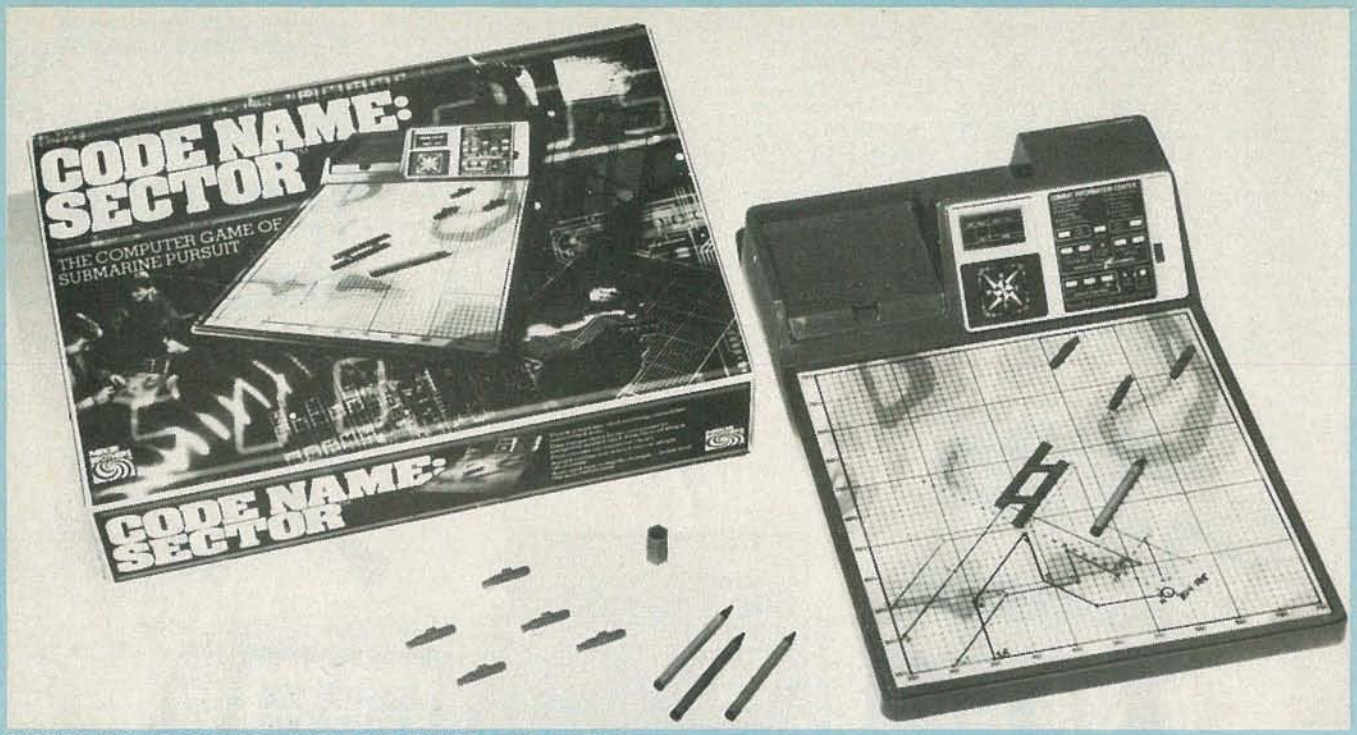
The momentum continued in January, 1977, buoyed by the announcement of the impending availability of six new game IC's coming from General Instrument. A list of the new games appears in Table 1.

The prospects for 1977 looked exciting. Coleco (GI's first major customer for the AY3-8500), Magnavox, and many others began expanding production facilities for the anticipated doubling of the videogame business during the coming year. Magnavox revealed that it would market a 24-game master system, based on several of the new GI IC's, for under $100 in September, and National Semiconductor announced that its new version of *Adversary* might be ready as early as June.

TABLE 1—GI's SECOND GENERATION IC's

IC1	IC2
Blackjack	Combat Squares
Draw Poker	Racing Squares
Acey/Deucy	Shooting Squares
War	Juggling Games
IC3	**IC4**
Volleyball	Barricade
Projection	Collision
Hazard	Avoidance
IC5	**IC6**
Road Race	Submarine

But neither system reached the marketplace. Suddenly, the demand for videogames disappeared. Were videogames only saleable on Father's Day and at Christmas? Was the market only temporarily saturated? Most videogame manufacturers ran out of money before they found out. Others pulled out of the business to turn their attention to other, more profitable, ventures.



MICROPROCESSOR-BASED TABLETOP GAMES, such as Parker Brothers' *Code Name: Sector*, gave the early programmables some stiff competition.

BRINGING HOME the thrill of an arcade, *Video Pinball* was one of the first home videogame versions of that popular game.

THE SCREEN BURN SCARE

AT THE CONCLUSION OF THE CHRISTMAS, 1976, SELLING SEASON, A CANAdian department-store chain, the T. Eaton Company, announced that two of its floor-demonstration TV sets had permanent ion-imprint burns. The two sets, both black-and-white models, had been operated 12 hours a day for five weeks. The story received major attention in the press and from the broadcast media. Although it was difficult to assess the effect on videogame sales at the time, many industry executives felt that game owners had reduced the amount of time they used their games.

A probe into ion-burn damage from prolonged operation was launched by the Federal Trade Commission and, as a result, many stores—including the Eaton Company, and some TV manufacturers—issued warnings to customers against operation at full brightness or full contrast over extended time periods. Today, fortunately, that problem no longer exists.

Boom or bust

As it turned out, the effect of the shortage of game systems and cartridges during the peak portion of the 1976 holiday season was far worse than the industry anticipated. Toy department personnel had been forced to switch customers to other products when the shortage set in. Customers who had purchased systems and then couldn't buy cartridges weren't easy to placate either.

As systems and cartridges became available in 1977, retailers, even more than customers, were psychologically switched off. The TV game industry failed to realize that both groups would have to be resold. Many videogame departments at stores had been shut down and the space had been restocked with other merchandise. Many major retailers objected to reordering the same cartridges (and, in some case, through ignorance, the same system) they had carried the previous season. Some retail outlets were influenced by reports of a new generation of TV games in development and decided to wait for their introduction.

As the months went by, even consumers who wanted to buy videogames had a difficult time obtaining them. "First, no one could buy them; then no one could sell them. Finally, no one could find them," recalls a retailer.

It was at that time that handheld games exploded onto the scene. During 1976, the industry's first three handheld electronic games had been introduced (Texas Instruments' *Little Professor*, controlled by TI's TMS1000 four-bit microprocessor, and two Mattel games—*Football* and *Auto Race*, also controlled by a four-bit microprocessor, Rockwell's PPS-4).

It seemed as if microprocessor-based handheld and tabletop games were being shot onto game-store shelves in 1977. Instant success was achieved by many of those products, including *Code Name: Sector* by Parker Brothers, and *Comp IV* and *Electronic Battleship*, both products of Milton Bradley.

In the videogame industry, momentum had temporarily been replaced by inertia. It would be a while before the videogame staged a comeback and recaptured the public's fancy. **R-E**

VIDEO GAMES

Magnavox Odyssey

The original home videogame is still with us—
but in a much more elaborate version than the original

DANNY GOODMAN

IF, AS THE DEFINITION GOES, AN ODYSSEY IS "A LONG WANDERING, beset by radical changes in fortune," then the videogame name "Odyssey" has been on such a journey for quite a while, with its fortune now changing from good to even better.

Those of us who can remember way back to the dawn of the home-videogame age—a whole ten years ago—may remember the first Magnavox *Odyssey*, a battery-operated device that hooked up to a home TV-set. It offered a choice of 12 different videogames—all variations on a paddle-ball theme.

The display was black-and-white, and got a little help from playfield overlays taped to the TV screen. The graphics consisted of three little white squares on a black background: one square for each hand controller, with the third acting as a ball or cursor, depending on the game. That first-ever home videogame unknowingly foretold the future: The console was programmed (but they didn't call it that, then) by different plug-in cards to provide game variety.

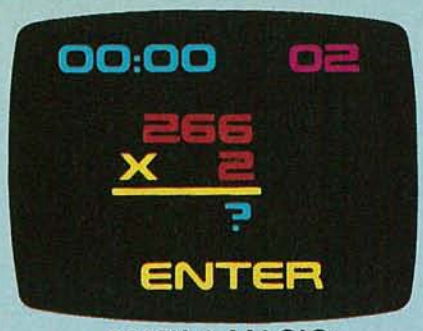
In spite of what the news reports called a "steep price" of $99.95, the first version of *Odyssey* sold well at first. But, as had happened with the pocket calculator not long before, the videogame became more highly integrated: that is, more functions and even sets of complete games were designed into fewer integrated circuits. The "programmable" concept faded temporarily while "dedicated chip" games like the *Odyssey models 300, 400,* etc. were designed to play only the selection of games programmed into their IC's at the factory.

But by the mid- to late-seventies, consumer interest in dedicated-chip games diminished as product obsolescence and price decreases became almost monthly events. Perhaps more important, the games were easily mastered and thus failed to hold their owners' attention for long. As Mike Staup, Director of Business Planning at Odyssey, recalls, "People opened them up on Christmas Day and played with them maybe until New Year's Day, put them in a closet, and never got them out again." The Odyssey name (and more than a dozen others) faded to black...only to resurface later.

In 1978, Magnavox introduced a totally new videogame system, *Odyssey²*. The "2" indicated a step up from the early dedicated-chip games to the world of programmable videogames already on the market from Fairchild (the ill-fated, but recently resurrected, 2Channel F system), Atari (the still-popular *Video Computer System*), and others. Although *Odyssey²* was not an overnight success—indeed, all of today's popular videogame systems struggled at first—it has now taken off as a result of the incredible consumer interest in cartridge-based videogames. Some recent innovations in the cartridges now available for the unit are surely adding to its rise in popularity.

The *Odyssey²* no longer carries the Magnavox brand name. That came about as the result of a realignment of the several companies and familiar brand names owned by North American Philips. Odyssey is now a separate business entity within N.A.P. Consumer Electronics Corp. and, according to Jerry Michaelson, Odyssey's Vice President of Marketing, the company will be responsible in the future for a "a whole world of interactive devices."

But for the present, we have *Odyssey²*, the only videogame console to sport an alphanumeric, typewriter-style keyboard. That



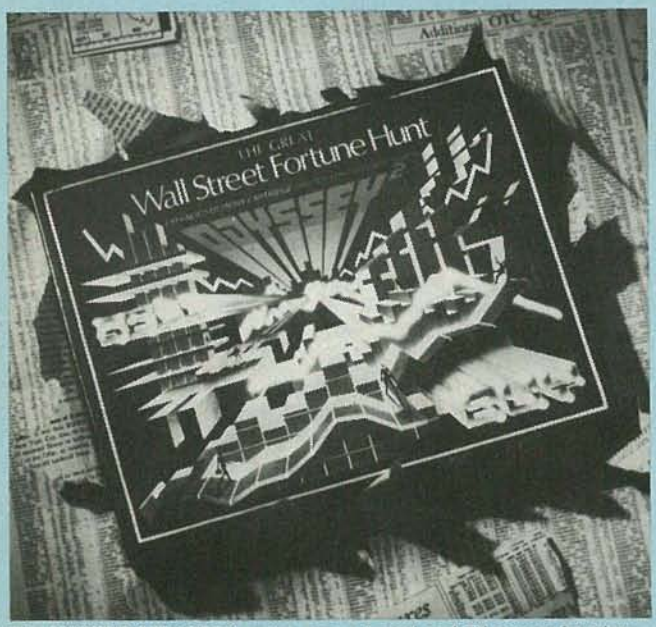
MATH-A-MAGIC

ECHO

COMPUTER INTRO

keyboard, laid out in the familiar "QWERTY" arrangement, had little use with the early game cartridges, but is now becoming an increasingly important element in many of the newer interactive games. The plastic-keyboard design is called "monoplanar"—"flat" to you and me—and because of its sealed nature prevents soft-drink spills or peanut butter-and-jelly-sandwich drips from getting inside the unit.

After four years on the market the console is still attractive, even though somewhat bulky for its light weight. Other than the keyboard, the only other features visible on the console are a big red POWER button and the cartridge slot. Looking into the slot, you can see a circuit-board connector and a small plastic block on one wall, deep in the slot. That block fits into a groove on each plug-in cartridge, insuring that the cartridge can only be inserted one way. (Inserting a cartridge backwards would cause it to be damaged.)



The *MASTER STRATEGY* series uses a board and TV screen for play.

Accessories

Ask any dedicated videogamer, and he'll tell you that hand controllers are an important element. They are the link between you and the object you're controlling on the screen. The *Odyssey*^{2} controllers are wired directly into the back of the console. (It appears that the console designers had the option of building the console to accept plug-in controllers, buy may have discovered that the plugs and jacks could become a source of service problems after a lot of insertions.) A disadvantage of such hard-wired controllers is that if one should go bad, you'll have to take the whole console in for repair, even though repairing or replacing a controller is a simple job.

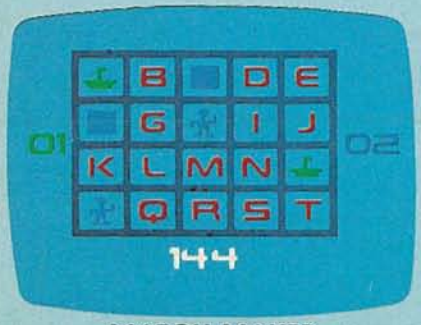
The *Odyssey*^{2} controllers consist of a vertical joystick that can be moved in any of eight directions, plus a red "action" button, frequently used to shoot missiles or to activate a screen character once he has been maneuvered into place by manipulations of the joystick.

Operation is quite simple. With the console off, insert a cartridge. (The cartridges have small molded handles to make them easier to insert and remove.) Then turn the unit on using the POWER button. A few musical tones sound through the TV set's speaker and the words "SELECT GAME" appear on the screen. That's the time to head for the pamphlet included with each cartridge for game rules and instructions.

Many cartridges require a signal from the controllers (movement of the joystick) to establish whether one or two players are in the game. At the end of each round (for example, when time runs out for both players), the game resets automatically, and is ready for the player(s) to try again.

If no one picks up the challenge, the computer "plays itself" over and over, complete with sound—perhaps an annoyance if you have to leave the game to answer a phone in the same room, but a guarantee that you won't leave the game and TV set going unattended for too long.

New this year is the *Odyssey*^{2} *Voice and Sound Module* that uses a high-quality electronic speech-synthesis system from General Instrument to generate voice output for games—though more applications are likely to appear in the educational area. The module plugs directly into the console's cartridge slot and is styled to blend with the console. Power comes from the cartridge slot, and a speaker (with volume control) is built into the module. That differs from



MATCH-MAKER

LOGIX

BUZZWORD

BASEBALL

COMPUTER GOLF

Mattel's new *Intellivision* voice add-on, which plays the voice through the TV set's speaker, together with the rest of the game sounds.

Of course, special game cartridges (that plug into the module) are needed. They contain speech data as well as game data, but all existing non-speech cartridges are compatible with the module. Unfortunately, at the time of writing, we were unable to try out any of the planned audio-videogames, but they promise to add a whole new dimension to game playing.

Games

Until the development of the *Challenger* and *Master Strategy* series of game cartridges, much of the *Odyssey*^{2} software collection lacked the graphic and sonic pizzaz of many of the other programmable-game systems currently on the market. Screen characters and other objects were derived from a fixed library preprogrammed into the *Odyssey*^{2}*'s* character set and presented rather coarse graphic designs that didn't do justice to the better detail actually available from the unit.

Of the 35 cartridges available in early 1982, the greater part is divided into sports and arcade games. The sports category consists of the old favorite ball games, common to all videogame systems, plus Alpine Skiing, Computer Golf, Electronic Table Soccer and Billiards. None of the sports game-cartridges will win awards for graphic or strategic realism, but that does make for a simplicity that makes the two-player competitive games quick to learn—even for non-arcade types. As simple as the Basketball game appears to be the subtleties of its one-on-one play—ball stealing, eight-second limit before shooting, random shot-angle and velocity—make for plenty of entertainment. Oddly enough, the same cartridge contains an uninspired bowling game. Two-player competitive sports games on the *Odyssey*^{2} may not be graphically interesting, but can make for family fun.

The arcade collection has a number of space, shoot-out, and other games loosely derived from arcade-machine themes. In that category, the two-player competitive games are the most enjoyable: Showdown in 2100AD and Blockout/Breakdown rank high.

The *Challenger* series of games breaks away from the character-generated mold of earlier ones with some tricky one-player games in UFO and Monkeyshines.

One feature of some *Challenger*-series games worth noting is that the player who scores higher than any previous high score can enter his or her name onto the screen via the keyboard. Therefore, the highest score and name of the player attaining it remain on the screen—until someone does better, when the game asks for the name of the new champion. (As is typical of current home videogames, that information is not stored once the cartridge is removed or the power turned off.

The top end of the *Odyssey*^{2} cartridge games is the *Master Strategy* series, consisting of Quest for the Rings (adventure), Conquest of the World (tactical/strategy), and the Great Wall Street Fortune Hunt (financial world simulation). Those games offer a hybrid of video- and board-game play, and make use of the console's keyboard. In Quest and Conquest, the winner is determined by the position of game pieces on the board; however, a player's progress on the board is based on how well he performs in the several video battles that take place in the course of the game.

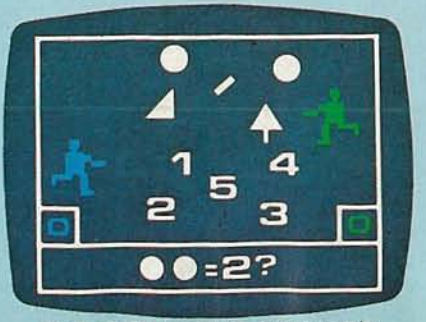
The graphics in this series are much more detailed than in the standard games. The sight of griffon-like creatures (called Doom-winged Bloodthirsts) in Quest for the Rings devouring a hero is unlike anything else around. Expanded-memory cartridges allow more variety in terms of situations and action, as would be expected from a $49.95 game pack.

Newest of the *Master Strategy* series is The Great Wall Street Fortune Hunt. The game stakes you with $100,000, which you are free to invest in a variety of ways. A ticker of real NYSE stocks, and other market prices, flows across the top of the screen, while a worldwide news ticker periodically makes announcements that may affect your portfolio. Players use the keyboard to buy and sell assets in a bid to make more money than their opponents. That game keeps your mind glued to the action.

For dedicated *Odyssey*^{2} players—their numbers are growing—the company has recently begun a quarterly magazine, *Odyssey*^{2} *Adventure*. Issues keep players abreast of coming attractions, give playing tips, high scores submitted by readers, and present informative articles. A one-year subscription is available for $3.00 from *Odyssey*^{2}, 30400 Van Dyke, Warren, Michigan 48093. **R-E**

ODYSSEY^2
N.A.P. Consumer Electronics Corp.
I-40 & Straw Plains Pike
Knoxville, TN 37914

TAKE THE MONEY AND RUN



I'VE GOT YOUR NUMBER

INVADERS FROM HYPERSPACE

Astrocade

Originally developed by Bally, this deluxe videogame offers superb graphics and sound.

DANNY GOODMAN

FEW VETERAN VIDEOARCADE GOERS CAN FORGET SOME OF THE great old games from the late 1970's; games like *Gunfight, Sea Wolf* (remember looking through the periscope), and *280 Zzzap*. Those games were so much fun to play that you can still find them in many arcades, although you may have to look around a bit. You can now play them at home, too, if you own an *Astrocade* from Astrocade, Inc.

If the unit and the manufacturer are unfamiliar to you, it is because both have undergone name changes recently. The *Astrocade* was formerly known as the *Bally Arcade*; the manufacturer's old name was Astrovision. That unit was originally developed by Bally, the manufacturer of the popular Midway coin-operated arcade games; Astrovision bought all the rights to the videogame from Bally a few years ago. All those name changes are bound to cause some confusion, but Astrocade's current plans include some aggressive marketing and a hefty advertising budget—that should help things along.

In its earlier days, the unit was known for its detailed color graphics and interesting displays. No one could fail to smile when the defense ran out on the field in *Baseball*. The sound was far better than its early contemporaries, too.

Even today, that videogame is one of the most sophisticated on the market. The heart of the unit consists of three separate microprocessors. The central processing unit is a powerful Z80 IC that operates at 1.8 MHz. A custom video-processor LSI IC is used to control the color for better animation effects. In addition, that IC, operating at 7 MHz, increases animation speed 20 times. The *Astrocade* is also the only videogame with an NTSC-standard video output, making it fully compatible with all video recorders and broadcast equipment. The third microprocessor, a custom I/O processor, handles all of the joystick and keypad inputs, and creates the sound effects; three separate on-board sound synthesizers generate both AM and FM noise, and have a frequency range of 2 Hz to 100 kHz. Of course, all of that sophistication has a price—the *Astrocade* is one of the most expensive units available, with a suggested retail of over $300.

But you get a lot for the money—the videogame has a number of excellent features that, unfortunately, no other game makers have picked up. First of all, the hand controllers are the pistol-grip type with a trigger for the "action" button, and a single knob on top; that knob is both a joystick and rotating steering control.

But playing the game is not all that the controllers are used for. Once the unit is turned on, you don't need to touch the console again until you change or install a cartridge; everything can be done using one of the controllers. That's because the *Astrocade* is menu-driven.

When you turn the console on (the ON/OFF switch is rather inconveniently located in a recessed position at the console's rear) a menu appears on the TV screen. If no cartridge is plugged in, the four games built into the unit (*Gunfight, Checkmate, Calculator,* and *Scribbling*) are listed; with a cartridge installed, those games are listed along with all those on the cartridge.

Once you've decided what game you want to play, you have to enter that and a few other pieces of information into the unit. A series of prompts is used here to make sure that you have done it correctly. Press the controller's trigger, and it asks for the number of the game you want. Rotating the knob on the controller, changes the number shown under the prompt message. When you have the

number of the desired game on the screen, press the trigger and the game number is entered into the computer. The number of players, the number of rounds, and the difficulty are all entered in the same manner—there's no need to get up from your easy chair.

Another *Astrocade* feature is a calculator-like keypad. That can be used in place of the hand controller to enter the information required before the game begins; it is also used by the *Calculator* and *Scribbling* games, as well as by the *Astro BASIC* cartridge.

All of that aside, the reason you buy any videogame is the games available. Having four games built into the machine is an advantage. Actually, two of them aren't games at all, but could be more accurately called "activities.". *Calculator*, for example, is a "video" calculator that displays all of the figures entered and all of the operations performed, as well as their results. Although only 10 lines are displayed at any one time, it is possible to scroll up and down through up to 92 entry lines. *Scribbling* lets you use the built-in keypad and the hand controllers to create a wide variety of multi-colored patterns. Perhaps the most interesting feature in that activity is that it lets you create a random kaleidoscope of color and patterns on your TV set by simply entering "0" players when the "how many players" prompt appears. Those patterns and colors are simply amazing to watch.

Getting to the games, *Checkmate*, a game similar in concept to Atari's *Surround*, is a great deal of fun. In that game, the object is to create as long a line as possible without running into your own, or any of your opponent's lines. The version here is for anywhere from one to four players. All of the games start out with four lines, however, with the computer generating any lines that are not under "human" control.

Gunfight is a two-person game that is just what the name implies. Players shoot at each other until one reaches a score determined at the start of the game. In later stages of the game, a moving "covered wagon" obstacle adds some interest.

As nice as having all that built into the unit, the real strength of any videogame lies in the plug-in software that is available. In the *Astrocade*, the game ROM's are housed in cartridges that are shaped like audio cassettes, without the holes for the tape spools. One advantage of those smaller-sized cartridges is that they are much easier to store. In fact, there is storage space for up to 15 cartridges under the *Astrocade's* plastic cover. Any owner of other cartridge-based video games can tell you what a headache it is keeping cartridges from being strewn around the room.

Perhaps the most frantic action of any cartridge for any game is found in Astrocade's *Space Fortress*. The play is based on the arcade videogame *Space Zap*. In *Space Fortress*, you are in control of a spaceship in the center of the screen. You aim your laser in one of four directions—up, down, left, and right—using the joystick; the laser is fired by pressing the trigger. What you are shooting at is an alien gun and the fireballs it launches. The gun can appear at random at any of the four screen edges. Your goal is to keep the fireballs away from your ship. The longer you last, the more intense the barrage, until guns seem to be blasting away at you from all four directions at the same time. If all of that wasn't enough, you also have to contend with an errratic robot kamikaze.

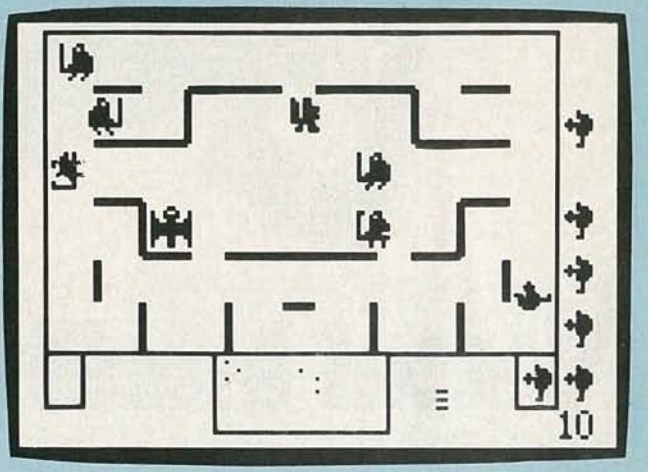
The action and sound are superb, but the best part happens when you are finally blasted. Your ship's explosion is among the most stunning effects found in any videogame.

Galactic Invasion, which is very similar to the *Galaxian* arcade game, shows off the *Astrocade's* detailed graphics very well. The motion of the aliens gives that "floating" or wavy look. And the individual aliens retain their colors and resolution when they peel out of formation to attack. And just like the arcade games, the number of points earned for hitting a difficult target is shown in a cloud of video "debris" where that target used to be. Other cartridges worth looking into are *Amazin' Maze*, *Astro Pin*, *and Astro Battle*.

But, as with many of the other videogame manufacturers, the best is yet to come. Several new cartridges are due by the end of 1982.

Wizard is a good home version of the popular *Wizard of Wor* arcade game. It has many of the features of the coin-operated

VIDEO GAMES



***THE WIZARD*, a home version of *Wizard of Wor*, has many of the features of that popular arcade game.**

version including a "radar screen" display to track the invisible monster in the maze.

Pirate Chase, though not as graphically interesting as some other cartridges, is still a good hand-eye coordination test. The object is to steal a treasure without being "caught" be a speedy pirate.

Everyone seems to be coming out with a *Pac-Man*-type gobble game, and Astrocade is no exception. We tried out a prototype cartridge for their new game, *Munchie*, and found it to be one of the most satisfying home versions of that theme.

A typewriter-like keyboard addition for the *Astrocade*, *Zgrass 32*, has been in the works for some time and should be available soon (see the April 1982 issue of **Radio-Electronics** for a report on that unit). But in the meantime, you can still take advantage of the *Astrocade's* programmability with the *Astro BASIC* (formerly *Bally BASIC*) cartridge. That version of BASIC is rather limited, but the cartridge can get the interested and creative user going quickly. The cartridge has a built-in audio interface that allows you to store your programs using a cassette recorder. An overlay for the console keypad shows you how to enter letters and commands (two-button sequences). Users groups have sprouted up in several areas around the country, giving everyone a wider library of software.

Another nice feature of the *Astro BASIC* cartridge is the above-average instruction booklet. Rather than just providing instructions, it is, in fact, a small course in computer programming—complete with programming examples, screen, and other illustrations, etc. It is really quite impressive. Unfortunately, the same cannot be said for the instruction booklets that accompanied the rest of the cartridges. Mostly, they consisted of little more than a description of game play; no illustrations, suggested strategies, etc., were included. Hopefully future instruction booklets will be upgraded to bring them up to the high level of the one included with *Astro BASIC*, and the sophistication of the *Astrocade* itself. **R-E**

MANUFACTURER

Astrocade, Inc.
6460 Busch Blvd.
Columbus, OH 43229

Mattel Intellivision

High-quality graphics and true-to-life realism are two of the features of this sophisticated videogame system that soon will even be able to talk back to you!

DANNY GOODMAN

IT'S SOMETIME DURING WORLD WAR II AND YOU ARE FLYING A B-17 bomber on a mission across the English Channel. While you are plotting your location on a situation map of the area your captain announces "Enemy 9 o'clock low." You switch your view to just outside the plane and shoot down the oncoming fighters. "Target in sight!" suddenly warns the bombardier in a heavy southern accent. Looking through the bombsight you locate your target—an enemy rail yard. In a John Wayne-like voice, your co-pilot warns you to "watch out for flack!" You are over your target now—hit the FIRE button, and your bombardier confirms, "Bombs away!" Just as in the movies, you see the stream of bombs fall away from the plane, getting smaller and smaller until flashes from the explosions confirm a hit. But no time now for congratulations as the Captain is yelling "Enemy 3 o'clock low." You're not through yet...

Take the excellent graphic resolution, versatile sound effects, and fascinating game play of Mattel's *Intellivision* videogame system, then add a book-sized module called *Intellivoice* and special voice-coded game cartridges (both scheduled to be available later this year), and you have the potential for home videogame realism unmatched by any other system. High-quality electronic speech can add an entirely new dimension to playing a videogame. Sound is no longer a mere effect (explosions or footsteps, for instance); nice, but not critical in playing the game. Instead, a realistic voice now plays a key role—alerting you to "external" conditions or giving the computer a pseudo-personality.

The scenario we described at the beginning of this article was an example of some of the things that go on when you play *B-17 Bomber*, one of the new voice-coded cartridges. In that game, the voices are those of your crew members speaking to you over the cockpit headphones. In *Space Spartans*, the voices are of an ever-vigilant, female-sounding on-board computer that provides you with needed status reports as you vigorously fend off the hazards of deep space, plus a male-voiced computer from your home base that alerts you to dangers in other parts of the galaxy. The more senses used to play the game, the more realistic it becomes.

Hardware

From the beginning, *Intellivision* has placed more emphasis on strategy and realism than any other game system. While that greatly adds to the realism and enjoyment of the game, it is not without some disadvantages. Some of the sports games—notably football, baseball, and basketball—require keypad entries during play. For players used to arcade type games in which attention is paid only to the screen (you work the controllers more or less automatically during play), looking away to be sure the right buttons are pressed can be rather disconcerting. The keypad functions change from game to game, so thin plastic overlays that slip over the keypad are included with each cartridge.

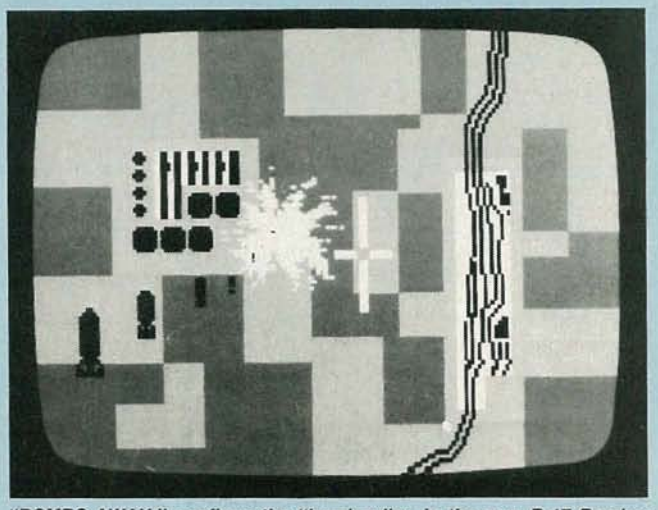
Speaking of the keypads, and the hand controllers in general, they are unlike anything else now on the market. They feature action buttons on both sides to accommodate left- and right-handed players, a thumb-operated direction disc that moves characters or cursors on the screen much like a 16-position joystick, as well as that 12-button calculator-like keypad. What makes the controllers different is that all of those things are combined into a single unit that is hard-wired to the console. When not in use, the controllers fit neatly into pockets in the case.

The console is solidly constructed; the only controls are the ON/OFF and RESET switches. Cartridges slide into a recessed slot located at the bottom right side of the cabinet. That location lessens the chance of any "contamination"—like your favorite soft drink—getting at the connector. The unit's microprocessor is well shielded to avoid possible interference to nearby TV's or radios. The shielding, however, is soldered around the circuit board. While that certainly discourages tampering by unauthorized individuals, it must also be a time-consuming headache for authorized service technicians.

Software

In the past, titles in the *Intellivision* library did not include a great many arcade-type games, but, as we'll soon see, that is beginning to

VIDEO GAMES



"BOMBS AWAY," confirms the "bombardier, in the new *B-17 Bomber* voice cartridge from Mattel.

ADD HIGH-QUALITY SYNTHETIC SPEECH to your Intellivision with the new *Intellivoice* voice-synthesis module.

change. What *was* included, however, were a great many games that could not be found anywhere else. A nice feature found in some of those was a display that shifted from a large-scale overview, such as a map or a radar screen, to a close-up of the action as you "shot it out" with your opponent.

Space Battle is such a game. Play begins with a long-range scan of the galaxy you must protect. Several fleets of enemy ships are closing in on your mother ship (enemy-fleet sizes and locations change each time the game is reset). Your job is to deploy up to three squadrons of your own fighters to head off each enemy fleet, destory it, and zoom over to meet the next set of attackers. As one squadron gets within firing range of an enemy fleet, a siren sounds, and the display switches over to show the cockpit of one fighter.

If all of that going on at once wasn't enough, you can be involved in up to three battles at once; two are handled by the game system, while you handle the third in real time.

But, it is in sports games that *Intellivision's* realism and superior attention to detail becomes evident. In *Major League Baseball*, the players run out to their positions; penalties are imposed for illegal plays in *NHL Hockey*, and so on. The realism here is so good that the "crowd" will even let you know what it thinks of your performance.

One criticism of those sports games, and of the early *Intellivision* library in general, is that they did not seem concerned with the "solitaire" player—most games required two people, one in competition with the other. That has slowly been changing, and will change even more in the coming year as a greater emphasis is being placed on games featuring solitary play.

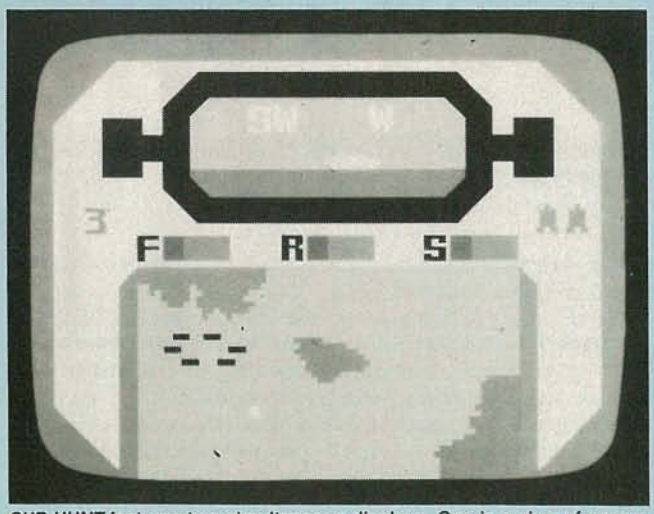
We've already looked at two of the voice games, *B-17 Bomber* and *Space Spartans* that will shortly be introduced; a third voice game—*Bomb Squad*—is also scheduled. The object of that game is to break a number code that will tell you how to disarm the bomb. Of course, there isn't too much time before it's set to go off. All in all, a rather exciting test of nerves, despite the presence of a calm, reassuring voice to help you out.

In addition to those voice games, 12 new non-voice games are also planned. (Incidently, just because you have an *Intellivoice* module installed, does not mean that you cannot use the standard cartridges—those will still work just fine, although no voices will be heard.) Several of those games are worthy of note.

Sub Hunt puts you in command of a nuclear sub in a last-ditch effort to save your country from a fleet of enemy destroyers; those are accompanied by PT boats. The display is most unusual, showing a view through a periscope, as well as a "high-altitude" view of the battle area indicating your location in relation to the enemy. The simultaneous displays are interesting—and a technique that is likely to be found in future cartridges from Mattel, as well as from others.

Among the most impressive cartridges is *Star Strike*, a challenge that any Earthbound Luke Skywalker would drool over. In that game, your space fighter is zooming along a narrow green canyon on an enemy planet bent on destroying Earth. On the floor of the canyon are five red missile silos that come into view at the horizon

ALL-IN-ONE HAND CONTROLLERS are featured in the *Intellivision* videogame unit. Those hard-wired controllers slip into pockets on the console when not in use.



***SUB HUNT* features two simultaneous displays. One is a view of enemy ships through a periscope; the other is an overhead view of the area.**

and pass under you. In the sky, ahead and to the left in your view, is the moon. Slowly, from behind the moon, Earth appears.

Your mission is to destroy the missiles before they can be launched—which happens automatically when the Earth is directly in front of the canyon. Timing here is critical, as you must blast the silos as they zoom past beneath you—that is, of course, unless you are shot down first! By the way, it's rather unnerving to see the Earth blown to bits, as is certain to happen the first few times you play the game. *Star Strike* also offers outstanding simulated 3-D effects and other graphic surprises.

For those of you who have imagined yourselves as benevolent rulers, or perhaps despots, *Utopia* may be the game for you. In it, you get to control the destiny of a small island kingdom—feeding and educating the population, coping with natural disasters, etc.

A "must have" for all fantasy and adventure fans is *Advanced Dungeons and Dragons*, based on the role-playing game of the same name. The object here is to collect a treasure from a computer-controlled maze, while avoiding the obligatory dragon.

For early *Intellivision* owners, the rollout of new cartridges was at times painfully slow. The library is now growing to a respectable size, though, and this year it is getting an infusion of software from two independent suppliers, Coleco and Imagic.

The real good news, especially for arcade-game fans, is that Coleco's first *Intellivision* titles are predominantly licensed versions of arcade games. The list is impressive: *Zaxxon, Carnival, Ripcord, Sidetrack, Turbo, Mouse Trap, Venture, Cosmic Avenger, Lady Bug*, and *Donkey Kong*. While that list is tentative, and certainly subject to change, the future does look bright for those who have missed that kind of game. In addition, a game based on the highly successful *Smurf* cartoon character is planned. *Intellivision's* high-quality graphics should lend themselves well to those arcade adaptations—but remember that your TV-set has built-in limitations that make it impossible to reproduce the crisp, detailed graphics found in arcade machines. And, even the most sophisticated home-videogame system won't be powerful enough to compare with the coin-operated versions. But at least you'll be able to play over and over again without worrying about your supply of quarters. **R-E**

MANUFACTURER

Mattel Electronics
5150 Rosecrans Ave.
Hawthorne, CA 90250

INTELLIVISION-COMPATIBLE CARTRIDGE SUPPLIERS

Coleco Industies, Inc.,
200 Fifth Ave.
New York, NY 10010

Imagic
20665 Fourth St.
Saratoga, CA 95070

Atari

VIDEO GAMES

More exciting cartridges and a new high-resolution system are mong the things Atari has in store for us this year.

DANNY GOODMAN

JUST LIKE COMPUTERS, MOST VIDEOGAME CONSOLES DO NOTHING by themselves. It takes software, in the form of game cartridges, to get the console to display a field of football players or a remote starbase under alien attack. And, again like computers, the more software, and the wider the variety of software available, the more attractive the unit.

That, in part, explains the great popularity of the Atari *Video Computer System*, or *VCS* for short. Ever since the introduction of those cartridge-based, programmable videogames in 1978-79, Atari, blessed by the financial backing of giant Warner Communications, has continually added to its library of game cartridges. Some titles were adaptations of the very popular arcade videogames manufactured by the company's coin-op division, while other titles were designed specifically for the *VCS*.

Today, while other videogame manufacturers are catching up to Atari, at least in terms of the number of cartridges available for their systems, no fewer than five outside companies, including Mattel Electronics and Coleco, have announced plans to introduce cartridges for the Atari *VCS*. And don't be surprised if others, including another major coin-op game producer, follow suit.

As we went to press, Gabriel Industries, the toy and game division of CBS, Inc., announced an agreement with Bally Manufacturing to market Atari-VCS-compatible versions of that company's videogames. Gabriel plans to have three to four cartridges available by the end of 1982.—Editor.

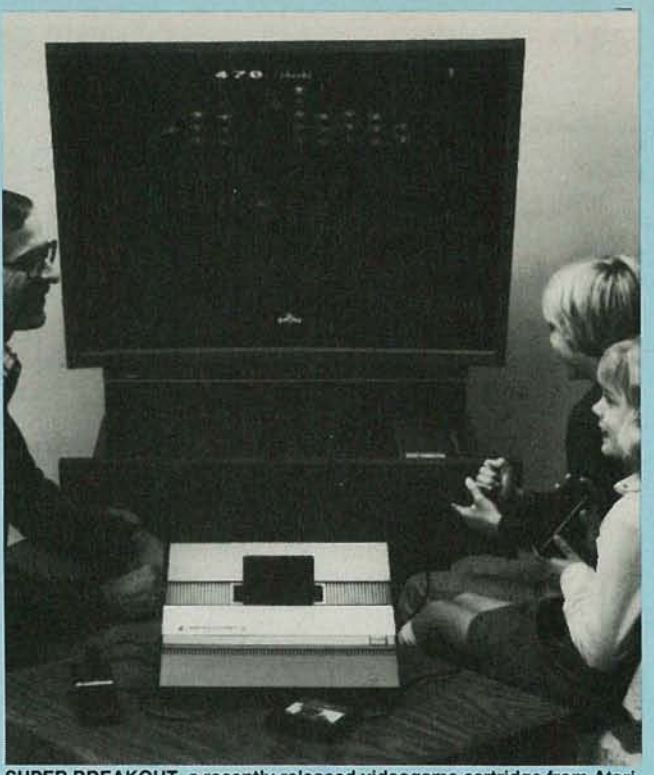
With sales of about 3 million new *VCS* consoles in 1981 alone, there is certainly a big enough audience for those cartridges. And it seems to be an audience with an insatiable appetite for new games. The number of Atari-compatible cartridges that are available is continuously changing. Currently, 89 cartridges are available, or will soon be released. Nearly half of those (45) come from Atari itself; the rest come from several independent suppliers. Those suppliers, and the number of cartridges either available or announced, are listed in Table 1.

Those cartridges make up quite a library. If you had access to all of them, and played each one for only 10 minutes, it would take you almost 15 hours to get through them all. And that's not including the time it would take to try out all of the game variations on each—as many as 112 on a single cartridge.

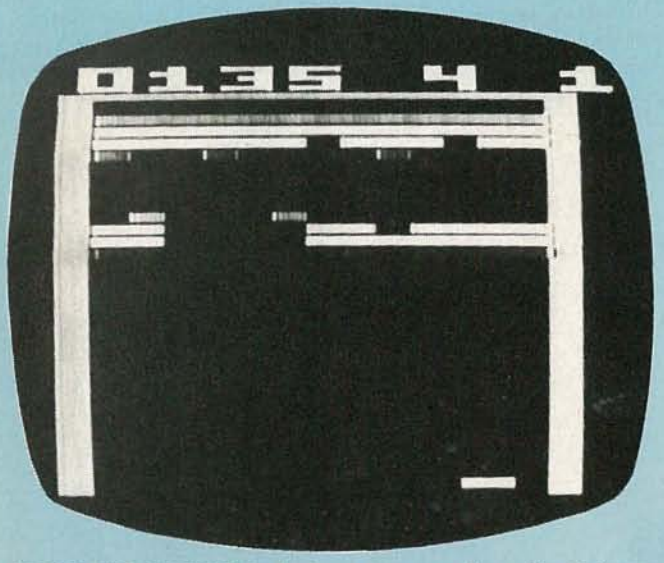
But first you need the basic unit, the *VCS*. (Incidently, the name for the game system may change later this year to end confusion with Atari's personal-computer lineup.) The *VCS* console attaches to your color or black-and-white TV set through a switch box (included) at the set's TV-antenna terminals. Plug in a cartridge,

TABLE 1
Atari-Compatible Cartridge Suppliers

Manufacturer	No. of Cartridges
Activision 3255-2 Scott Blvd. Santa Clara, CA 95051	14
Coleco 200 Fifth Ave. New York, NY 10010	9
Imagic 20665 Fourth St. Saratoga, CA 95070	3
Mattel Electronics 5150 Rosecrans Ave. Hawthorne, CA 90250	10
Parker Bros. 50 Durham Rd. Beverly, MA 01915	2
Apollo 1300 E. Arapaho St. Suite 101 Richardson, TX 75081	6



SUPER BREAKOUT, a recently released videogame cartridge from Atari, is an updated version of the popular videogame, *Breakout*.



ARCADE-LIKE GRAPHICS for the home are among the exciting features promised by the new deluxe *VCS* from Atari.

turn on the *VCS*, select the game variation that you want to play (the variation number appears on the TV screen), and you're ready to go.

Unlike many of its competitors, the *VCS's* controllers are not hard-wired into the console. Instead, four sets of plug-in controllers are available. Two of them, the joy sticks and the paddles, are included with the console; most of the games require one or the other of those controllers. A set of keypad controllers are available as an accessory; those are mainly used by the educational cartridges. The fourth controller, a special steering-wheel controller, is packaged with the only game that uses it—*Indy 500*. Unplugging and plugging-in the controllers when you're changing games can get to be a bit bothersome, but you tend to schedule your game selections around the controllers already plugged in.

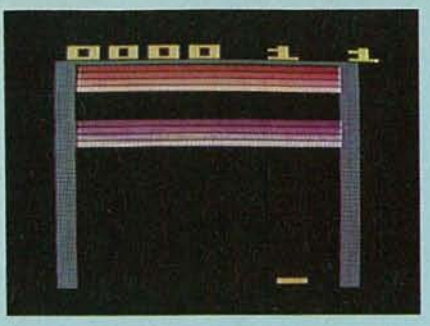
Atari's strength lies primarily in arcade-type games. Many of the original arcade coin-op versions were either developed or marketed by Atari; the rest have been licensed to Atari for their *VCS*. The list of arcade games is a long one, and one full of names that would be familiar to anyone that has ever dropped a few quarters into any of those greedy little machines. Those games include *Breakout, Super Breakout, Pac-Man, Asteroids, Missile Command, Space Invaders, Dodge 'Em*, and *Warloads*.

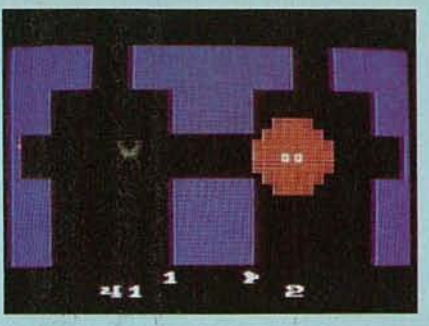
The recently introduced *Pac-Man* cartridge will probably outrank the fabulously popular *Asteroids* cartridge before long. The *VCS* version was not designed as a direct copy of the arcade game, but it has many of its features, including slightly better graphics than might be expected for a "down-sized" version of the high-resolution original.

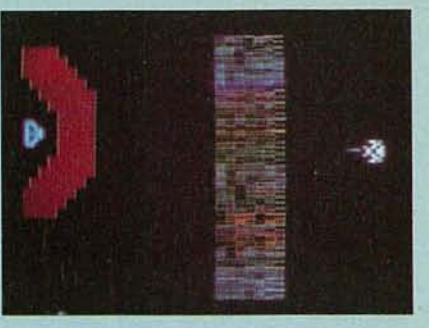
The object of the game is the same, to "eat" as many of the "dots" (actually, they look more like dashes here) in the maze as possible, without being eaten by the ghosts that are also roaming about. The maze, however, is different, with fewer straightaways and more turns. As in the original, you can turn the tables on the ghosts by eating one of the four different-colored dots; when that happens, your Pac-Man is "energized," and the ghosts turn blue momentarily and flee. That's because the Pac-Man can eat the ghosts himself when he is energized; things return to normal when the ghosts' color changes again. Clearing the maze of all dots earns you an extra Pac-Man. Limitations of the *VCS* precluded the re-creation of the arcade game's "wocka-wocka-wocka" sound, but *VCS* players who have awaited a home version of *Pac-Man* won't be disappointed. Eight levels of play offer different Pac-Man and ghost speeds, each with solitaire or 2-player versions.

Super Breakout is another impressive cartridge that was introduced in 1982. Just like the personal-computer version, the cartridge offers four different game variations. One variation, Progressive Breakout, is a sort of cross between regular *Breakout* and *Space Invaders*. Your goal, of course, is to knock out bricks by bouncing the ball up the wall above your cursor; but in Progressive Breakout, the wall moves down toward the bottom of the screen as play progresses. The longer you keep a ball in play, the faster the walls approach. New walls appear at the top of the screen with small gaps in between. The play gets frantic if you let the walls get close to the bottom of the screen. A unique feature of that game is that the sound effects are chosen at random each time you reset.

Haunted House, a fast-paced game in the tradition of the popular *Adventure* cartridge, has some of Atari's best *VCS* sound effects to





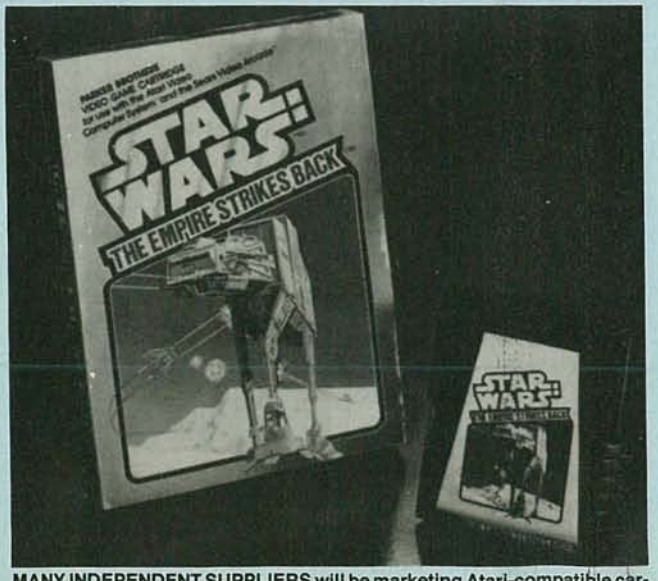


date, including an imitation of the "Twilight Zone" theme at the end of a successful search.

Yar's Revenge, which should be available by the time you read this, is better suited to experienced *VCS* players—even the best players will find some good challenges in this cartridge. The game is complex, featuring more play elements than can be covered here adequately. One of the more interesting features, however, is the shield that surrounds your ultimate target; that shield alternates between two versions, the second one being more difficult to penetrate. That causes the player to change attack strategies, reminiscent of arcade video games that offer successively more difficult variations of the game. And, if you penetrate a shield and successfully fire your cannon (no easy feat, considering all the obstacles you must dodge) you are treated to the sight and sounds of a spectacular cosmic explosion.

In addition to the Atari cartridges, many of the cartridges from the outside suppliers are worth looking into as well. While most of us are familiar with the offerings from Activision (for more on those cartridges, see the Activision story elsewhere in this issue), before the end of this year, several other companies plan to be marketing cartridges for the *VCS*. One of those, Imagic's *Demon Attack*, brings arcade-like graphics quality to the *VCS*. The game plays much like *Space Invaders*, but the demons flit about the screen, making it difficult to shoot them with your ground-based cannon. In later stages of the game, the demons split into two smaller flying creatures when hit.

Coleco's planned Atari-compatible cartridges are mostly home versions of popular arcade games like *Donkey Kong*. *Frogger*, another arcade winner, is scheduled to be released by Parker Brothers. They also have an action game based on the ice-planet scene from *The Empire Strikes Back*. In that game, you must knock out six elephant-like "Imperial Walkers" before they reach your home base. You even have a radar screen to see what's approaching from beyond what you can see on your screen.



MANY INDEPENDENT SUPPLIERS will be marketing Atari-compatible cartridges. One game will be Parker Brothers' *The Empire Strikes Back*.

New deluxe videogame

But, even with all the exciting new games about to be introduced, perhaps the biggest news from Atari is a new deluxe videogame that promises the closest reproduction of arcade-quality graphics and sound on the market. At a suggested retail price of around $350, the deluxe Atari game is no toy—it's a *serious* toy.

The sleek, dark brown and brushed chrome console has only a flush ON/OFF pushbutton switch and a slot for the special deluxe game cartridges (note: the cartridges for the older *VCS* **will not work** in the new model). A new, universal controller has been designed for this unit; each includes a joystick, a paddle, and a keypad controller, and has the PAUSE, GAME SELECT and RESET switches located right on it—no more getting up to reset the game. Like the controllers found on many competing units, the universal controllers are hard-wired to the console. (The wireless controller that was described in the January, 1982 issue of **Radio-Electronics** was not brought to market).

The TV/GAME switch box has also been totally redesigned; you never have to touch it once it is installed. Instead, the box automatically switches to GAME when the console is turned on; it switches back to TV when the console is turned off. Also, in the past the unit had to be switched off to safely remove and install the game cartridges. Now, for the first time, the TV picture simply goes black and the sound goes off when you change cartridges.

As exciting as all that is, it is the game play that may set that unit apart from anything else available. One of the earlier cartridges to be released will be a version of *Space Raiders*, originally developed for Atari's *model 400/800* personal computers. The graphics and sound quality of that cartridge equals those of the computer version, well known for its superior resolution. In addition, the game has all of the on-screen features including displays showing fuel, enemy-ship locations, deflector shields, etc. That cartridge is just one of many planned for release at the same time that the console is introduced; that is scheduled for late 1982. The other cartridges currently scheduled for introduction include a selection of space, arcade (including a high-quality version of *Pac-Man*), and detailed sports-strategy games.

There are some indications that peripherals will be available some time in the future for the deluxe videogame. Among those indications is a mysterious, multi-pronged jack that sits quietly at the back of the console; the use for that jack is currently "undefined." Among the possibilities are such things as voice synthesis, speech recognition, and...who knows what else they're dreaming up?

The good news for the owners of the older *VCS* is that there are no plans to discontinue it. Instead, as evidenced by the many new cartridges introduced, or scheduled to be introduced this year, Atari intends to keep right on manufacturing the unit and introducing more and more cartridges. After all, with well over 6 million *VCS* consoles already sold, there seems to be quite a bit of life in that under-$200 unit. **R-E**

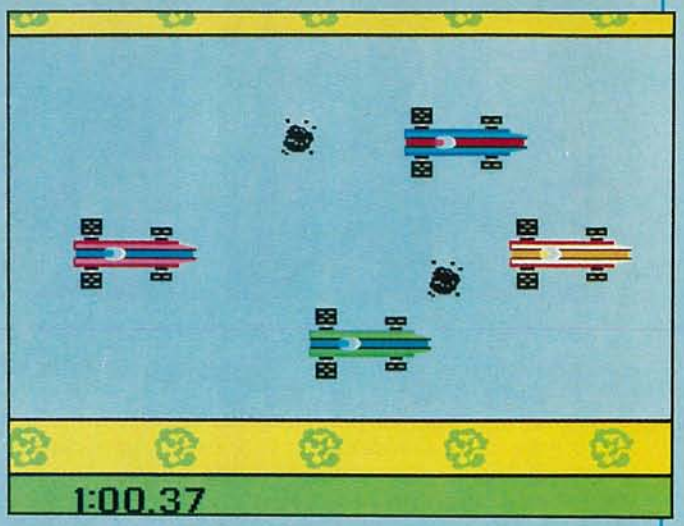
Manufacturer

Atari, Inc.
1265 Borregas Ave.
Sunnyvale, CA 94086

Activision

Easy to learn, difficult to master, this independent company's game cartridges are very popular with Atari VCS owners.

DANNY GOODMAN

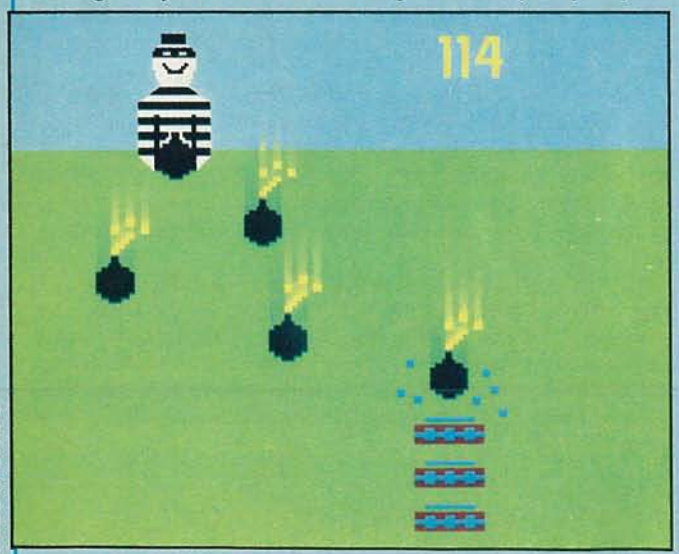


FEATURING ALL THE ACTION of Grand Prix racing, *Grand Prix* from Activision is one of that company's newest videogames.

IF SOMEONE HAD COME UP TO YOU THREE YEARS AGO AND ASKED you to invest in a new company whose sole business was the design and manufacture of videogame cartridges, what would your reaction have been? Remember—at that time, videogames were only moderately popular, and the whole industry had been known to be subject to some severe ups and downs.

Fortunately for Atari *VCS* players, a venture-capital firm liked the idea presented by four talented ex-Atari game designers and an experienced businessman named Jim Levy. Activision was born—and with it a growing library of clever cartridges for the Atari *VCS*.

Attention to even subtle details make those cartridges attractive to novice and expert players alike. For example, the boxes in which Activision cartridges are packed present a stylized but realistic artist's rendering of what you'll see on your TV screen. Activision instruction manuals (except for *Bridge*) are laid out in such a way that the new-cartridge owner can get a quick idea of how to start playing the game without doing a lot of studying. Also included are strategy tips and a few paragraphs written by the designer. Best of all, however, the manuals offer an indication of what kind of score a skilled player should be able to attain. Having a goal to work toward makes the games very addictive ("I can do it *this* time."), and also gives you some feedback as to how well you're mastering the cartridge. If you do reach that "magic" score, you qualify for membership in Activision's High Scorer's Club for that game. By the end of 1981, a total of over 12,000 players had made it.



A NERVE-WRACKING TEST of hand-eye coordination, the fast action of Activision's *Kaboom* is typical of that company't titles.

The real fascination of the Activision cartridges, though, lies in the playing. For the most part, the games are fairly easy to learn, but very difficult to master—a compelling combination. You'll find yourself reaching for the Activision cartridges to introduce a first-time videogame player to the fun that your *VCS* provides, but you'll also find yourself playing those same cartridges over and over.

One of the newest cartridges is *Barnstorming*. In it, you're in a race against the clock to maneuver a bi-plane over windmills and through open barn doors, while avoiding the birds that are flying at random overhead (hitting a bird slows you down). It may sound simple—and it *is* simple to learn—but going after the qualifying time of 33.3 seconds on even the easiest course (there are four different ones) is no piece of cake.

Another new game, *Grand Prix*, features the thrills of grand-prix style racing. In that game, brightly colored cars zoom down a roadway, dodging oil slicks, crossing bridges, and avoiding collisions. The player uses the joystick as a steering device, brake, and throttle as he steers around one of the four courses on the videogame cartridge.

The mission in *StarMaster*, a game scheduled for introducction in June, 1982, is to protect four starbases from enemy attackers. That game is one of the more complex ones available for the Atari *VCS*, featuring a switchable display, ship status reports, and starbases with which the player can dock for repairs and refuelling. Having played a prototype cartridge, *StarMaster* looks like a sure winner.

A number of the recent games, *Barnstorming* among them, use the same graphic technique of having a stationary player/character move only up and down on the left side of the screen, with targets or barriers scrolling across the screen. The games themselves, however, offer vastly different situations and require different strategies for good results. In *Chopper Command* (another new game for June), for example, the object is to protect an army convoy from enemy attack using a helicopter gunship that flies overhead.

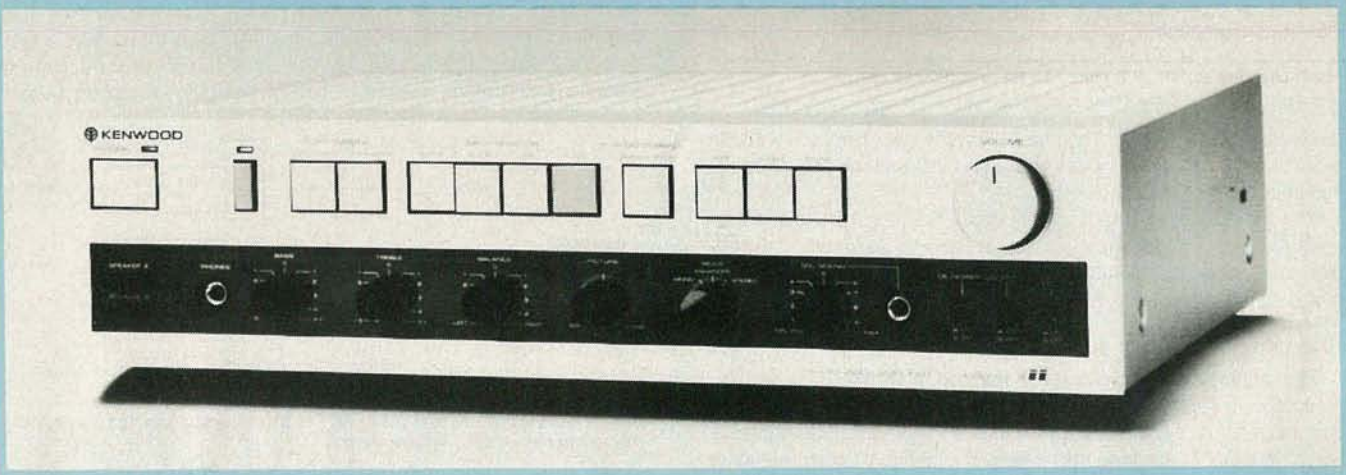
For the future, Activision is beefing up its already impressive team of designers with the addition of three new people, and plans to develop cartridges for other videogame systems in addition to Atari, most likely for Mattel's *Intellivision*. **R-E**

MANUFACTURER

Activision, Inc.
3255-2 Scott Blvd.
Santa Clara, CA 95051

VIDEO GAMES

Enhance the performance of your home-entertainment center with this new device from Kenwood. It also makes your home videogame sound more like the coin-operated versions.



Kenwood KVA-500 AUDIO/VIDEO Enhancer

JERRY and ERIC EIMBINDER

IF YOU WERE ASKED TO DEFINE WHAT MAKES UP A COMPLETE HOME-entertainment electronics system, what components would you include? Obviously, you'd list the basic video (TV receiver, VCR, videodisc player) and audio (turntable, audio-tape deck, amplifier, tuner) necessities but what else would you include? One thing that you probably wouldn't mention (simply because you haven't heard about it) is an audio/video amplifier.

The first of those units is the Kenwood *KVA-502*. At first glance, that device might be mistaken for a sophisticated switch box. Twenty-three input jacks at the rear of the unit, and multiple front-panel controls, provide the flexibility needed to interconnect almost any home-entertainment setup.

But, while the unit *does* act as your home-entertainment control center, that is not its only purpose. What it does besides is to offer, in one package, a number of functions that upgrade the performance and ease the use of a home-entertainment system. In addition to being an audio amplifier with a power rating of 50-watts RMS minimum per channel (see Table 1 for other audio-amplifier specifications), here are some of the things that the unit does.

Video enhancer

The unit has a circuit that shapes the pulse waveform of the video signal to adjust image quality. That circuit can be used to increase the high-frequency gain to make the image sharper, or to lower that gain for a softer image. That is shown in Fig. 1.

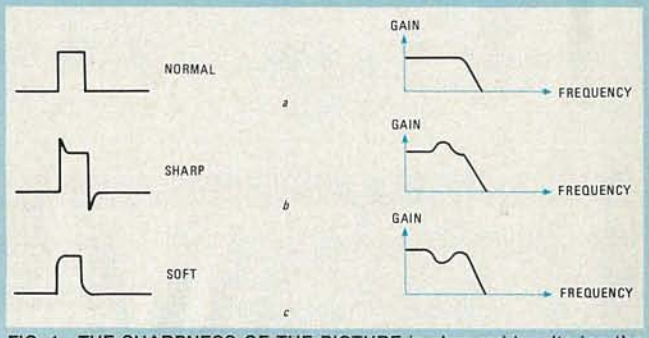


FIG. 1—THE SHARPNESS OF THE PICTURE is changed by altering the shape of the video signal's pulse waveform. That is done by altering the signal's gain at 1-2 MHz. Increasing the gain sharpens the picture; decreasing the gain softens it.

Simulated stereo

Although it is available elsewhere, television with true stereo sound is still unavailable in the U.S.—a situation that seems unlikely to change in the near future. For those getting impatient with the wait, the *KVA-502* separates monaural signals into left- and right-channel signals to provide a pseudo-stereo effect. That is done by feeding the monaural input through a non-inverting amplifier into a

TABLE 1
***KVA-502* Specifications**

Power per channel, minimum, RMS, with 0.05% maximum total harmonic distortion*	50 watts
Clipping power at 8 ohms	70 watts
Clipping headroom at 8 ohms	1.5 dB
Intermodulation distortion at rated power into 8 ohms	0.003%
Power consumption	2.7A

*Both channels driven, at 8 ohms, 20 Hz to 20,000 Hz.

three-stage phase shifter. The phase-shifted signal is mixed with the monaural signal (which is not phase-shifted) and the mixed signal becomes the left-channel output.

The right-channel output is obtained by taking the same phase-shifted signal, further phase-shifting it through an inverting amplifier, and mixing the resulting signal with the monaural signal. A block diagram of that system is shown in Fig. 2.

Reducing videotape audio noise

The signal-to-noise ratio for an audio signal recorded on videotape is approximately 40 dB. That is relatively poor when compared to the performance provided by ordinary audio-cassette tapes. In many cases, tape hiss is very noticeable when a videotape is played back. To reduce that hiss, the audio/video amplifier contains a circuit that changes the frequency response in accordance with the level of the input signal.

Dubbing

The audio/video amplifier can also be used for both audio and video dubbing. Audio signals from an audio tape-deck, tuner, or phonograph can be dubbed onto the videotape with ease. Dubbing a video signal from a VCR or videodisc player, or dubbing audio and video simultaneously from two separate sources, is also easy.

Videogames

Videogame systems are certainly an important part of a home-entertainment system. The sound effects found on currently available cartridges range from primitive to resourceful. While most of the sound and music adds enjoyment to the games in its own right, playing it through the audio/video amplifier can give it an almost "arcade-like" quality.

For example, the fun is multiplied when a player beats his opponent (or the computer) at Intellivision's *Checkers*, as a victory march is much more impressive when it is heard in stereo. Of course, if you lose to the computer, the arcade-quality "Bronx cheer" it gives you (no one ever said that computers were good sports) is just that much more devastating.

The sound effects in *Checkers* are typical of the kind of things found in most *Intellivision* games. In both *Space Battle* and *Sea Battle*, a hit results in a loud explosion. In *Armor Battle*, as tanks fire on each other, the first two hits result in explosions, indicating that some damage has been done. But the third hit produces a larger-scale explosion indicating that the tank has been destroyed.

In *Horse Racing*, music from the *William Tell Overture* opens the action; "Call To the Post" plays as the horses enter the track. As the horses run, their hoofs can be heard pounding on the track and, as the winner crosses the finish, the crowd roars. *Math Fun* has especially unusual sound effects including tom-toms, bird calls, splashing water, and the roar of a lion. Atari also uses interesting sound effects in many of its cartridges. *Space Invaders* uses a rythmic beat to intimidate players, and *Missile Command* concludes with eerie sound effects as the player's last city is destroyed—a sort of preview of the "end of the world."

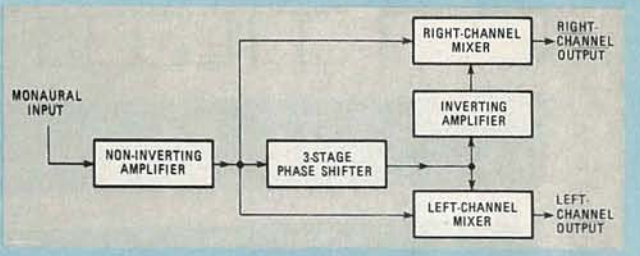


FIG. 2—A PSEUDO-STEREO EFFECT is produced by the Kenwood *KVA-502* using the system shown here.

Most of the sound effects in videogames are simply intended as background, but, in some cases, sound plays a more important role. In Atari's *Brain Games*, for instance, sound is deliberately used to distract a player as he tries to solve problems; the same cartridge also permits the player to create his own musical passages.

Some also does a great deal to enhance the realism of the games. One example is the engine roar in Activision's *Dragster*.

Videogame sound is often impressive in its own right, but when played through the Kenwood *KVA-502*, a noticeable improvement occurs. Incidently, keep in mind that you will need an adaptor plug (those are easily found in many electronics stores) if you are going to connect your videogame to the Kenwood unit, or, for that matter, directly to a VCR. **R-E**

MANUFACTURER
Kenwood Electronics, Inc.
1315 E. Watsoncenter Rd.
Carson, CA 90745

PREVIEW: COLECOVISION VIDEOGAME SYSTEM

IF YOU THOUGHT THAT THE CHOICE AMONG home-videogame systems was tough with four big names to choose from, it won't be any easier when *Colecovision* appears in the stores this fall to make a fifth!

Prototype units and cartridges shown at the 1982 Toy Fair, held in New York early this year, gave the impression of remarkable high-resolution graphics for a home game in the $200 price range.

Scheduled to be included with the console is *Donkey Kong*, a licensed cartridge version of the popular arcade game. Of the more than 20 cartridges planned to be released this year, most are licensed versions of arcade and other games, including *Challenger Chess* from Fidelity Electronics.

Probably the most significant feature of the Coleco unit is an expansion slot in the front of the case. While it may be used for voice-synthesis modules or a computer keyboard later on, this year Coleco plans to have ready for it a module that will accept all Atari, and Atari-compatible, cartridges. The graphics are said to be Atari VCS-quality.

That will allow Atari owners who want another game console to continue using their present Atari game libraries. And those whose first videogame is the new *Colecovision* will have immediate access to more than 80 Atari-compatible cartridges, as well as to Coleco's own cartridges. Now *that's* entertainment. **R-E**

VIDEO GAMES

Handheld and Tabletop Games

Games have gone from arcades to home TV-sets, and from there to self-contained tabletop and handheld units. Here's a look at portable games that are new for '82

DANNY GOODMAN

THE 20 BILLION QUARTERS THAT AMERICANS DROPPED INTO arcade-game coin slots last year seem to have attracted the attention of virtually every non-video electronic-game producer. The result: By Christmastime this year, you'll be able to buy a handheld or tabletop version of practically every popular coin-operated video game in the arcades today; and many of the games will closely resemble scaled-down versions of the big arcade-boxes.

The big arcade games (the ones that eat your quarters) use special color-TV picture tubes that give a very high degree of resolution and bright colors. However, until someone develops a flat panel, low-power color video-display, that sort of detail will have to remain in the arcades.

The displays used in the handheld and tabletop games generally consist of two types—vacuum fluorescent and LCD (*L*iquid *C*rystal *D*isplay). Light-emitting diodes (LED's), popular until recently, are no longer used—they consume too much power and cannot give the resolution that the other types can.

Vacuum-fluorescent displays work by causing pre-shaped gas-filled areas to glow. Several colors are available—and can be used in the same display panel—and more can be created by using filters. (For example, a red filter will change blue to purple.)

Liquid-crystal displays, so far, are monochromatic—that is, black-and-white. Colored LCD's are under development, though, and we'll probably be seeing them in a year or two.

Still, the visual results are impressive, and so are the games.

Coleco's collection of tabletop arcade-derivatives will entice the arcade-goer who is hooked on any of such popular games as *Pac-Man, Galaxian, Donkey Kong, Berzerk, Omega Race,* and *Frogger*.

We spent some time with the Coleco *Pac-Man* game to see how it compared with its big brother from Midway Manufacturing. The maze layout resembles the original arcade game more closely than that of any other licensed *Pac-Man* game we've played, but has only 64 dots and 4 "energizers" due to its small display size. Two levels of skill are selectable.

The display is a detailed, multi-colored vacuum-fluorescent type, showing a yellow Pac-Man and four red-outlined monsters in pursuit. When the Pac-Man is "energized," the monsters temporarily lose one small yellow dot of the three comprising their "innards," indicating that they are vulnerable. As in the coin-operated version, you earn an extra Pac-Man when you reach 10,000 points. The sound is good, too—though not the "wocka-wocka-wocka" of the coin-operated game. At the beginning of the game, the player is even treated to the *Pac-Man* musical theme.

Two game-variations included were even more fascinating than the original. In an untraditional 2-player Head-to-Head Pac-Man game, there are two Pac-Men and each human player has control over his own. Each goes after dots and monsters (when "energized") in competition with the other. At the end of the game, the

AMONG THE MOST POPULAR arcade videogames, *Defender* is now available in a handheld version from Entex.

LONG BOMB FOOTBALL **from Mattel gives you a chalkboard view (X's and O's) of the action.**

SURE TO BE POPULAR with adventure and fantasy game fans, Mattel's *Dungeons & Dragons* is a pocket-sized version of that role-playing game.

display indicates which player scored the most points, and by how many points he beat his opponent. The other variation, called Eat & Run, is an even tougher challenge, because the Pac-Man must not only eat the "energizers," but bring them back inside "home base," with its randomly opening gate, to score.

All the Coleco arcade replicas have 2-player head-to-head games as well as the original solo game, and cost under $70 each.

Other *Pac-Man* (and similar) gobble-games will also tempt the arcade afficionado. Tomy has two *Pac-Man* handheld games, the most challenging one being *Pac-Man II*, which features a multi-colored vacuum-fluorescent display (about $65). And Bandai's popular *Packri Monster*, which first appeared in time for Christmas last year, will still be available.

A popular arcade-game feature that keeps the play interesting as a player's skill improves is that of displaying different graphics challenges at increasingly difficult levels. We find that happening in several home versions of arcade favorites.

For example, Tomy's *Scramble* offers five progressively difficult levels of obstructions to avoid, and attacking objects to hit. Also from Tomy is *TRON*, based on the Walt Disney special-effects movies just being released. Featured here are actually three different games in one handheld unit and played in order of difficulty. Both units feature multi-colored vacuum-fluorescent displays.

But perhaps your arcade favorite is *Defender*, *Super Cobra*, *Stargate*, *Turtles*, *Spiders*, or *Crazy Climber*. If so, then Entex has a handheld or tabletop game for you. In *Defender* (about $50), you need almost the same dexterity as you do for the arcade version. You have UP, DOWN, REVERSE, SMART BOMB, THRUST, and FIRE buttons to worry about as vacuum-fluorescent ships try to take away the planet's people.

Non-arcade games

Adventure/fantasy-game players have a good selection to choose from this year. One of the most appealing is Mattel Electronics' LCD *Dungeons & Dragons* pocket game. About the size of a credit card, and perhaps ¼-inch thick, the game puts you in a maze of rooms. Hidden among the rooms are a dragon, an arrow with which to slay the dragon, bats that can pick you up and drop you anywhere, deep pits, and ladders to help you out of the pits. Your goal is to deduce the location of the dragon, and attack it from an adjacent room. The detailed display keeps you entertained with such things as a depiction of your warrior using his ladder to climb out of a hazardous pit. Rooms are numbered in a grid pattern to help you picture in your mind where you are in relation to dangers you've experienced. Because of its small size (offering extreme portability) and reasonable price (under $35), Mattel's pocket *Dungeons & Dragons* just might be the most popular handheld of the year.

Some favorite board games have been updated through elec-

ANOTHER ARCADE GAME in handheld form, *Super Cobra* from Entex can be played by one or two persons.

ELECTRONIC HANDHELD AND TABLETOP GAME MANUFACTURERS

Applied Concepts, Inc.
207 North Kirby St.
Garland, TX 75042

Bambino, Inc.
2049 Century Park East
Los Angeles, CA 90067

Bandai America, Inc.
6 Pearl Court
Allendale, NJ 07401

Coleco, Industries, Inc.
200 Fifth Ave.
New York, NY 10010

Entex Industries, Inc.
303 W. Atresia Blvd.
Compton, CA 90220

Fidelity Electronics, LTD.
8800 N.W. 36th St.
Miami, FL 33178

Mattel Electronics
5150 Rosecrans Ave.
Hawthorne, CA 90250

Milton Bradley
PO Box 3400
Springfield, MA 01101

Parker Brothers
50 Dunham Road
Beverly, MA 01915

Radio Shack
One Tandy Center
Fort Worth, TX 76102

Selchow and Righter
2215 Union Blvd.
Bay Shore, NY 11706

SciSys Computer, Inc.
Suite 7967
One World Trade Center
New York, NY 10048

Tomy Corp.
901 East 233 St.
Carson, CA 90745

Tryom, Inc.
23500 Mercantile Road
Beachwood, OH 44122

MONOPOLY PLAYMASTER **from Parker Brothers does not replace the popular board game, but instead becomes part of the action.**

tronics this year. Milton Bradley's popular *Stratego* is now also available as *Electronic Stratego*, a clever version that adds sound effects and interesting play aspects to an already good strategy game (under $50).

Of course, *Monopoly* has not been immune from some electronic wizardry. Thus, this year we see *Monopoly Playmaster* (about $65) from Parker Bros., makers of the board game. *Playmaster* does not replace the board game, but becomes integrated into board play, speeding up the game all the way through. It rolls electronic dice for each player, forces auctions of unowned properties, and gets the negotiation process among players going more quickly. Sound effects are added, like the tune "I've Been Working On The Railroad" when someone lands on a railroad property, or "Taps" when a player goes bankrupt.

For those with a taste for the more traditional board games, several manufacturers (Mattel, Fidelity, Tryom, SciSys, Novag, Applied Concepts, and others) offer electronic versions of chess and/or backgammon. Selchow and Righter, makers of the very popular word game, *Scrabble*, also offer an electronic word game, *Lexor*.

THIS CARTRIDGE-PROGRAMMABLE STAND ALONE, recently announced by Entex, promises better graphics than any other handheld or tabletop game.

ONE OF THE MOST POPULAR arcade videogames of all times, *Pac-Man*, and *Pac-Man*-type games are available in a wide variety of home versions including this tabletop one from Coleco.

Even a few old favorite electronic games are getting updated this year. Mattel Electronics, who started the handheld business "way back" in 1978 with a couple of sports games, brings a new car-racing game *(Speed Freak)* and two new football games—all using detailed LCD displays. One of those, *Long Bomb Football* (under $40), gives you a chalkboard view (X's and O's) of five players each for offense and defense. As quarterback, you first program how long a pass you want to toss (6, 10, 20...etc. yards). You then hike the ball and dodge defensive tackles while giving your receiver time to get downfield. When you think it's time, you let 'er go and see the players and field scroll under the ball. As the scrolling begins to slow (indicating that the ball is starting to come down), you've got to position your receiver under the ball just right—otherwise it's an incomplete pass, or even an interception! Other entertaining sports-type games are made by Coleco and Bambino, among others.

The immensely popular *Merlin*, by Parker Bros., is joined by *Blue Master Merlin* (about $45), that offers nine new activities around a lighted keyboard similar to its little red brother.

Radio Shack offers a line of handheld games; new models are usually introduced in time for Christmas.

Choosing a game

There is plenty to choose from this year in handheld and tabletop electronic games. If it's at all possible, play with the games you're interested in at the stores before you buy them. If you're looking for an arcade replica, for example, the vacuum-fluorescent or LCD display may not measure up to the standards you had in mind. (However, Entex has announced a cartridge-accepting stand-alone game for about $75 that has a 6000-dot matrix display.)

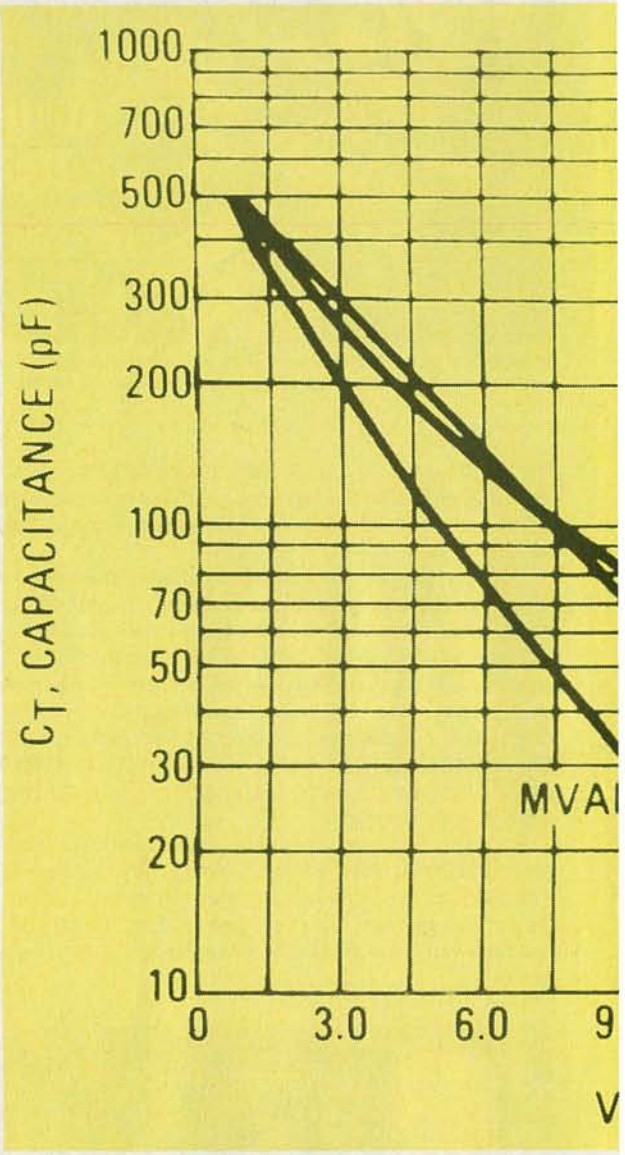
Also, see how well you score your first couple of times "at bat"—even on the higher-skill levels. If you do well, then it's a sure thing you'll be able to master the game too quickly and soon put it away on a shelf to be forgotten. The trick in choosing a good game is finding one that is challenging even after a lot of play.

Take your time and be selective, and you'll find the game that brings you and your friends or family the most fun. **R-E**

How To Design ANALOG CIRCUITS

Special Purpose Diodes

Diodes can do more than just rectify AC. Here's a look at some of the specialized diodes, including varactor and tunnel diodes.



MANNIE HOROWITZ

LAST MONTH, WE DISCUSSED JUNCTION diodes and Zener diodes. We looked at their characteristics and how circuits are designed using them. However, the term "diode" encompasses more than just junction and Zener diodes. This month, we will expand our discussion of diodes to include the "specialized" diodes such as tunnel, pin, and varactor diodes.

Tunnel diodes

When both semiconductor slabs of a junction diode are much more heavily doped, the diode characteristic curve changes dramatically. In fact, the characteristic curve no longer resembles that of a standard junction diode. The new device is called a *tunnel* diode and a typical characteristic curve is shown in Fig. 1. Here, the current through the tunnel diode rises rapidly until it reaches a peak. The peak occurs when about 0.07 volt is applied across the diode. The peak current is I_p and the voltage at which it occurred is V_p. As the voltage across the diode is increased further, you would expect the current to rise. Instead, the current drops and keeps on dropping as the voltage keeps on rising. The current continues to decrease until a voltage, called the valley voltage (V_v), is applied across the diode. At that voltage, between 0.3 and 0.6 volt, the characteristic reverts to that of an ordinary junction diode. The current begins to rise with an increase in voltage.

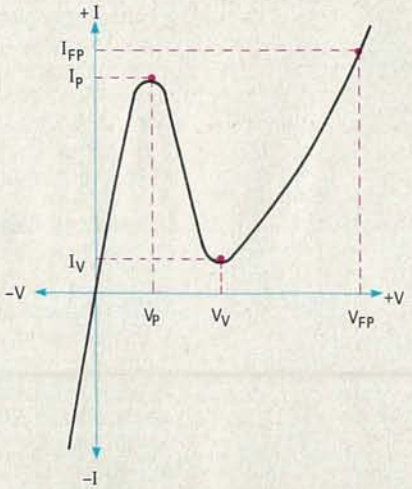
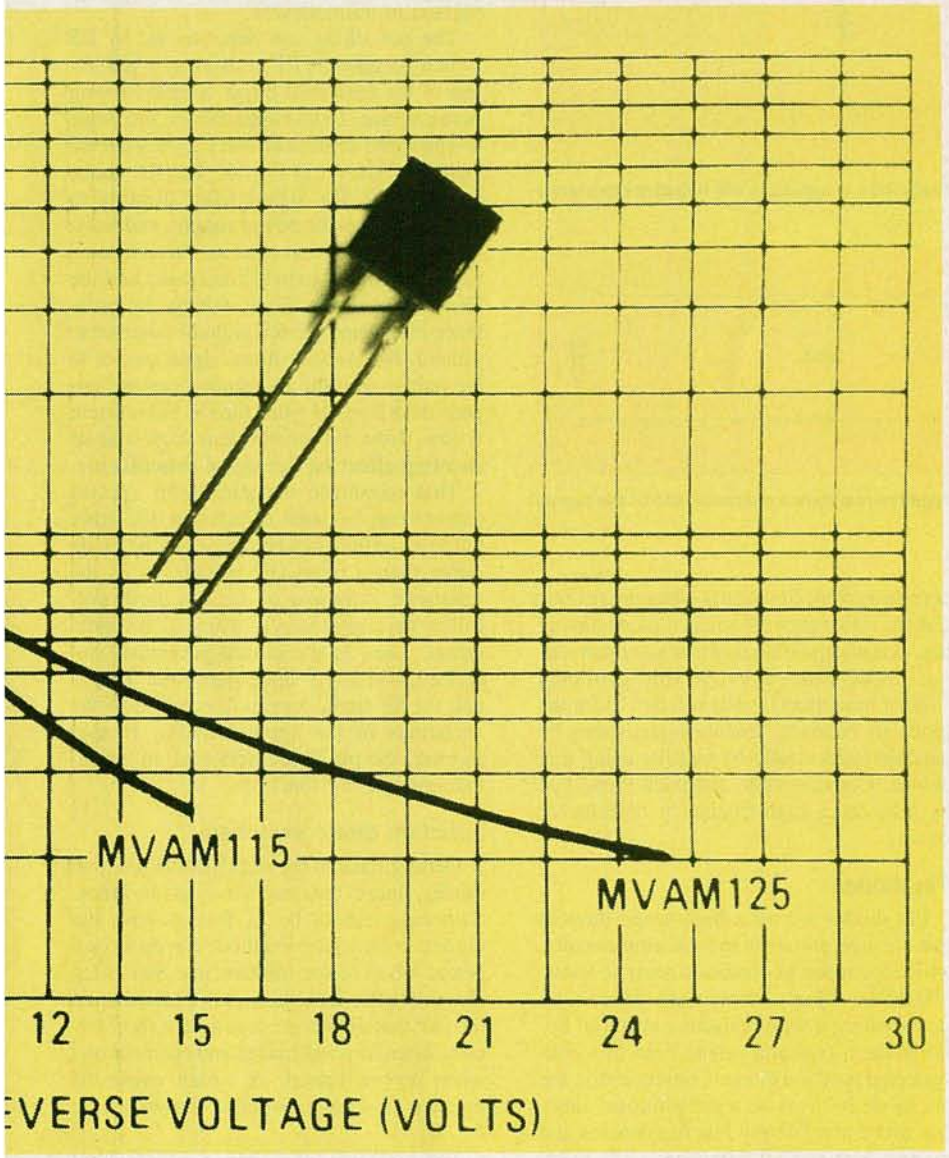


FIG.1—TUNNEL-DIODE characteristics are due to doping the semiconductor material heavily. Maximum allowable forward current through the diode is I_{FP}, so forward voltage must not exceed V_{FP}.

Taking a closer look at the characteristic curve in Fig. 1, we get one very important bit of information. When the current rises as the applied voltage is increased, the AC resistance (equal to V/I), is positive. We can see that more clearly with the help of Fig. 2-a. The AC resistance of that rising characteristic, is V = 30 − 20 = + 10 divided by I = 3 − 2 = +1, or +10 ÷ +1 = +10.

Figure 2-b shows a characteristic where the current drops as the voltage is increased.



Calculating the AC resistance for Fig. 2-b: V = 20 − 30 = −10 and I = 3 − 2 = +1, so the AC resistance here is −10 ÷ +1 = −10. The minus sign indicates that the slope of the line in Fig. 2-b is negative. The line represents the characteristics of a negative resistance.

Using that information, we can see two positive slopes or resistances on the tunnel-diode curve in Fig. 1 and one negative slope. The negative slope indicates that the diode behaves as a negative resistance when the applied voltage is between V_p and V_v.

The tunnel diode is a high-speed device; as such, it is used primarily in high-frequency applications. Applying those characteristics, the tunnel diode is used primarily as an RF oscillator, high-speed switch, or an RF amplifier. Let's see how.

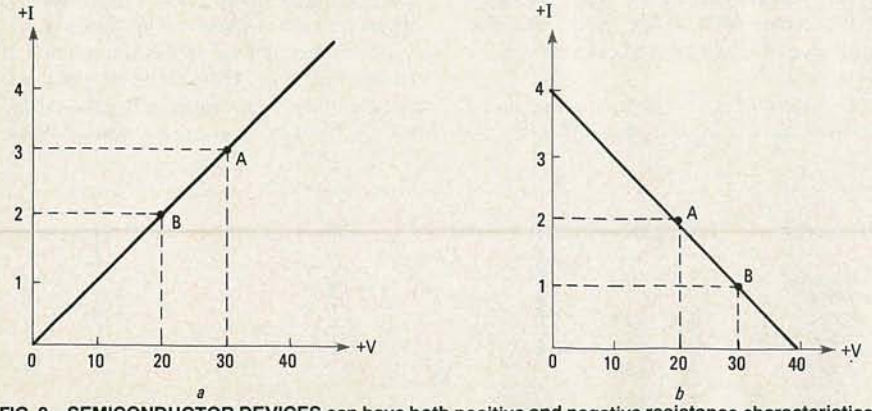


FIG. 2—SEMICONDUCTOR DEVICES can have both positive and negative resistance characteristics. A positive-resistance characteristic is shown in *a*, and a negative-resistance characteristic is shown in *b*.

Tunnel-diode applications

As an amplifier, the tunnel diode should be biased at about the center of the negative-resistance slope of the curve. That spot is referred to as the *inflection point*. Current at that point, I_o, is usually equal to about $I_p \div 2$. The current I_o is also known as the inflection current. The load at the output of the amplifier can be an L-C-resonant tank circuit, or it can be a simple resistor.

A tunnel-diode amplifier circuit using a load resistor is shown in Fig. 3. The diode is forward-biased by battery B1 through resistors R1 and R_L so that with no input voltage, the current through the diode is equal to I_o. With no input signal, a constant voltage is developed across load resistor R_L equal to $I_o \times R_L$. Should the RF input signal be at its peak amplitude, the current flowing through the diode is reduced, thereby reducing the instantaneous voltage developed across R_L. During the negative-voltage portion of the input cycle, current flowing through R_L increases in the positive direction. The voltage across R_L is now at a peak. The ratio of the peak-to-peak voltage developed across R_L to the peak-to-peak input voltage, is the voltage gain of this circuit.

If the amplifier is to do its job properly, the bias voltage must be stable. It must operate within its frequency limits. To meet that requirement, the input frequency should be less than one-third of R_o, a quantity specified in the data sheets as the *resistive cut-off frequency* of the tunnel diode. Another specified value is f_{xo}, the *self-resonant frequency* of the diode. The signal to be amplified must also be below that frequency. Proper amplification also requires a relatively low noise level, so that the noise will not mask the amplified signal. Diodes can be judged for that factor by considering the product $10 \times I_p \times R_n$, defined as the *noise constant*. Here R_n is the resistance at the negative portion of the diode characteristic. The noise produced by a tunnel diode is lowest when the noise constant is lowest.

Similar requirements must be taken into account when the diode is used in a negative-resistance oscillator circuit. Such a circuit is shown in Fig. 4. The tunnel diode is again biased in the negative-resistance region. Resonant circuit L-C has resistance losses, due to its components. The negative resistance of the diode compensates for those losses.

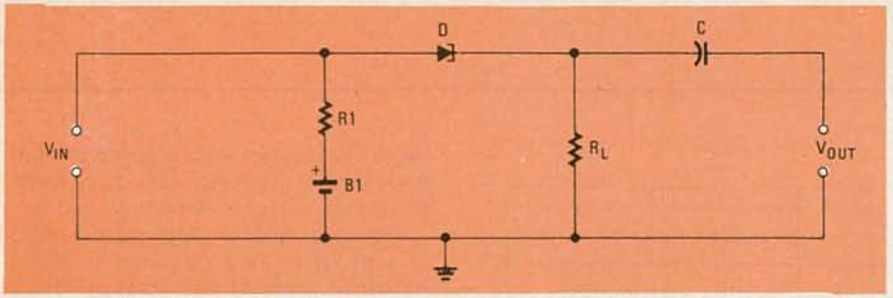


FIG. 3—RF AMPLIFIER using a tunnel diode. The tunnel diode is biased in the negative-resistance portion of the characteristic curve.

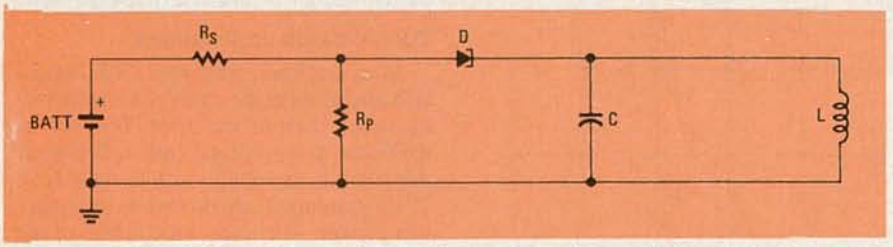


FIG. 4—RF OSCILLATOR using a tunnel diode. The negative-resistance characteristic of the tunnel diode overcomes the losses in the tank circuit.

The L-C circuit must be adjusted so that the circuit oscillates below the *resistive cut-off frequency*, f_{ro}. Care must be exercised when constructing the circuit so that the diode leads, as well as all other leads, are kept as short as possible. Otherwise the gain and output power will be limited at high frequencies. Use diodes with high I_p specifications to maximize the possible output signal.

A tunnel diode can be used effectively as a switch, because of its high-speed capabilities. Such a switching applicaiton is shown in Fig. 5. The diode is biased in the positive-resistance portion of the curve closest to the y-axis. The voltage across the diode at that point is less than V_p (see Fig. 1). A positive trigger-pulse raises the current through the diode to I_p. Because the current cannot go above I_p, the operating point jumps to the second positive-resistance portion of the curve, farther from the y-axis, and remains there. It stays there so long as there is no negative pulse applied to the circuit. Once a negative-voltage trigger-pulse is applied, and if it is of sufficient magnitude, the current drops below I_v. Because current cannot go below I_v, the operating point jumps back to the original positive-resistance section of the curve. Now the output voltage is relatively low and remains at that level until there is once again a positive trigger-pulse. The circuit, therefore, has two stable states; one state is when the output voltage is high and the other state is when the output voltage is low. The state the circuit is in depends upon the polarity of the last applied input pulse. The circuit in Fig. 5 is consequently referred to as a bistable switching circuit.

Applications can also be found that use the reverse-bias characteristics of the tunnel diode. Here, reverse current increases with increasing reverse voltage. Note, however, that unlike a standard junction diode, the reverse-current flow starts when the reverse voltage is just above 0 volts. A diode having that characteristic is known as a *unitunnel* or *back* diode. Since a reverse voltage of only slightly more than 0 volts is required for the diode to conduct, minute signals can be handled successfully by circuits using that device. Consequently, the back diode can be used as a high-frequency detector or mixer.

Pin diodes

Pin diodes are ultra-high-speed devices that are used primarily in switching circuits, where the speed of operation must be above 300 MHz. Those devices are formed by sandwiching a high-resistance material between the n-type and p-type slabs of a conventional junction diode. Consequently, the pin diode behaves as a conventional junction diode at relatively low frequencies and as a resistor at high frequencies. The frequency at which the transition occurs can be calculated using a specification that is found in the data sheets for pin diodes. That specification is commonly called the *recombination lifetime* or the *effective minority carrier lifetime* and its symbol is τ. The frequency at which the diode action stops, and the resistance characteristic takes over, is $f_o = \frac{1}{2} \times \pi \times \tau$.

At frequencies above f_o, the pin diode behaves as a current-controlled resistor. The actual resistance can vary from one ohm to more than 10,000 ohms depending on the current flow through the pin diode. The resistance at a given current flow is approximately equal to 48/I, when I is expressed in milliamperes.

The pin diode can function as an RF switch because its RF resistance is a function of the amount of direct current flowing in the device. In this application, the diode can be wired across a circuit carrying the RF signal, as shown in Fig. 6. The RF choke prevents the RF signal from shorting to ground through the power supply, and resistor R sets the DC bias current when switch S is closed. When switch S is closed and the DC current in the diode is high, its resistance is low and the RF signal is shorted to ground. No, or very little, signal passes to the output. But the pin diode does not impede the RF signal when the DC bias current is low. Now its resistance is high and its shunting effect on the signal is negligible.

That resistance variation with applied current can be used effectively for other purposes. Audio can be applied to the diode rather than a fixed DC voltage. Now the resistance variations of the pin diode will follow the amplitude variations of the audio signal. Used in the circuit previously described, where the diode shunts the RF signal, the RF signal level will now follow the variations in the applied audio. In that fashion, the pin diode performs an amplitude-modulating function.

Junction diode switches

Getting back to the standard PN junction diodes, those too can serve as switches. Switching cannot be as fast as with pin diodes, but the junction diode can do a competent job at lower frequencies. Switching characteristics and abilities are based upon the fact that diodes are practically short circuits when forward-biased and open circuits when reverse-biased. A circuit using the junction diode as a switch is shown in Fig. 7.

The diode is forward-biased and conducting when the switch is set to ON. Now the audio signal will pass through the diode to the output. The two capacitors prevent any DC from appearing at either the input or output terminals. When the switch is set to OFF, the anode of the diode is negative with respect to the cathode. The diode is reversed-biased and no significant amount of current will flow. Obviously, the peak amplitude of the audio signal must not exceed the DC voltage level or the diode will be-

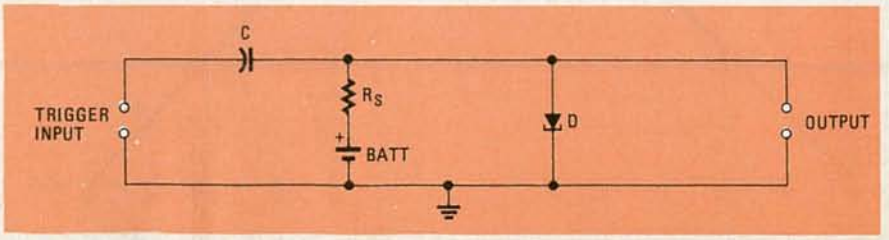


FIG. 5—A BISTABLE SWITCHING circuit using a tunnel diode. The circuit changes state in response to trigger pulses.

come forward-biased and conduct.

A very fast-acting switching circuit can be constructed using the *snap-off* or *step-recovery* type junction diode. Here, charge is stored in the diode when it is forward-biased. After being reverse-biased, the charge is depleted. The diode turns off instantly once the charge is no longer present.

When ordinary diodes are switched off, a reverse current keeps flowing for a short interval. Then the reverse current diminishes slowly until no significant amount of current is left to flow. Should the snap-off diode be used, the reverse current shrinks to zero in a practically infinitesimal time.

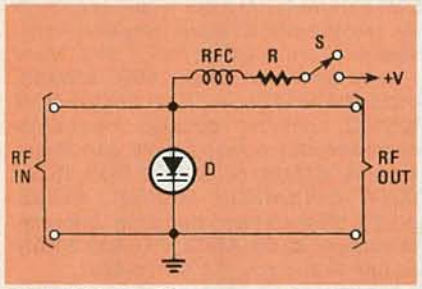


FIG. 6—PIN DIODES are commonly used in high-frequency switching circuits. Here, a DC voltage switches the RF signal on and off.

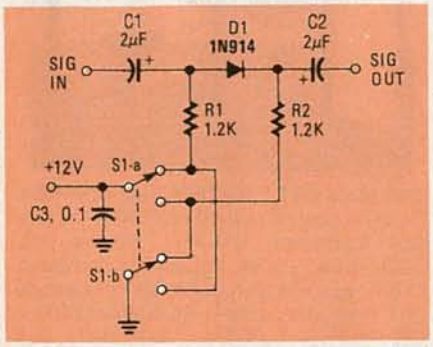


FIG. 7—STANDARD JUNCTION DIODES can be used in low-frequency switching circuits. Here, a DC voltage switches an audio signal on and off.

A similar switch-off characteristic is reflected in the performance of the hot-carrier diode. However, that is not a junction device, but is constructed from a metal and a semiconductor. The metal has a sharp point where it contacts the semiconductor and the diode is referred to as a point-contact diode. In all point-contact diodes, the metal behaves as an anode while the semiconductor is the cathode. The forward-bias characteristic curve does not rise as quickly as does the curve of the junction diode. Reverse-leakage current is seldom as low as it is with a standard PN junction diode. Despite those drawbacks, the point-contact device is very useful up to frequencies of about 3 GHz.

Varactors

As you may recall from our discussion last month, a depletion region exists at the junction of the n-type and p-type slabs in a standard junction diode. That region behaves as an insulator. Because that type of region exists between two semiconductor slabs, a capacitor is formed in the diode. The capacitance can be measured between the leads connected to the n-type slab and the lead connected to the p-type slab.

A *varactor* or diode is a junction diode specifically designed to take advantage of that capacitance. The capacitance is not a fixed value. It is a function of the reverse voltage applied across to the varactor diode. Capacitance will decrease as the reverse DC voltage is increased. That is due to the widening of the depletion region with the increase in voltage. The varactor diode, therefore, behaves as a voltage-variable capacitor. Capacitances as high as 2000 pF can be attained.

The figure of merit, Q, of a varactor diode is the ratio of capacitive reactance to the resistance of the diode. It is typically about 300, but in some instance it can be as low as 50.

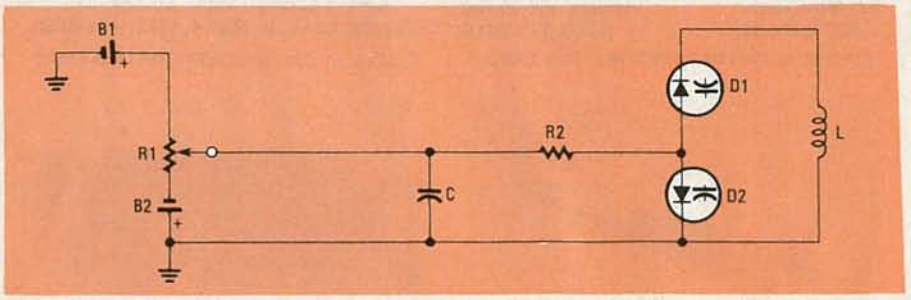


FIG. 8—VARACTOR DIODES are voltage-variable capacitors. In the circuit shown, a DC voltage is used to tune a tank circuit.

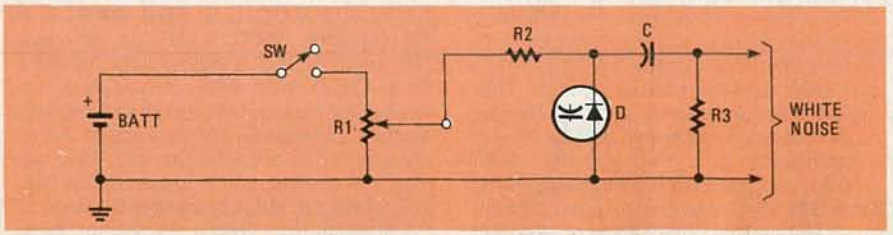


FIG. 9—SPECIALLY SELECTED VARACTOR diodes are used to generate white noise by biasing the varactor close to the reverse breakdown-voltage point.

Varactors are used as tuning devices in RF circuits. One such arrangement is shown in Fig. 8. Here, the RF circuit consists of L in parallel with two varactor diodes, D1 and D2, connected in series. The resonant frequency is:

$$f_o = \frac{1}{2\ LC} \qquad (1)$$

where L is the inductance of the coil in Henrys and C is the total capacitance of the two diodes and expressed in Farads. The total capacitance of the two diodes is

$$C = \frac{C1 \times C2}{C1 + C2} \qquad (2)$$

where C1 is the capacitance of D1 and C2 is the capacitance of D2.

Varactors are non-linear devices; the capacitance varies in a non-linear fashion with the applied voltage. They are frequently used instead of mechanical variable capacitors as tuning devices in radios and television sets. They can also serve in switching applications, harmonic-generating circuits, in parametric-amplifier circuits, and so on.

White-noise generator

Varactors, like other junction diodes, will break down and conduct if the reverse voltage applied to it is great enough. As the breakdown voltage is approached, random voltage-irregularities are present in the device. Those irregularities can be used in a circuit to generate white noise. Specially selected diodes that are capable of producing high levels of noise are used for that application.

White noise is a signal composed of different frequencies. Each frequency has identical energy. Frequencies theoretically present in the signal are from 0 Hz to ∞ Hz. In audio applications, white noise sounds like the "hiss" heard when tuned between channels of an FM radio.

To produce white-noise efficiently, the circuit in Fig. 9 may be used. Because white noise is at its maximum when the voltage applied to diode D is at a specific value, potentiometer R1 is used to obtain that specific voltage. Switch S1 is simply the ON/OFF switch. Load resistor R3 should be a high value, about 1 megohm, to prevent loading the diode. Capacitor C passes the white noise to the output; it should be large enough so as not to affect the low frequencies in the white-noise signal.

Photodiodes

Photoresistors are single-slab semiconductors. When exposed to light, their resistance drops. A similar optical-electrical relationship can be established for the photodiode. Current will flow through that device if it is first reverse-biased by a voltage and then exposed to light. Barring any circuit limitations, the quantity of current increases linearly with the amount of light hitting the junction. Thus if the light inten-

continued on page 109

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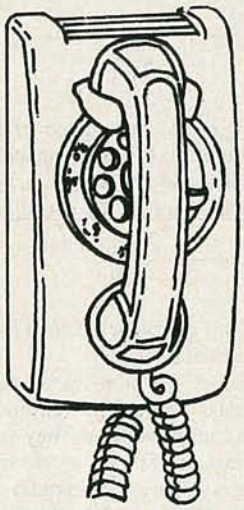

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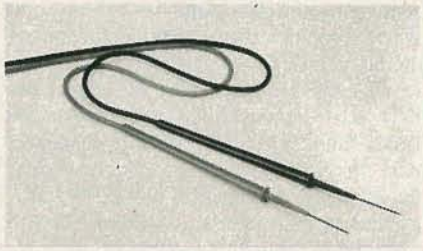

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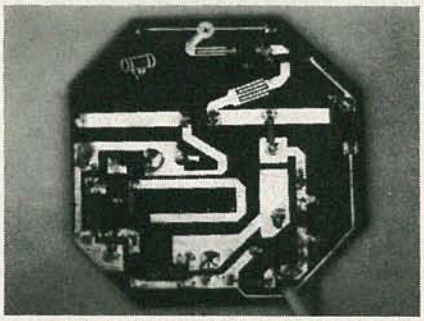

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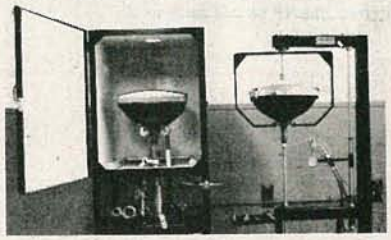

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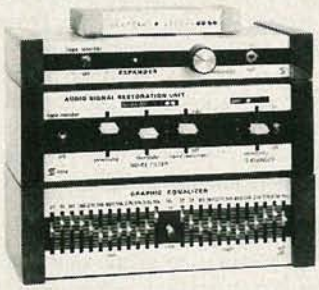

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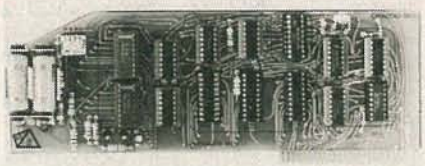

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SATELLITE TV RECEIVER

Part 3

Aligning a TVRO receiver can require some complex and expensive equipment, but it's possible to do an acceptable job without it. The final part of this article describes both methods.

THE FINAL PART OF this article will discuss testing and alignment procedures for the R2B satellite-TV receiver.

Before applying power to the receiver, inspect the PC board carefully for solder bridges and for unsoldered connections, and make sure that all the components are in the correct locations and are oriented properly. Errors in soldering and component orientation are responsible for 90% of all problems. If everything seems to be in order, apply about 18-volts AC to jack J5 on the main board and measure the output voltages of the three regulators. If they are correct (15 volts from IC11, 12 volts from IC12, and 5 volts from IC13), you're ready to begin alignment of the receiver.

70-MHz IF stage and 1170-MHz oscillator

If you bought the complete R2B from the supplier in the Parts List, you'll find that the second-IF section and 1170-MHz oscillator have already been aligned. The reason for that, as you will see shortly, is that those sections require special test equipment—that may not be readily available to you—for alignment. To align the 70-MHz IF filter, you'll need a CATV-type sweep generator with markers at 60, 70, and 80 MHz, and an extended-response oscilloscope with an external-trigger input. (The tuning-coil adjustments are highly interdependent, and tuning the filter point-by-point using an ordinary signal-generator can be quite frustrating, if not impossible.)

Figure 22 shows a block diagram of the equipment used for the IF sweep-alignment. The output of the sweep generator should be injected into the circuit at TP1, and the output of the filter section taken from TP2. Adjust coils L2-L6 for a bandpass of approximately 20-25 MHz centered on 70 MHz. As shown in Fig. 23, the dip (or peak) in the waveform viewed on the scope should not be more than 0.1 dB. The gain through the system (TP1 to TP2) should be at least 25 dB. Figure 24 shows the component side of the PC board and indicates the various test- and adjustment points.

A rough alignment can be performed by preadjusting the IF coil-slugs a specific number of turns out from the bottom of the coil forms. That will generally get you "in the ball park" and provide a usable IF bandpass. Be careful when turning a slug down to the bottom of the form—do not force it—since the slugs are quite brittle and crack easily.

The procedure to follow is to adjust each slug so that it is at the bottom of its travel, and then back it out a specific number of turns. The slugs of L2 and L6 should be backed out eight turns, those of L4 and L5 five turns, and that of L3 just three turns.

Whether you use the former (sweep-generator) method or the latter, when you have finished, jumper the rearmost two pins of TP1 together to complete the path from the mixer to the 70-MHz IF.

The next step is to align the high (1100-

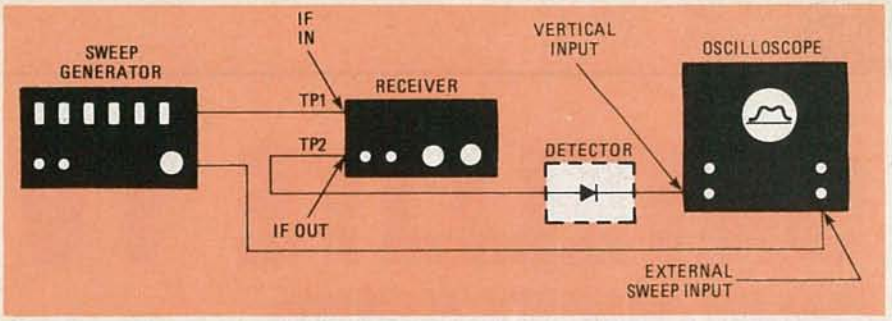


FIG. 22—ARRANGEMENT FOR PERFORMING IF alignment on satellite-TV receiver. See text for equipment requirements.

MHz) IF stage. If you have access to a spectrum analyzer and tracking generator, it's simple, but—alas—most of us are not that lucky. Fortunately, it's possible to "rough-align" this section and then peak each adjustment while receiving a satellite signal. Capacitors C4, C5, C9, and C10 are piston types in which the piston screw is part of the capacitor itself. That means that you must use an insulated tuning-tool to adjust them. The tool must be totally plastic (or some other insulating material) and must *not* contain any metal. Each screw should be backed out exactly five turns from its bottom position. The results should be quite good, but response can be peaked up later using an off-the-air signal.

The second local-oscillator is the last high-frequency section to be aligned, but it is far from being the least important—the operation of the entire receiver depends on its being properly adjusted. If you purchased the receiver in kit form, the alignment was done for you; if you're building from scratch, now's the time to make friends with your local cable-TV operator.

Probably the best way to align this stage is to observe its response on a calibrated spectrum-analyzer. (Those analyzers are quite sensitive and just holding an input lead near the local oscillator will cause its "pip" to be displayed clearly.) It's then just a matter of adjusting C18 until the "pip" is at 1170 MHz.

An alternate calibration method uses a sensitive (5-10 mV) frequency counter, capable of operating up to at least 1200 MHz. The measurement should be performed without touching any part within the local-oscillator's shielded area. A simple pickup loop is ideal, since bringing it near the local oscillator will not throw off its frequency significantly, while the counter will still be able to be triggered. When you get a stable reading, adjust C18 for a reading of 1170 MHz ±2 MHz.

As a last resort, if you don't have access to any of the equipment mentioned, back C18's alignment screw out 4½ turns. That will put you near 1170 MHz and "fudging" the high-IF frequency while peaking up using an off-the-air signal (see below) will balance out the effects of a slightly off frequency second local-oscillator.

Demodulator and tuning alignment

Three more simple adjustments will complete the receiver alignment. First, the divider-bias pot, R13, should be set to mid-range and then fine-tuned using a received signal. Second, the PLL tuning capacitor, C39, should be adjusted in the same manner. Finally, R37, the range-adjustment potentiometer, will set the maximum tuning frequency of the receiver. To maintain proper front-panel calibration, it should be adjusted to give a reading of 12 volts at TP3 when the tuning dial is set to the transponder-24 position (fully-clockwise). Since that voltage is the control voltage for the first local-oscillator, IC10, you can also check it at the positive lead of C71.

At this point, you can install the receiver board in its enclosure, and the TUNING potentiometer on the front-panel. A suggested front-panel layout is shown in Fig. 25. The rear apron is shown in Fig. 26.

Overall system

Before hooking up the receiver, it is a good idea to verify that the rest of your TVRO system is in good working order. (That way, the receiver cannot be blamed for a problem caused by the antenna or other part of the system.) The simplest—and best—way to check things out is to hook up a receiver that is already known to work well, and to adjust the other components of the system for optimum performance.

The antenna should be aimed at the satellite that provides the weakest signal you intend to watch, and all tune-up procedures carried out while a color-bar pattern is being transmitted (color bars are usually transmitted at low power, and are quite difficult to reproduce well). The reason for choosing those conditions is that they represent the worst signal the receiver will ever have to process—and if it can do that well, it will have no trouble with other material.

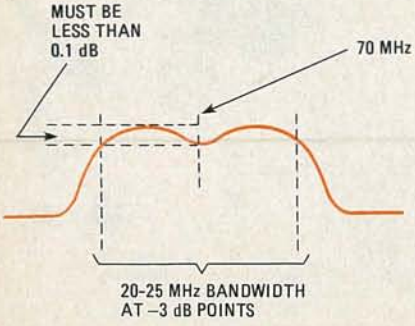


FIG. 23—IF CURVE should not deviate by more than 0.1 dB.

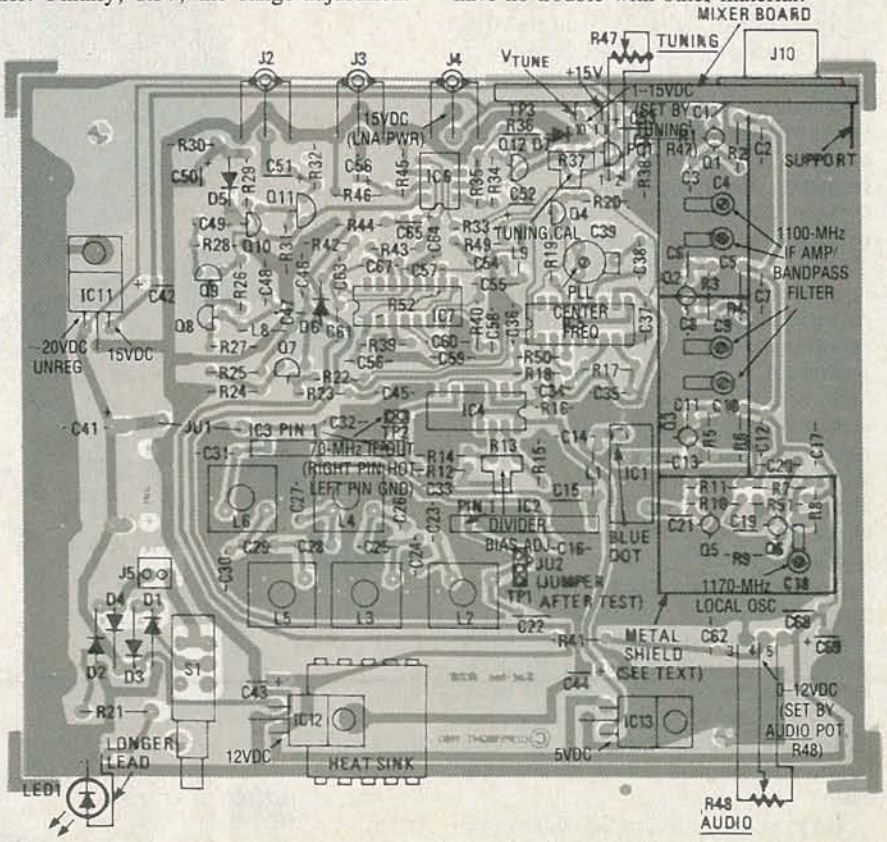


FIG. 24—TEST POINTS and critical voltages involved in alignment procedure. Don't forget to jumper TP1 when you're finished checking out IF stages.

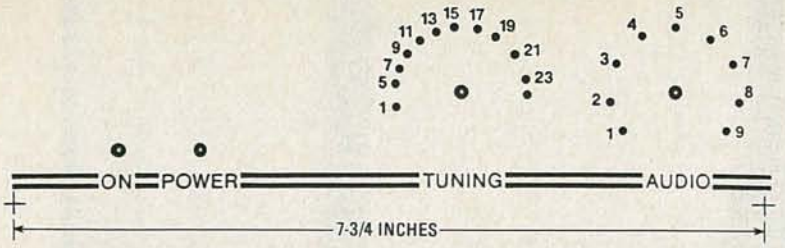


FIG. 25—FRONT-PANEL LAYOUT for receiver. Note that tuning scale is not linear.

FIG. 26—REAR-APRON CONNECTIONS for the satellite TV receiver. If you are not building the kit, any layout that is convenient may be used.

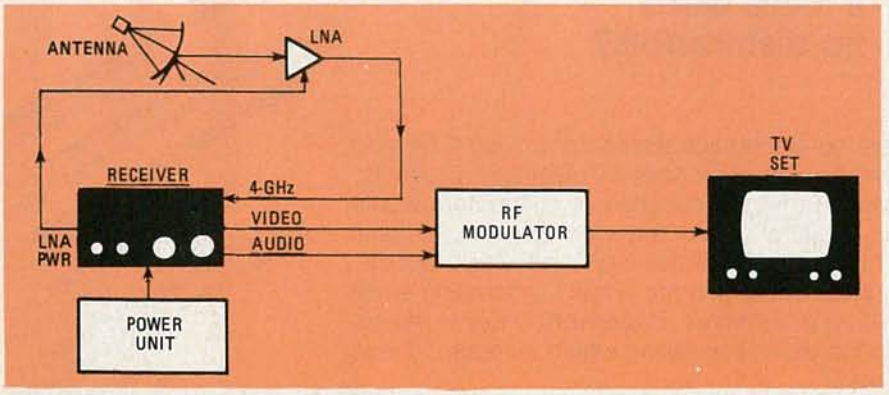


FIG. 27—INTERCONNECTIONS used with R2B receiver. RF modulator must be able to handle video *and* audio subcarrier.

"Off-the-air" tuneup and final alignment

A representative system-hookup is shown in Fig. 27. Note that the receiver provides baseband video and audio at its outputs, for use with a video monitor. If you use a standard TV set, you'll need an RF modulator with both video *and audio* capability in order to feed the signal to its antenna terminals.

Power for an LNA is available at J4 or, alternatively, you can feed power to the LNA thorugh the coaxial cable that connects it to the receiver. To do that, just solder a length of wire between the center pins of J4 and J10. Capacitive coupling at the LNA's output and at the input to the receiver will prevent the DC voltage from interfering with the 4-GHz signal.

Knowing that the rest of the system is operating properly, you can procede with the final "tweaking." It is a spellbinding experience to watch the picture improve with each turn of the alignment tool!

With the antenna aimed at a satellite (naturally), turn on the receiver and rotate the front panel TUNING control, R47, while watching for something that looks like a picture. If nothing is found, rotate R13 back and forth slightly for the noisiest and snowiest screen. That should then allow you to tune for a picture. If you still get nothing, double-check your connections to the antenna/LNA system. If you cannot get even a snowy screen, proceed to the troubleshooting section below.

With a picture on the screen, adjust R13 for minimum snow—or "sparklies" as they say in the trade. Then, using the plastic alignment-tool, adjust C39 for the best picture as well as for an equal amount of black sparklies and white ones. Next, adjust capacitors C4, C6, C9, and C10 in the high-IF section for the best picture. Since they are interactive, you should repeat your adjustments several times. **Do not, under any circumstances, touch the 1170-MHz local oscillator adjustment, C18, once it has been set by either you or the kit supplier!**

The front panel TUNING knob can now be fine-adjusted. Tighten the knob on the shaft of the potentiometer with the pointer at "15" and the shaft set to the middle of its travel, then rotate the knob to "24" and adjust R37 for transponder 24. That should give you good tuning accuracy, but the process can be repeated several times if you like, for more accurate calibration.

The following are available from Ramsey Electronics, 2575 Baird Rd., Penfield, NY 14526: Complete Sat-tec R2B satellite-TV receiver kit with pre-aligned 70-MHz IF and 1170-MHz oscillator sections, $495.00; completely wired and tested Sat-tec R2B satellite-TV receiver, $749.95; RM3 RF modulator, $69.95; Watkins-Johnson V815 oscillator IC (IC10), $125.00; Avantek 120°K, 50-dB gain LNA, $595.00.

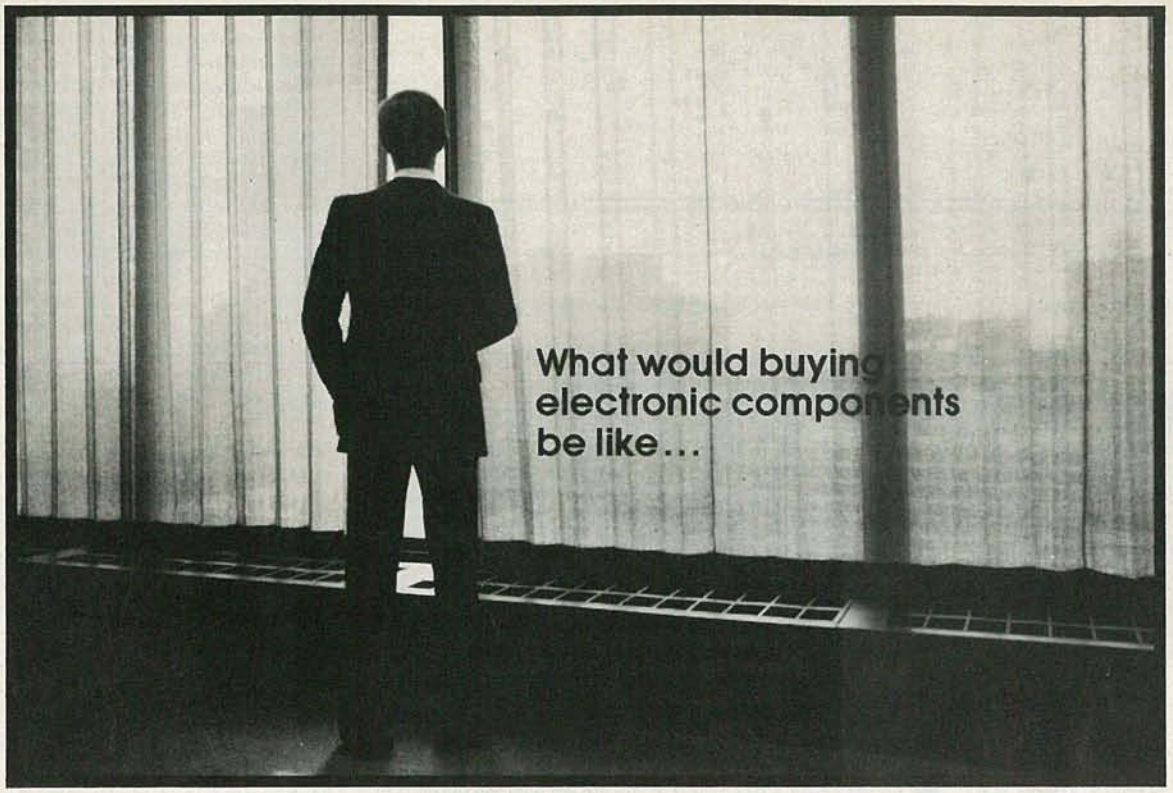
The above prices include shipping and insurance charges to points in the U.S. and Canada. Overseas orders please add 15% to cover shipping. MC and Visa accepted.

Troubleshooting

As was mentioned earlier, the most common causes of problems are poor solder joints, solder bridges, and wrongly placed components. Sometimes you can't see the forest for the trees, so get someone else to look over your work. Measurements of power-supply voltages, as well as tracing the flow of power to each IC and transistor, can be helpful. If you can localize a problem—in the audio stage, one of the IF stages, etc.—so much the better; small parts of a complex circuit are easy to trace.

One problem involved in troubleshooting a TVRO system is that there are so many variables involved. That's why it's best to test your receiver with a system that's known to be in proper operating condition.

A common problem encountered with low-cost dual-conversion receivers is LNA image-noise. Image noise presents itself as excessive sparklies, which no amount of tuning will get rid of. Some LNA designs, particularly a number of the early ones, produce a lot of noise in the 1.5-2.6-GHz range. That problem does not appear in single-conversion receivers, or in high-priced dual-conversion units with input bandpass-filters, but the inexpensive R2B receiver cannot afford the luxury of a built-in 4-GHz bandpass filter. The result is that out-of-band noise from the LNA is converted to the high-IF frequency along with the satellite signal...and there goes the signal-to-noise ratio! The best insurance against that problem is to use a quality LNA of recent manufacture, or, if it proves necessary, to break down and purchase a 4-GHz bandpass filter. **R-E**



if there were no distributors?

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Distributors help us—by serving you.

As members of the Distributor Products Division of the Electronic Industries Association, the companies bringing you this message are pleased to help "sell the system."

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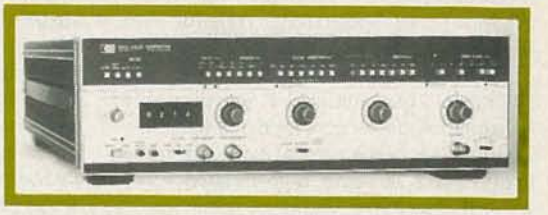

ALL ABOUT PULSE GENERATORS

The results you get using a pulse generator are only as good as the test setup you use. Here are some of the potential problems to watch for, and what you can do to eliminate them.

CHARLES GILMORE

Part 3 WITH ANY SIGNAL source, such as a function generator, a properly terminated transmission line is required to maintain waveform integrity. With pulse generators, however, even more care should be taken to avoid mismatches at any of the connections in a test setup. In this part of our series on pulse generators, we'll see just why that is the case, and what steps should be taken to insure the best results when using those devices. Let's begin by discussing briefly the nature of a pulse generator's output.

Maintaining pulse characteristics

It is known that complex waveforms, including pulses and square waves, can be analyzed using Fourier analysis. Fourier analysis reduces the complex waveform to a sine or cosine waveform of a certain amplitude at the waveform's fundamental frequency. Added to the fundamental is a series of harmonically related sine or cosine waveforms, each of differing amplitude. For example, a square wave contains a sine wave; the frequency of both waveforms is the same. In addition to that sine wave, sine and cosine components are also present at the odd harmonics (third, fifth, seventh, etc.); the amplitude of those components decreases at each succeeded harmonic.

Figure 3 shows the amplitude-versus-frequency display that would be seen on a spectrum analyzer with a square wave applied to its input; the spectrum analyzer actually performs a Fourier analysis. The basic repetition rate of the square wave is f_1. Frequencies of f_2, f_3, etc. represent the second, third, etc., harmonics.

As the rectangular waveform deviates from the perfect time symmetry of the square wave, two important changes in the harmonic content occur. The first is the appearance of even harmonics. The square wave contains only the fundamental frequency and its *odd* harmonics. However,

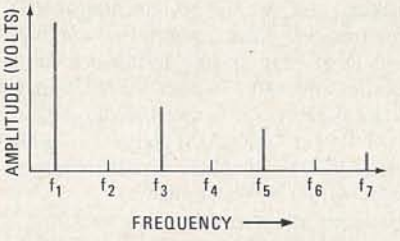

FIG. 3—A SQUAREWAVE as it would be displayed on a spectrum analyzer. The fundamental repetition rate of the square wave is the left-hand signal. Each succeeding signal is that of an odd harmonic.

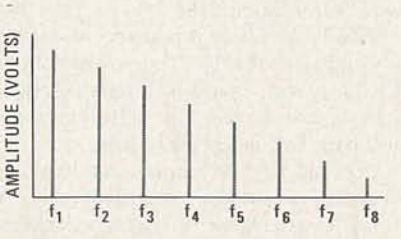

FIG. 4—A NARROW PULSE as it would be displayed on an spectrum analyzer. Note the even harmonic components and the much greater amplitudes of the harmonics.

the rectangular waveform contains both the odd harmonics and the even harmonics of the fundamental repetition rate. Second, the amplitude of the harmonics does not diminish as rapidly as with the square wave. Figure 4 shows the amplitude-versus-frequency display of a spectrum analyzer with a low duty-cycle pulse applied to its input. The amplitude and phasing relationships of those harmonics depend upon the pulse width and the repetition rate.

With the previous discussion in mind, you can begin to understand the problems involved in transmitting a high-frequency pulse signal from one location to another. A rather narrow pulse (one with an extremely low duty cycle) may show a spectral comb of harmonics whose amplitudes are so close to the amplitude of the fundamental signal as to be almost indistinguishable from it. Frequently, comb generators are used to obtain a high number of harmonics, and a pulse generator may serve that purpose.

Such a situation, however, can make it difficult to use a pulse generator. For example, a pulse that is 100 nanoseconds wide with a basic repetition rate of 1 MHz produces both odd and even harmonics of 1 MHz whose amplitudes are nearly equal to that of the fundamental frequency; those amplitudes remain nearly equal well into the 10- to 15-MHz range. If the system or the interconnections in which the particular pulse will be used cannot handle 10- to 15-MHz signals without significant attenuation or phase shift, severe degradation of the pulse will occur.

One of the first steps that must be taken to preserve the integrity of such a pulse is to terminate properly the transmission line that delivers the pulse from the generator to the load; it must be terminated into a load that is equal to its characteristic impedance. If that is not done, signals will be reflected back to the generator from the termination. Those reflections interact with the oncoming pulses, and degrade the pulse waveshape.

If the transmission line does not have the same characteristic impedance as the generator, an additional problem occurs. Signals that are reflected from the load due to an impedance mismatch, travel down the transmission line until they reach the generator. At that point, the signals once again find a termination (the generator itself) that does not match the characteristic impedance of the transmission line. That causes additional reflections, which then travel toward the load and interfere with both the initial signals and the reflected signals. The end result can be severe pulse distortion.

Even if the transmission line's characteristic impedance matches that of the gener-

ator, and it terminates in a purely resistive load that matches the characteristic impedance of the transmission line, the transmission line itself can contribute to pulse degradation. Unfortunately, transmission lines are not lossless. Although losses are usually very small in the low-frequency and DC ranges, the familiar I^2R losses of any transmission line occurs. When a transmission line (such as a coaxial cable) carries a narrow pulse, however, high-frequency losses will then cause additional problems.

If losses within the transmission line become substantial within the first decade of harmonics, pulse-waveform degradation occurs because of the improper relationship between the amplitude and phase of the high-frequency harmonics and the pulse's fundamental-frequency repetition rate. To avoid that problem, low-loss cable should be used wherever possible. Fairly low-cost coaxial cable, such as RG-58/U, is acceptable provided that the length of the cable is shorter than 30 feet and the frequency of the signal is kept below the 200- to 300-MHz range.

It must be emphasized that the termination must not only match the characteristic impedance of the transmission line, but it also must be purely resistive. Often, the pulse waveform is somewhat degraded when an in-line terminator driving a higher-impedance capacitive load is used. That results in a load whose resistive component approaches the transmission line's proper characteristic impedance, but with some additional capacitive effects.

Another cause of reflections within a transmission-line system is a discontinuity such as that caused by the insertion of extra connectors as shown in Fig. 5. In that figure, the transmission line leading from the pulse generator to the load is tapped by a T-connector that allows the pulse to be observed using an oscilloscope. If the frequencies involved are low enough, the pulse width is great enough, and the rise times are not particularly fast, the effect of the connector may be negligible. If the load is 50 ohms and the scope's impedance is 1 megohm shunted by a few picofarads (as it is in most oscilloscopes) reflections occur at the oscilloscope. If the cable to the scope is long enough, those reflections degrade the pulse on the main transmission line.

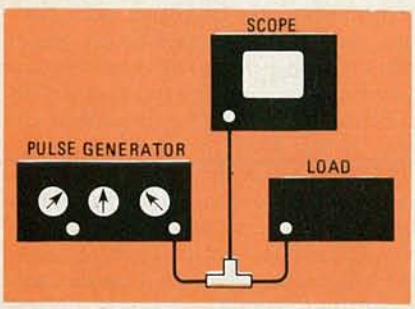

FIG.5—AN IMPROPER METHOD of connecting an oscilloscope to monitor the output of a pulse generator. For the proper method of making this connection, see text.

Reducing reflections

To reduce that pulse degradation substantially, the T-connector can be connected directly to the oscilloscope so that only minor reflections occur at the leading and trailing edges of the pulse. A somewhat passable solution that can eliminate some of the discontinuity and still maintain the basic integrity of the pulse waveform is to run two equal lengths of 93-ohm cable from the T-connector to the load, and from the connector to the oscilloscope. Each cable must be terminated by a 93-ohm in-line terminator. At the T-connectors, the two cables combine to be slightly less than 50 ohms, which is a closer match to the 50-ohm cable.

There are still some discontinuities in that system, however, since a 50-ohm T-connector is being used to combine 93-ohm and 50-ohm cables. Also, having 93 ohms in parallel with 93 ohms gives 46.5 ohms, not 50. Therefore, some reflections occur here, too. The simplest way to minimize those reflections is to connect the generator directly to the oscilloscope to set the pulse, making sure that the 50-ohm transmission line from the pulse generator is terminated with a 50-ohm in-line terminator at the oscilloscope. The 50-ohm line (terminated or not as necessary) is then transferred to the desired load. If that load presents a 50-ohm termination to the cable, all pulse characteristics should be maintained.

If absolute perfection is needed, the T-connector can be replaced with a power-divider that splits the power coming from the 50-ohm pulse generator and properly terminates that line. Two outputs are provided from the power divider, each capable of driving a 50-ohm transmission line with proper termination. The drawback to that solution is the losses it introduces—on the order of 10 to 20 dB. The power splitter does, however, maintain a nearly reflectionless system when the pulse generator must have two independent loads.

A second type of transmission-line discontinuity is caused by damaged cable. A crushed coaxial cable can cause reflections at the point of damage, and any such damaged sections should be replaced.

There are two types of improper line terminations that we should pay particular attention to. One is when the pulse generator drives an open-circuited line; the other is when the generator drives a line that is short circuited. If the line is an open circuit, a complete reflection occurs. Figure 6 shows what happens in that case if the

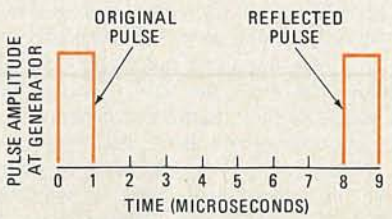

FIG. 6—A REFLECTED PULSE is generated when a transmission line is terminated in an open circuit. Here, the delay caused by the line is greater than the width of the original pulse.

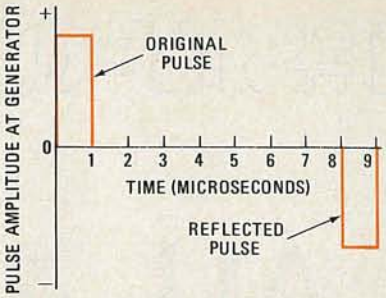

FIG. 7—A SHORT-CIRCUITED TRANSMISSION LINE will generate a reflected pulse with the same amplitude as the original, but of opposite polarity. Again, the line's delay is greater than the width of the pulse.

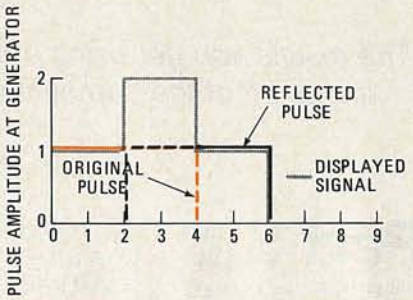

FIG. 8—IF A TRANSMISSION LINE is terminated in an open circuit, and the width of the pulse applied is greater than twice the line's delay, the original and reflected pulses add, generating the waveform shown here.

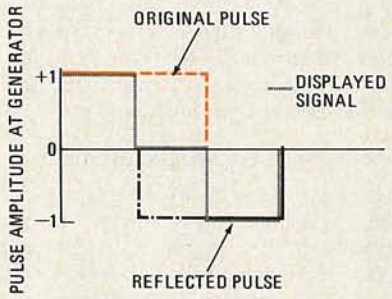

FIG. 9—IF A TRANSMISSION LINE is shorted, and the width of the pulse applied is greater than twice the line's delay, the original and reflected pulses cancel each other.

length of the line is such that the time the pulse needs to travel down the line and back is greater than the pulse width itself.

Figure 7 shows the opposite offset. The pulse generator is driving a transmission line terminated in a short circuit. The pulse returns with the same width as the original pulse but has the opposite polarity. Figures 8 and 9 show what happens when a pulse generator drives open and shorted lines and the width of the pulse applied is greater than twice the delay of the line. The rather complex pulses shown are the result of the original and reflected pulses adding and subtracting from each other. While the open- or short-circuit conditions would seem to be extreme cases, an open circuit can be approximated by terminating a 50-ohm transmission line into a 1-megohm oscilloscope input.

With that practical example, the impor-

tance of proper transmission-line termination becomes a little more obvious—let's look at some other examples. For instance, it is not uncommon to find a 50-ohm transmission line terminated with a 75-ohm in-line terminator because such terminators are frequently used in the TV industry. Such a mismatch generates approximately 10% reflected power. If the conditions for the example shown in Fig. 6 are duplicated, but the open circuit is replaced with a 75-ohm in-line terminator, a reflected pulse with one third the amplitude of the original is produced. That is shown in Fig. 10.

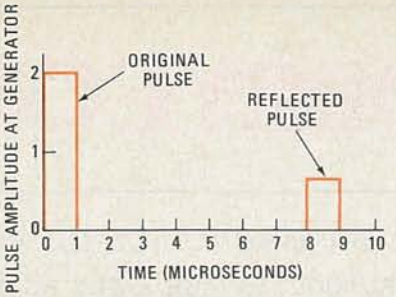

FIG. 10—THE WAVEFORM SHOWN here is obtained if a 50-ohm generator and transmission line are terminated in a 75-ohm load.

In some applications, such as digital logic circuits, that reflection could be completely ignored; generally, those circuits will ignore any pulse with a voltage lower than required to establish a logic 1. In analog systems, however, that could create confusion.

As we've seen, poorly matched transmission lines in a test setup can cause a number of errors. Unfortunately, those are not the only source of potential problems when using pulse generators. When we continue this series, we'll look at some others, as well as ways that they can be avoided. **R-E**

What's News

New troposcatter system uses digital techniques

A new tactical troposcatter radio system, developed by Raytheon, uses digital techniques to transmit information more accurately, efficiently, and securely than any other existing system. The new equipment, named the *AN/TRC-170,* provides 60 channels for voice and data transmission, and will take the place of the 24-channel analog equipment in use since the early 1960's.

The troposcatter transmitters can send signals well beyond the horizon. Thus they can communicate over large bodies of water, hostile territory, or inaccessible terrain. They can transmit a mix of digitally encoded voice channels with digital data signals, such as computer, facsimile, or teletype.

An ingenious modulation system uses multipath propagation characteristics to provide better performance. The digital modulation/demodulation technique was invented by Raytheon. Known as the Distortion Adaptive Receiver, it transmits a "time-gated" waveform to minimize intersymbol interference, then demodulates the received signals that contain multipath distortion by using an adaptive matched-filter detector.

THESE PARABOLIC TROPOSCATTER DISHES are precisely alligned to scatter signals through the atmosphere to receivers up to 100 miles away.

Energy management system serves hotels and motels

A system that reduces energy consumption in lodging facilities by turning room heating/cooling devices, lights, and other appliances on or off as guests check in or out is now being marketed by the RCA Service Co.

The central control at the front desk provides a video display of the status of every room—occupied, unoccupied or standby. (A "standby" room is one in which heat or cooling has been supplied in readiness for occupancy.) If desired, the display can show which unoccupied rooms have been cleaned.

The system permits individual room-to-room control, if needed, to compensate for rooms receiving heat from the sun, corner rooms, or rooms subject to other special conditions. It also provides for automatic or manual control of the energy use in common areas—lobbies, corridors, meeting rooms, etc.

The system uses the existing AC wiring, making for extremely simple and economical installation. It is most cost-effective for facilities of 75 to 400 rooms, and can be either leased or purchased.

Bank-at-home technology displayed at World's Fair

The Knoxville World's Fair has been selected by Prestel for its first U.S. Bank-at-Home demonstration using Prestel's Gateway technology. (Prestel is the trade name for the British Videotex system.) Two hundred Prestel terminals will be placed on the site of the World's Fair or in adjacent hotels, banks, and transportation stations.

GEC Computers Ltd. of Britain will provide the central Videotex computer for the demonstrations. It is the first Prestel system that the company has supplied to a United States firm.

Prestel's Gateway technology allows a Prestel terminal to be connected directly to a private database via the Prestel network. Software has already been developed to allow *Apple II* microcomputers to access Prestel.

A special database has been developed for the World's Fair project. It includes event schedules and information on the World's Fair, in addition to banking, shopping, and message-handling various demonstrations.

Satellite TV direct to home receivers

COMSAT subsidiary Satellite Television Corp (STC) has asked for bids for constructing two satellites (one operating and one spare) to begin a direct satellite-to-home pay-TV service to an area roughly approximating the U.S. Eastern Time Zone. The bids must also provide options for the additional satellites required to complete a planned nationwid direct broadcast service (DBS).

Each spacecraft is expected to provide at least 1700 watts of prime power and will use a shaped beam antenna that will cover an area roughly equivalent to a time zone. The output power is 20 to 40 times higher than that of conventional communications satellites now serving the United States. That high output power will permit television reception on small receiving antennas—generally 2½ feet in diameter—in individual subscribers' homes.

Construction will take more than three years, and STC is expected to initiate the service in late 1985 or early 1986. The service will offer three channels of premium pay television, without advertising. **R-E**

HOBBY CORNER

More on electronics for youngsters

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

LAST MONTH WE TALKED ABOUT BUILDING a few simple items that could be used by a youngster to get a start in learning about electricity. He can begin traveling a road that will lead him into the "crazy" hobby that has you caught—especially if you lend a hand.

You recall that we built a couple of battery holders, a switch, lamp holder, and an electromagnet. Now, I want to show you a few more items you can add to the set.

Let's add a sound-signaling device. You can use your original electromagnet or wind another on a big nail and fasten a Z-shaped strip of sheet metal to a wooden base, as shown in Fig. 1. Be sure to use a metal that is sensitive to magnetism.

When the sounder is connected to a power source such as your battery pack, it will pull the metal down to the head of the nail with a "klunk." Of course, you will have to bend the metal until it is in just the right position. Now, the youngster is ready to set

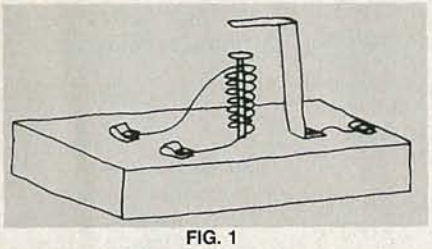

FIG. 1

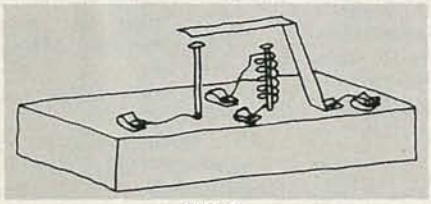

FIG. 2

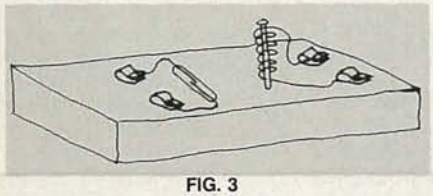

FIG. 3

up his own telegraph system.

If the sounder "arm" is lengthened as shown in Fig. 2, you will have the makings of a relay. Just put another nail (or metal strip) out where the end of the arm will contact it. Such an arrangement is fine for illustrating how relays function, but it is not very effective. To make a more useful relay, use a reed switch (such as a Radio Shack

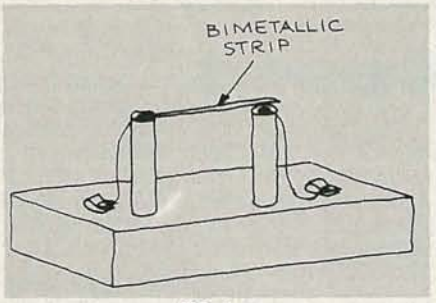

FIG. 4

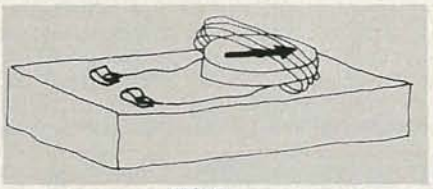

FIG. 5

275-1610) with the electromagnet, as shown in Fig. 3.

Closely related to the relay is the thermostat shown in Fig. 4. You can make the bimetallic strip from two different metals (to take advantage of their different coefficients of expansion) and a bunch of rivets, but it is easier just to take one from an old thermostat. (If your companion is very young, be especially careful in using a match or candle to heat the strip.)

Sooner or later, you will reach the point when you need to demonstrate the presence of a weaker current than the lamp or electromagnet can indicate. If you wrap a few turns of wire around a compass, as shown in Fig. 5, its needle will be deflected by small currents. The more wire you use, the more sensitive that "instrument" will be. Oh, yes—don't position the coil so that the magnetic field it generates will line up with

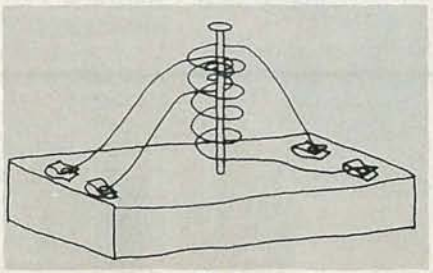

FIG. 6

the Earth's own; if you do that, you'll never see the compass needle move.

Figure 6 shows the last item, a "transformer" made from two coils of wire wound around a nail. One winding—the secondary—should have many more turns than the other. While a transformer will not work with direct current, you can simulate alternating current by using the switch to turn the current from the batteries on and off.

The compass-meter will show the presence of current in the secondary each time the primary circuit is made and broken. If your turns ratio is great enough, you'll be able to hook up a neon lamp to the large-winding secondary and see a flash of light with each make and break of the switch.

There are many items you can add to those to encourage the youngster to go farther in his play/study. A photoresistor (like Radio Shack's 276-116) will get him into light and its relation to electricity. A motor from a toy car (or a simple DC motor like a Radio-Shack 273-208) will demonstrate how electricity is generated. Another excellent addition to the lab would be an open-frame motor/generator such as the Radio-Shack 28-194.

As you can see, a little time and effort on your part can pay very great dividends for the child in your life. The "homebrew lab" will go a long way toward that end.

Eventually, however, the youngster will need to progress farther. At that time, you can begin to build more sophisticated items, or purchase one of the commercial electricity/electronics sets.

Where did I see it?

Judging by the mail, I am not the only one with an imperfect memory. Lately, there have been an unusual number of inquiries that start out "I can't find an article I remember seeing about..." Well, welcome to the club!

Of course, the first thing to do is to check the annual indexes, if you have them. (You do get the **Radio-Electronics** index each year, don't you?) The next choice is to run through the tables of contents of one issue after another.

Both of those approaches present an interesting problem. Authors and editors often do not title articles in a way that accurately reflects the subject(s) covered in them. (*We try, Doc*—The Editors.) In fact, sometimes a title will tell you almost nothing about the contents of an article. You

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CIRCLE 140

may be reduced to leafing through the pages of the magazines for months or years back before you find what you're looking for.

What you need, of course, is a *subject* index. About the only way to have a good one is to set up your own, and that's a time-consuming task.

If you have a computer, you may want to do what I am doing. I put my indexes (by subject, topic, equipment, etc.) on *TRS-80 Model III* disks. (I wrote a BASIC program that searches through 1200 article listings per minute.)

My indexes are not yet finished, but I have already saved quite a bit of search time using just what I've done so far. (Sometimes I wonder if the job will ever be complete—perhaps when I retire and have more time.)

Mailbag

The rest of you may be interested in this word to H.M., one of our readers in Welland, Ontario:

I have no idea how to detect a subliminal message that is on a VCR tape if it can't be done with the freeze-frame control. If you don't find it that way, I would think that none was there. After all, aren't those things just messages flashed very quickly on the screen in the midst of the regular frames? If so, single-frame examination should find them.

Anyway, where did you get a tape that you believe to be doctored with "mind stuff?" I thought subliminal advertising was prohibited by law.

Darn! Now you have me worrying again about people messing around in my mind. I did read about someone making a bundle selling storekeepers little boxes with subliminal audio telling me not to steal the merchandise. Now, how do I know that he isn't telling me to buy something I don't need or want?

How about it folks, what do you think: Is subliminal advertising really dead, or is it just subliminal?

Now for some inquiries from the mailbag: R.B. Heckert, of Escondido, CA, is looking for a circuit with which he can test the carbon-monoxide content of warm air from a furnace.

Another furnace request comes from Robert Beckert in Canton, OH. Bob wants a circuit to measure and display the temperature in the flue of a wood-burning stove and sound an alarm if it gets too high.

Francis LeBaron in Brockton, MA is looking for a way to measure and compare two absolute (not relative) humidities in order to keep a storage space as dry as possible.

P. Johnstone of Tulsa, OK wants to know how to modify a black-and-white TV set to produce an inverse image; he wants the black to be white and the white to be black. (It's for use with his computer.)

That's a sample of some of the recent inquiries that you might give a hand with. Now, get out your thinking caps and let's see what you can do. **R-E**

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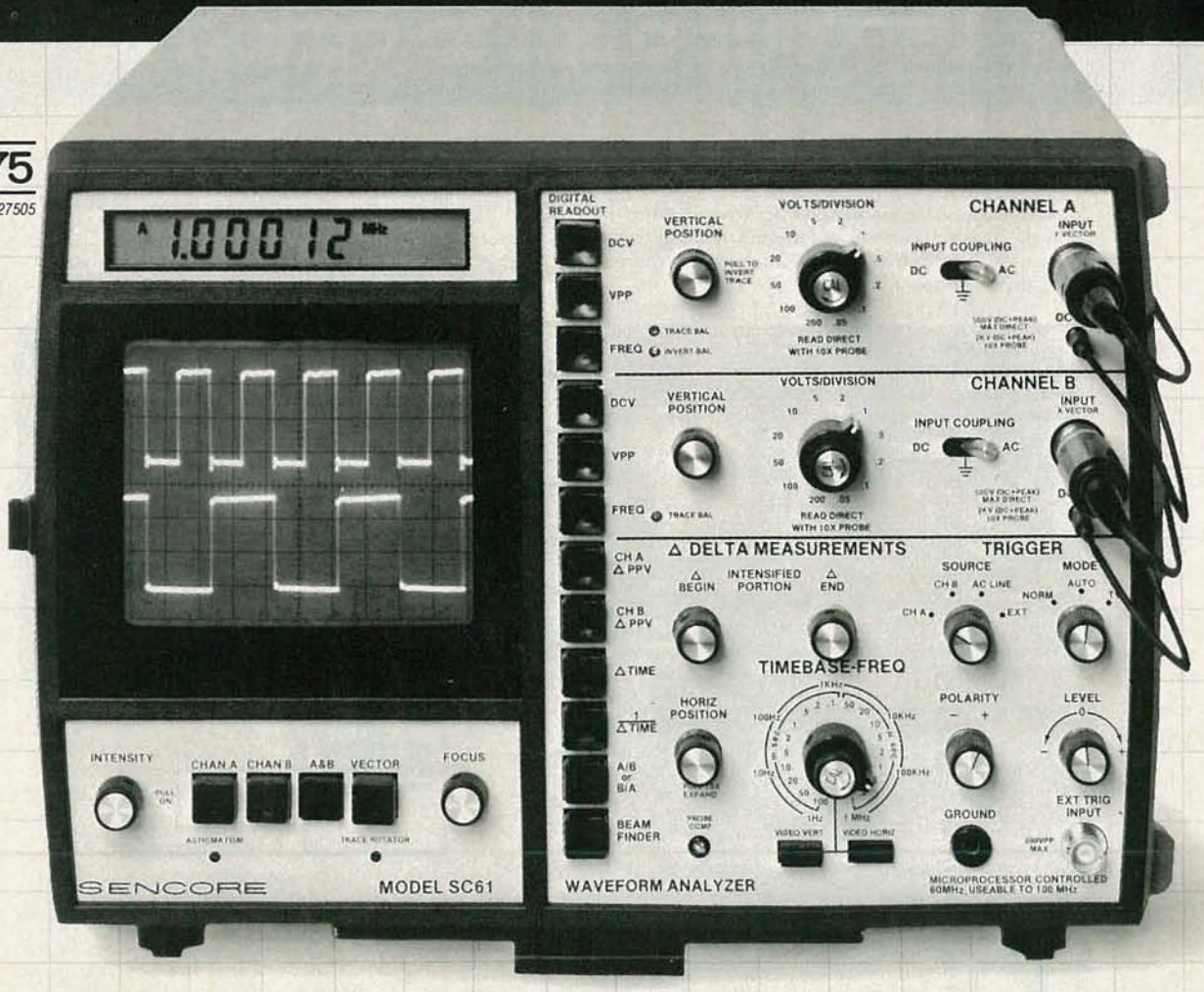

Sencore SC61 60 MHz Waveform Analyzer.

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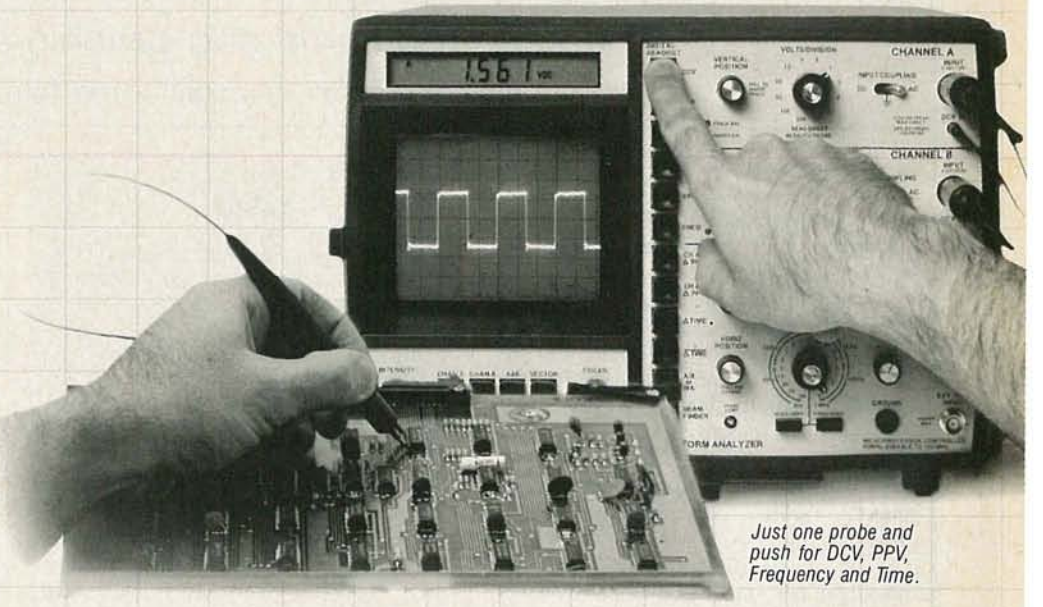

Just one probe and push for DCV, PPV, Frequency and Time.

Cut your scope time in half? We know that's a bold claim. But once you've tried the SC61 we know you'll agree it's a conservative claim. Why? Because the speed, accuracy, and ease of operation of the SC61 makes every conventional oscilloscope as outdated and cumbersome as the analog meter. Now all you do is just push a button and read.

The First Scope With Automatic Readout At last the oscilloscope has gone digital. No more graticule counting, calculating, or estimating your measurements. You can now make waveform measurements digitally accurate, digitally fast, at the push of a button.

Make All Measurements With One Probe Make no mistake. The SC61 is not a "piggyback" unit, but a completely integrated waveform monitoring system. You connect only one probe and the Autotracking™ display digitally tracks the waveform on the screen. You just push a button when you want to read DC volts, P-P volts, or frequency.

An Exclusive Breakthrough It took four patent pending circuits to completely integrate the scope and digital display. The end result is a breakthrough in scope technology that virtually obsoletes conventional scopes. Here's why.

It's 10 Times Faster The SC61 is 10 to 100 times faster than any conventional scope. How? Because all you do is push a button instead of counting graticules, calculating, or switching probes. Increased speed means increased productivity.

It's 10 Times More Accurate No matter how carefully you try to measure a waveform with a conventional scope, you will only be 5% to 15% accurate due to parallax and interpretation errors. Today's circuits demand greater accuracy than that. The SC61's digital readout is 10 to 1000 times more accurate to meet these testing needs.

It's Easier To Use The digital readout is simplicity itself. Just push and read. You'll make fewer errors because every measurement now becomes exact. Now you can concentrate on the circuit rather than the scope.

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CIRCLE 2 ON FREE INFORMATION CARD

STATE OF SOLID STATE

An audio preamp and graphic equalizer.

ROBERT F. SCOTT, SEMICONDUCTOR EDITOR

WE'D PLANNED TO OPEN THIS COLUMN WITH a discussion of some pertinent characteristics of IC operational amplifiers (op-amps), and to show how you can use those characteristics to select the best device for your needs and then design a circuit for optimum performance. But, after looking over Joe Carr's excellent article "Designing Circuits with Op-Amps" in the March 1982 issue of **Radio-Electronics,** we decided to hold off for a couple of months to give you time to digest what you learned from him. So, instead let's get on with the "circuit of the month"—which, coincidentally, is built around an op-amp.

Figure 1 shows how the 5532 dual low-noise high-performance op-amp from either Signetics or Exar can be used in a phono preamp and graphic equalizer. The circuit itself is not very new, but its performance is greatly improved by the 5532 because it develops less noise, has improved output-drive capability, and has greater small-signal and power bandwidths than most common op-amps. The characteristics of the 5532 op-amp are listed in Table 1. The device is internally compensated for unity gain. If you use it where very low noise is of prime importance, you'll want to specify the 5532A version with its guaranteed noise specifications.

TABLE 1

- Small-signal bandwidth: 10 MHz
- Output drive capability: 600Ω, 10V (rms)
- Input noise voltage: 5nV/√Hz
- DC voltage gain: 50000
- AC voltage gain: 2200 at 10 kHz
- Power bandwidth: 140 kHz
- Slew rate: 9V/μs
- Large supply voltage range: ±3V to ±20V

Returning to the schematic, the phono-preamp stage, IC1-a, provides standard RIAA equalization for a magnetic cartridge. The necessary bass-boosted response is provided by the R-C network in the op-amp's feedback loop. The cartridge loading-resistor, R1, has a value of 47K to match the impedance of the average magnetic cartridge. Adjust R1's value as required if your cartridge works best into a different load resistance.

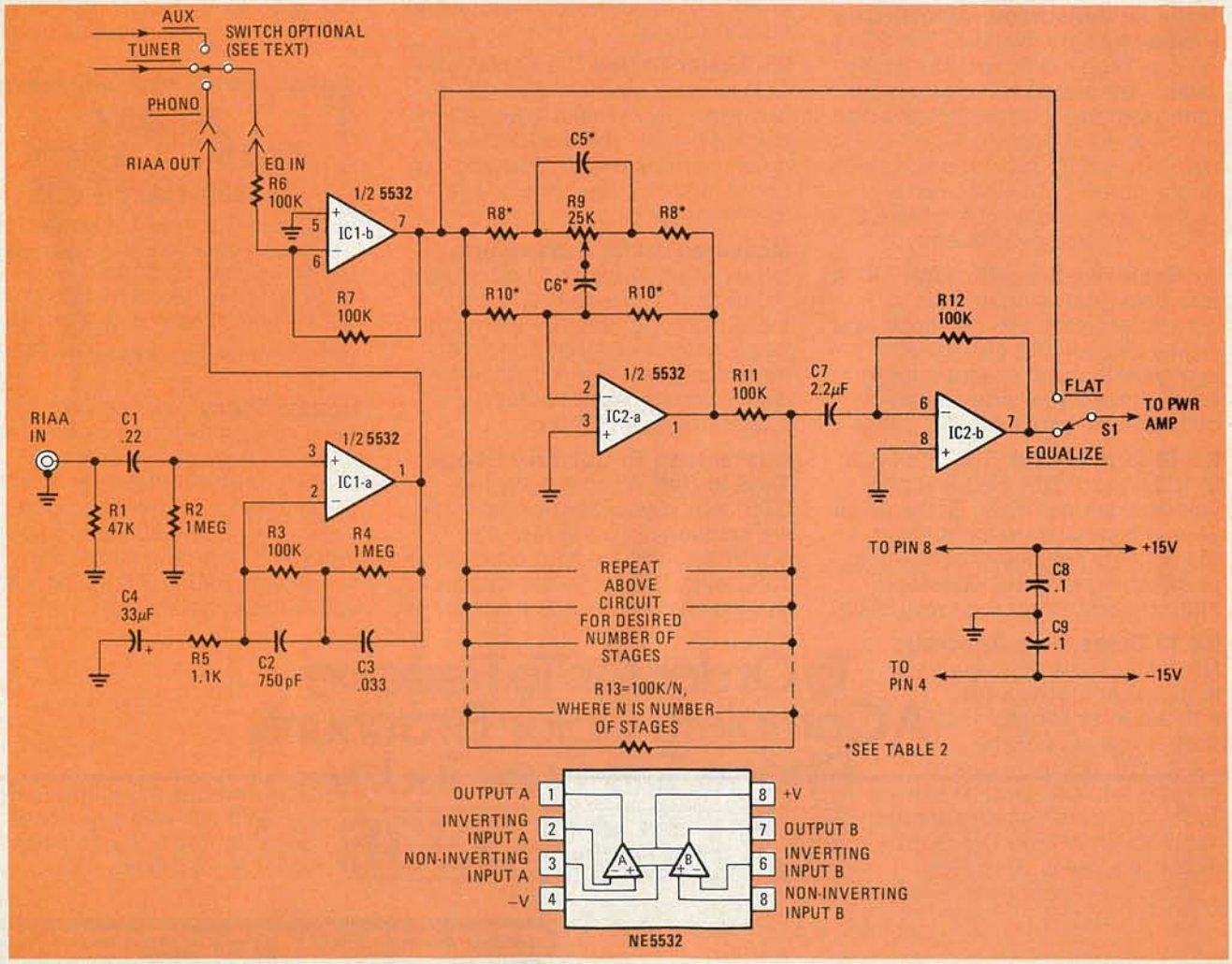

FIG. 1

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Model UES-A56F

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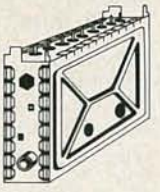

Freq. Range UHF470 - 889MHz
Antenna Input 75 ohms
Channels 14-83 Output Channel 3

KIT NO	PART NO	DESCRIPTION	PRICE
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3	TP7-SW	P.C.B. Potentiometers, 1-20K, 1-1K, and 5-10K ohms, 7-pieces	5.95
4	FR35-SW	Resistor Kit, ¼ Watt, 5% Carbon Film, 32-pieces	4.95
5	PT1-SW	Power Transformer, PRI-117VAC, SEC-24VAC, 250ma	6.95
6	PP2-SW	Panel Mount Potentiometers and Knobs, 1-1KBT and 1-5KAT w/Switch	5.95
7	SS14-SW	IC's 7-pcs, Diodes 4-pcs, Regulators 2-pcs Heat Sink 1-piece	29.95
8	CE9-SW	Electrolytic Capacitor Kit, 9-pieces	5.95
9	CC33-SW	Ceramic Disk Capacitor Kit, 50 W.V., 33-pieces	7.95
10	CT-SW	Varible Ceramic Trimmer Capacitor Kit, 5-65pfd, 6-pieces	5.95
11	L4-SW	Coil Kit, 18mhs 2-pieces, .22μhs 1-piece (prewound inductors) and 1 T37-12 Ferrite Toroid Core with 3 ft. of #26 wire	5.00
12	ICS-SW	I.C. Sockets, Tin inlay, 8-pin 5-pieces and 14-pin 2-pieces	1.95
13	SR-SW	Speaker, 4x6" Oval and Prepunched Wood Enclosure	14.95
14	MISC-SW	Misc. Parts Kit Includes Hardware, (6/32, 8/32 Nuts, & Bolts), Hookup Wire, Ant. Terms, DPDT Ant. Switch, Fuse, Fuseholder, etc.	9.95
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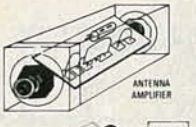

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RG-59/U	75 ohm Low Loss Coax Cable	$ .12 p/ft
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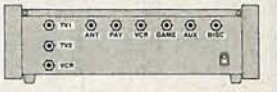
Now you can eliminate ... the drudgery of disconnecting and reconnecting your video equipment each time you use it ... the tangled mess of cables which are impossible to trace out ...not being able to use more than one function at a time.

Bambi lets you enjoy using your video equipment the way it should be ... electronically and on line at the push of a button.

Model BEVS-1 **$129.95**



Bambi's front panel was designed with the user in mind. Computer styled construction, with soft-touch keyboard (rated for over 10 million operations), arranged in matrix form allows easy input/output selection without refering to charts. Functions selected through the keyboard are immediately displayed on the 18 LED status indicators.

Check the quality of Bambi against that of much higher priced competition. All solid state electronic switching provides low attenuation (3dB), wide frequency response (40-890 MHz), and excellent isolation between signal sources (each I/O section individually sheilded for 65dB min. isolation).

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Input Return Loss	12dB min.
Isolation	65dB min.
Power Req.	117VAC 60 Hz, 2W
Dimensions	10¼ W x 6¾ D x 3¼ H
Weight	4½ lbs

SWD-1 VIDEO CONVERTER FOR CABLE TV

The SWD-1 Video Converter is utilized on cable TV systems to remove the KHz's signal from a distorted video (channel 3 in/out) and also pass thru the normal undistorted/detected audio signal. Rocker switch selects operating mode to remove KHz's distortion from the video or pass all other channels normally. Simple to assemble—less than 30 minutes. Pre-tuned. Input/output Channel 3. Impedance 75 ohms. 117VAC.

SWD-1 Video Converter Kit **$69.95**

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Simple Simon Video Stabilizer, Model VS-125, eliminates the vertical roll and jitter from "copy guard" video tapes when playing through large screen projectors or on another VTR. Simple to use, just adjust the lock control for a stable picture. Once the control is set, the tape will play all the way through without further adjustments. Includes 12V power supply.

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7+11 PWD PARTS KITS

INTRODUCING OUR 7+11 PWD PARTS KITS

NEW

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2	2CB1-PWD	Printed Circuit Board, Pre-drilled	18.95
3	3TP11-PWD	PCB Potentiometers 4-20K, 1-.5K, 2-10K, 2-5K, 1-1K, and 1-50k. (11 pieces)	8.95
4	4FR-31-PWD	Resistor Kit, ¼W, 5% 29-pcs, ½ W 2-pcs	4.95
5	5PT1-PWD	Power Transformer, PRI-117VAC, SEC-24VAC at 500ma.	9.95
6	6PP2-PWD	Panel Mount Potentiometers and Knobs, 1-1KBT and 1-5KAT with switch	5.95
7	7SS17-PWD	IC's 7-pcs, Diodes 4-pcs, Regulators 2-pcs Transistors 2-pcs, Heat Sinks 2-pcs	29.95
8	8CE14-PWD	Electrolytic Capacitor Kit, 14-pieces	6.95
9	9CC20-PWD	Ceramic Disk Capacitor Kit, 50 WV, 20-pcs.	7.95
10	10CT5-PWD	Varible Ceramic Trimmer Capacitor, 5-65pfd, 5-pieces	4.95
11	11L5-PWD	Coil Kit, 18mhs 3-pcs, .22μhs 1-piece (prewound inductors) and 2 T37-12 Ferrite Toroid cores with 6 ft. #26 wire	6.00
12	12ICS-PWD	IC Sockets, Tin inlay, 8 pin 4-pcs, 14 pin 1-pc and 16 pin 2-pcs	2.95
13	13SR-PWD	Enclosure with PM Speaker and Pre-drilled Backpanel for mounting PCB and Ant. Terms	14.95
14	14MISC-PWD	Misc. Parts Kit, Includes Hardware, (6/32, 8/32 Nuts & Bolts), Hookup Wire, Solder, Ant. Terms DPDT Ant. Switch, Fuse, Fuseholder, etc.	9.95
15	15MC16-PWD	Mylar Capacitors, 14-pcs and Silver Mica Capacitors 2-pieces	7.95
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The graphic-equalizer section consists of an input buffer (IC1-b), variable-boost/cut active filter (IC2-a), and output summing-amplifier (IC2-b). The IC1-b circuit is designed for unity gain and is used mainly for impedance-matching between the preamp and the equalizer (active filter) input. The filter is a variable-bandpass or notching device, depending on the setting of control R9.

Any number of equalizer filter-stages can be used within the range of about 20 Hz to 20 kHz. However, the more stages you have, the easier it is to boost or cut a particular frequency without affecting the response at adjacent frequencies. All the filter stages use the same R-C feedback-network configuration shown in Fig. 1, to provide a maximum of about 15-dB of boost or cut at f_o, the center frequency. The only differences in each stage are in the values of C5 and C6, which set the values of f_o. Table 2 lists the values for C5 and C6 for 22 center frequencies in the audio spectrum. Note that C5 is ten times as large as C6 and that the values for R8 and R10 are both related to the value of R9 by about a factor of 10. The center frequencies have been adjusted so that C5 and C6 are standard, off-the-shelf, values. We recommend using linear slide-potentiometers for R9.

The value of R13 depends on the number of filter stages used. It insures that the gain across the equalizer is unity when all con-

TABLE 2

R8 = 2.4K	R9 = 25k	R10 = 240k
f_o	C5	C6
23 Hz	1μF	.1μF
50 Hz	.47μF	.047μF
72 Hz	.33μF	.033μF
108 Hz	.22μF	.022μF
158 Hz	.15μF	.015μF
238 Hz	.1μF	.01μF
290 Hz	.082μF	.0082μF
350 Hz	.068μF	.0068μF
425 Hz	.056μF	.0056μF
506 Hz	.047μF	.0047μF
721 Hz	.033μF	.0033μF
1082 Hz	.022μF	.0022μF
1588 Hz	.015μF	.0015μF
2382 Hz	.01μF	.001μF
2904 Hz	.0082μF	820pF
3502 Hz	.0068μF	680pF
4253 Hz	.0056μF	560pF
5068 Hz	.0047μF	470pF
7218 Hz	.0033μF	330pF
10827 Hz	.0022μF	220pF
15880 Hz	.0015μF	150pF
23820 Hz	.001μF	100pF

trols (R9's) are in the FLAT or 0 dB position. The value of R13 is 100K divided by N, where N is the number of stages used. Note that only one audio channel is shown in the circuit in Fig. 1. You'll need two of those circuits for stereo.

This circuit was taken from the NE5532 data sheet and from the applications note "Signetics Low-Noise Operational Amplifiers."

DAC technical data sheets

D/A Converter Products offers the designer a wide and versatile range of eighteen DAC's (*D*igital-*A*nalog *C*onverters) to choose from. The series consists of the 8-bit industry-standard MC1408 and DAC-08 converters and microprocessor-compatible DAC subsystems. Also included is complete data on the recently announced microprocessor-compatible 10-bit NE5020 DAC. The 67-page data book opens with a converter cross-reference guide to aid the designer in selecting the device best suited to his requirements.—**Signetics Analog Marketing,** Data Converter Division, PO Box 409, Sunnydale, CA 94086

RF transistor catalog

Short Form Catalog No. 503A is a 10-page listing of the pertinent characteristics of approximately 150 RF transistors by TRW. Devices are cataloged under such headings as *small-signal/low-noise, linear SSB, mobile radio* (20 to 870 MHz), and *broadband microwave* (0.6 to 6.0 GHz). Package outlines and dimensions are shown in detail.—**TRW RF Semiconductors,** 14520 Aviation Blvd., Lawndale, CA 90260 **R-E**

SERVICE CLINIC

Expect the unexpected

JACK DARR, SERVICE EDITOR

IN THE BUSINESS OF ELECTRONICS servicing, when we make a diagnosis of a fault, we usually find the things we *expect* to find. We're familiar with the problems: If there's no voltage at a given point, we know right where to start looking. However, there are times when we find a familiar symptom, but all of the "normal" checks fail to show up its cause. When that happens we must learn to look for something that is logical, but unexpected! (All faults in electronics turn out to have a logical basis, but sometimes we don't realize that until after the fact.)

For example, I once had a tube-type black-and-white TV set where I could get sound, but no raster. Checking, I found no HV, but the B + checked out normal and the tubes all lit up. The DC voltages on the horizontal-output tube were all OK; the screen voltage was a bit high, but the control grid showed a normal drive-signal and bias.

Finally, I put a milliammeter in series with the cathode of the output tube; the current was practically zero. When I checked the plate voltage on the damper tube I read full B + , but when I checked its cathode voltage (knowing it was safe to do so, because there was no boost voltage), it turned out to be zero! That was strange—it should have also been full B + ! Continuity from the cathode of the damper to the plate-cap of the horizontal-output tube proved to be perfect.

With the damper's cathode-voltage at zero, there was no plate voltage at all on the output tube—every bit of current used in the horizontal output stage must flow *through* the damper tube; there's no other connection to B + . While the tube *looked* good, something was obviously wrong. I replaced the damper tube, put a voltmeter on the cathode, and turned the set on. When the set had warmed up, the cathode voltage had risen to full B + and was continuing to go up. Removing the voltmeter hastily, I looked at screen and saw a perfect picture.

What had been wrong with the damper? Examining its base under a strong light with a magnifying glass I could see that the ribbon connecting the cathode cylinder to the base pin (Fig. 1) had a hairline crack in it—the cathode was completely open!

Along the same line, some time later on I got a set that would play perfectly for exactly 60 seconds, then lose all AGC. That would happen any time the set was turned on from a cold start—60 seconds exactly! A

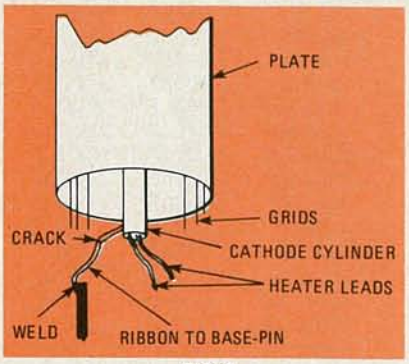

FIG. 1

faint bell rang in my mind and I pulled the AGC tube, a 6GH8. On the tube tester, the reading came up to normal, stayed there for exactly 60 seconds, then dropped to zero. Examination under the magnifying glass showed exactly the same fault that I'd found in the other set—but in this case, when the tube cooled off, the ribbon made contact again! In exactly one minute, it heated up and expanded enough to break the contact again. That tube is still somewhere on top of my bench; it'll do its trick over and over again on request.

Another tale of the unexpected

The set this time was a brand new tube-type black-and-white portable, right out of the box. It had no vertical sweep at all; there was just a very thin horizontal line on the screen. I opened it up to check the vertical-sweep circuit. (In those sets, a very thin line usually meant a problem in the output stage. A problem in the input stage made a thicker line due to stray AC-pickup on the grid of the output tube.) All the DC voltages were OK, with the single exception of that on the grid of the first stage, which seemed to indicate that the circuit just wasn't oscillating.

Several minutes later, I'd tested every part in the vertical-sweep circuit—every part that I expected to cause that type of trouble, that is—and everything had checked out OK. I applied 6-volts AC to the grid of the input stage but still got nothing but that thin line. I was puzzled—what part in there *hadn't* I checked? (At that time, I thought of a phrase I'd seen in many, many letters from readers: "I've checked every part in this circuit and it still won't work!") I finally realized that I hadn't tested the output transformer. (It was not really part of my vertical-stage servicing technique to do that, since that part is so seldom bad. More perfectly good vertical-output transformers are replaced than any other part, I believe.)

So, I checked it. I knew it had continuity, for I'd checked the plate voltage of the output tube; I'd felt safe doing that since it obviously wasn't working and had measured full B + . Now, I measured the resistance of the primary...and then sat there and laughed! It was a big flat zero ohms! I disconnected the leads and rechecked. Still zero—a shorted primary. I really hadn't expected that, since the set was brand new.

When I tacked in a substitute output transformer, I immediately got full deflection and when the new part from the dealer arrived, the set worked like a charm. Somehow, I managed to keep the original part and, sometime later, I cut the paper wrapping off the windings and found exactly what I'd suspected. The bare ends of the leads of the primary had slipped and were making very good contact with each other. Separating and retaping them, I had a perfectly good new transformer, which I used in a set of the same make a bit later on.

There again, all the normal procedures had failed to turn up the problem. The cause was eventually found, but in an entirely unexpected place. *Moral*: When the usual tests fail to produce results, look somewhere you normally wouldn't! You will have one solid fact to start with—the stage doesn't work, so there *must* be a bad part in it that you didn't check. **R-E**

SERVICE QUESTIONS

TEMPERATURE-SENSITIVE IC

This RCA CTC-97 JB starts up with a little color, and then goes to a good black-and-white picture when the temperature is in the 90's. When it's in the 80's, the color's OK for few minutes, but then goes to reddish-brown. In the 70's, the color is there most of the time. I suspect the chroma-processor IC; could it be temperature-sensitive, and how can I tell?—R.D., Dutton, VA

From the description, I'd say that something in there is very definitely temperature-sensitive. It may be the IC, or could even be external parts. An easy test is to warm up the

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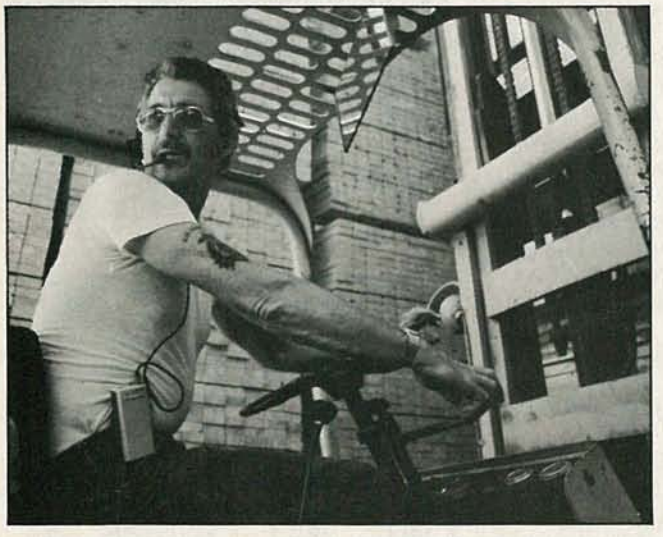

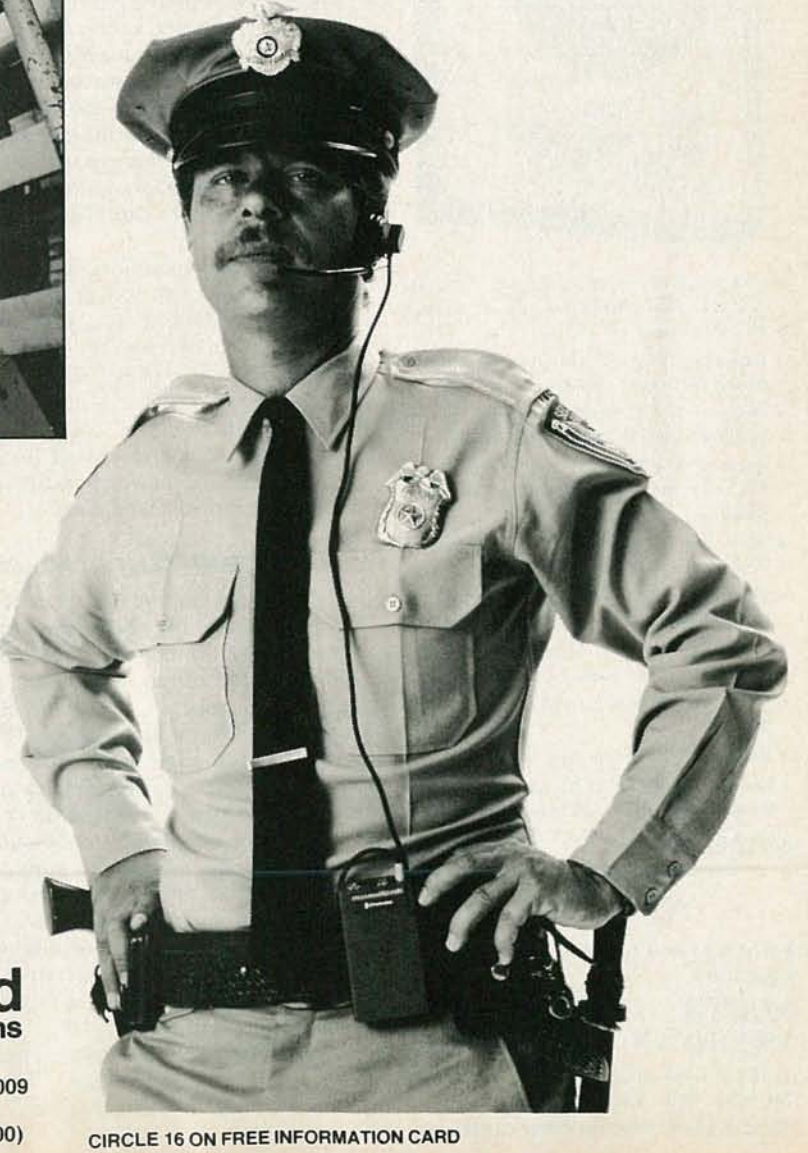

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chassis (borrow a hair drier) until the problem shows up. Then spray coolant carefully on each suspected part. If the color comes back when a particular one is sprayed, there you are. That will check the IC, too.

Run the set for a while and then feel the case; I don't think it should be warm. If it is, you might want to rig up some sort of heat sink to see if it helps.

INTERMITTENT VERTICAL SWEEP

This job came in with intermittent vertical-sweep. When the sweep was off, the screen showed a beautiful damped sine-wave! I suspected the yoke, but it was OK and the oscillator was still running at all times. As I poked around, the sweep went on and off! That made me suspect a loose connection and, sure enough, I found a cold solder joint on the yoke plug! As you'd say, Jack, don't overlook the obvious, even though it may not be!—*R.J. Bohland, Toledo, OH*

POWER TRANSFORMER BURNOUT

I've been having some trouble with power-transformer burnout on Electrophonic chassis-20 consoles. When I called in for a new transformer, the fellow I spoke with said to change the output transistors to a different type: The 2SA643 should be replaced by a 2SA684, and the 2SD261 by a 2SC1384. The old ones are 2-watt types; the new ones 3-watt types. He says the problem shows up when the volume is run wide open. Do you have any ideas?—Don Wainwright, Taos, NM

Thanks very much for the hint, and we'll pass it along. I've had similar problems, blowing out output transistors in small amps that used similar types. My quick-and-dirty fix for this is to open the collector supply to each channel-output, and insert a small 22 or 33-ohm two-watt resistor. That will help hold down excessive current through the transistors (and power transformer), but won't cut the volume too much.

INTERMITTENT BLACKOUT

The screen of this GE 19QA goes dark intermittently; the sound stays normal. I found that the collector voltages of all three video output-transistors go way down, to about +20 VDC; the base and emitter voltages stay normal. When the raster does come back, the collector voltage returns to normal, about +100 volts. The supply voltages don't vary at all. Any ideas?—W.B., Portsmouth, VA

Well, for one thing, I don' think the problem is in the three color-video-stages. I think what you're seeing is a *symptom*. (Since the output transistors drive the grids of the CRT, and grids shouldn't draw current, if the grids *do* draw current, the collector voltages will drop.)

What you're seeing could happen if you lost the CRT cathode-voltages. I see those are fed through a "current-limiter" transis-

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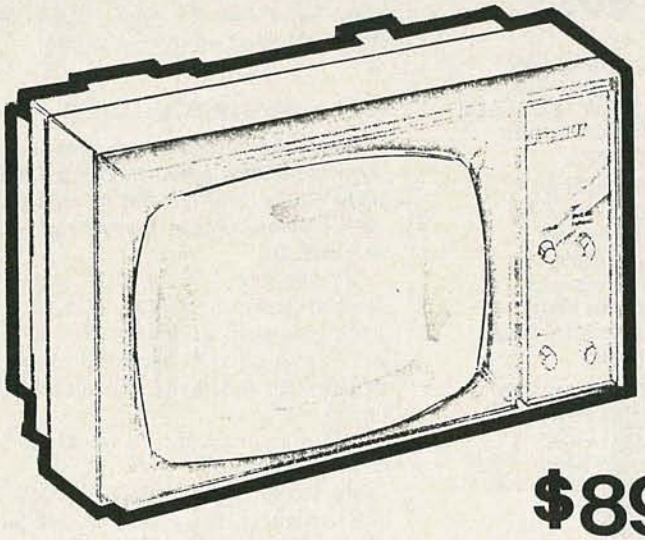

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Input Impedance	75 ohms
Scan Frequencies	Horizontal: 15600Hz Vertical: 50/60Hz
Display Size	210 (W) x 158 (H) mm
Deflection Linerity	Horizontal: 10% Max. (refer to EIA ball Chart and dot Pattern.) Vertical 8%
Video Response	12MHz (±6dB)
Resolution	Center: 650 Corners: 550

Power Source	120V Ac, 50/60 Hz
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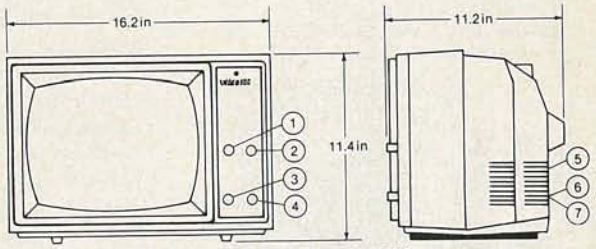

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tor to all three cathodes. If you lost the cathode voltages, the grids would go too far positive and draw current. When the set blacks out next time, read the cathode voltages, and check that current-limiter transistor; it's the one thing I see in there that could affect all three cathodes.

MYSTERY CHASSIS

I've been trying to locate data on a GE TV with no back cover. It uses a 15MP22 picture tube, and (...a list of others...). I need a Sams number or anything!—R.D., Augusta, GA

My first reply: "Look all over the rear apron of chassis. See if there's a good sized rubber-stamped legend there, like 'CD...,' etc." (It wasn't a CD, incidentally—I tried looking it up myself and couldn't find anything.)

R.D.'s second letter: "I found 'G1' on the rear of chassis."

My second reply: "Bingo! That's the chassis number. It's a 'G1;' look in Sams 973-2, plus a couple of PCB's (*P*roduction *C*hange *B*ulletins). The tubes all match, and everything looks good."

RCA HINTS

If you run into deflection problems in an RCA CTC-53 chassis, try changing the 31LZ6 (horizontal-output tube) to a 36CM6. The 31LZ6 can cause some odd problems, even in a vertical-output circuit.

Another factor responsible for the loss of vertical sweep is a bad trimpot on the high-voltage protector circuit, or a bad SCR.

Thanks very much to Douglas P. Hoff of Vacaville, CA for those hints. I remember the problems we used to have with 31LZ6's. I thought they were all gone by now, but evidently there are still a few floating around.

THREE PICTURES

I've got a problem in a Heath GR-900 color set, a kit. I brought the kit with me (to Alaska) and finished it here. Now I get three side-by-side overlapping pictures and can't do anything to straighten things out with the hold control or the horizontal-oscillator coil. I can't find a thing on the oscillator board. Now I've been checking everything else; I get a weird waveform on the video—the normal sync-pulse is flattened on top, and there are three more "sync pulses" between them where there should be video. Help!—S.V., Kodiak, AK

Don't bother checking "everything else!" That type of problem comes from only *one* circuit; the horizontal oscillator. It's the frequency-determining stage for all the rest of the set. Go back and check everything there, especially around the horizontal-oscillator coil/hold control/etc. circuits. The problem's in there somewhere. You might try killing the AFC to see if that's the cause.

(Feedback: Thanks. As usual, you were

right. A tantalum capacitor, C560, is on the oscillator board, in parallel with a Zener diode. When I took it off the board for checking, it fell apart! A new one solved the problem and the set's been going great now for several days.)

WHITE LINES ON LEFT

I've got white lines on the left side of the raster in a Sony KV-1733R, and I can't find out why. Can you?—J.S., Clementon, NJ

From the description, that sounds a lot like old-fashioned "yoke ringing!" Check the damper and its circuits for something open.

(Feedback: Thanks! I was on the way to the damper circuit when I noted the resistor and coil hanging on the anode of Q510 (an SCR in the horizontal-output circuit). I lifted one end of R586, an 18-ohm, 2-watt device. It was open and replacing it got rid of the lines.

Comment: Well, I got him in the right area, anyhow! Resistor R586 is shunted across the coil, L586, to damp it. When it opened, the coil rang. Thanks to John S. Smith, J Radio-TV Service, for the feedback. (Write this down somewhere and hang it over the bench. You might need it someday!)

VERTICAL SYNC PROBLEM

Recently you answered my letter about a vertical sync problem with several suggestions as to things to try. The one about spraying coolant on various parts did the trick. The vertical-output transistor was very "thermal." (I got an American equivalent type for $1.08 and it works beautifully.) Thanks.—*S.P., Melville, NY*

VERTICAL JITTER

This Panasonic MA-432 has very bad vertical jitter all the time. All the controls are OK, all the voltages within tolerance, and all the transistors and diodes check out. If the set is hooked up to a Variac, there's no jitter until about 115-volts. Beyond that point, the jitter starts and at full line-voltage, 120 VAC, it's very bad again.—N.D., Weirton, WV

I had a similar case many years ago. The problem was horizontal "piecrusting" (tearing due to jitter), but the symptoms were the same. After much checking, I found a filter capacitor just a wee bit low. Try putting a scope on the regulated DC supply for the vertical *and* sync-separator circuits (jitter can often be due to some horizontal-sync signal leaking into the vertical-sync circuits).

Find out what the regulated DC-supply reads at 115-volts, then see if that rises when you increase the input to normal line-voltage. If the regulator isn't "tight" enough it may be letting the DC go to high and upsetting the sync-separator circuits. Also, there should be practically no ripple at all at the output of the DC voltage-regulator. If there is, check the capacitors, transistors, etc., around it.

GOLDEN OLDIE

I got in a Magnavox 4-34-01 (Sams 511). The sound was weak and badly garbled. I used my substitution box to bridge the .01 μF coupling capacitor to the grid of the audio-output tube and the sound got much better. When I checked the value of the capacitor I'd substituted, I found I'd used a 15-μF electrolytic! Can you explain that?—W.R., Temple Hills, MD

That's a circuit that was quite popular several years ago; it was known as a "stacked B+" circuit. That circuit sounds complex, but isn't, really. The full B+—about 300 volts—is fed to the plate of the audio-output tube. The cathode voltage is about half that and is also used to feed the video IF—as well as other stages—whose cathodes are grounded.

The tricky part takes place in the audio-output grid circuit, whose voltage is clamped at the proper value by a voltage divider from the B+ supply. If either of the resistors in the divider changes value, the bias-voltage is upset. That is the same thing that happens if the coupling capacitor to the driver stage leaks. Evidently, when you put the electrolytic across the coupling capacitor, you brought the bias almost back to normal. **R-E**

NEW PRODUCTS

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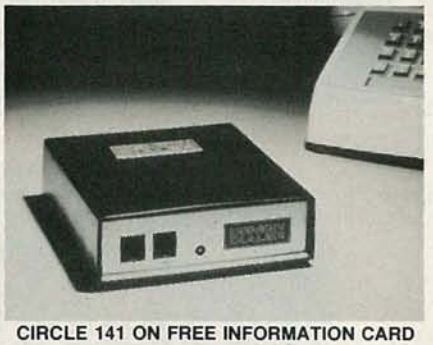
TELEPHONE DIALER, the *Demon Dialer,* stores up to 176 phone numbers, with any number up to 32 digits long. Numbers can be dialed by using easily remembered names, such as MOM or TWA. The silent-re-dial feature dials a "busy" number ten times in the first minute, then once every subsequent two minutes for up to two hours; it sounds a "success" tone when the "busy" signal changes to a ring.



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In another mode, the *Demon Dialer* dials an unanswered phone once every ten minutes for up to ten hours, and sounds a tone when someone answers the phone. The *Demon Dialer* is controlled by commands from any ordinary telephone—*Touchtone* or rotary, home or office.

There are four *Demon Dialer* models, with retail prices between $150 and $200.—**Zoom Telephonics,** 122 Bowdoin Street, Boston, MA 02108.

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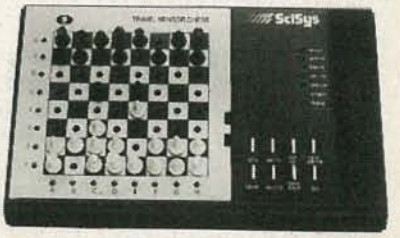
The unit's auto-repeat function automatically engages the rewind mode at the end of the tape. With the counter memory depressed, rewinding stops at the tape-start position, and the tape-transport mechanism is automatically shifted into the play mode.

The *model K-117* also offers a tough new *Sendust* record/playback head developed by Alps Electric, stereo mike input, a gear-control transport system, MPX filter, and independent left and right input controls. The *model K-117* is priced at $399.95.—**Luxman Division,** Alpine Electronics of America, 3102 Kashiwa St., Torrance, CA 90505.

CHESS COMPUTER, *Travel Sensor Chess,* is the smallest 8-level sensor-chess computer on today's market, measuring 7.25 × 4.5 × 1.5 inches. It features an integral sensorboard with red LED's running parallel to the edges of the chessboard. The sensorboard automatically enters all moves in the computer as the chess pieces are advanced. In response, the LED's illuminate the coordinates of the computer's next move. With its advanced CMOS technology, the average alkaline battery life is at least 50 hours.



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The *Travel Sensor Chess* provides such features as recognition and performance of castling, "en passant," pawn promotion, a positive set-up mode, and automatic verification. It can also store board positions, enabling continuation of a match after setting the computer to its OFF position and turning it on at a later time.

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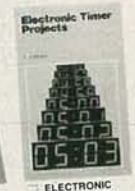

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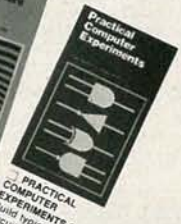

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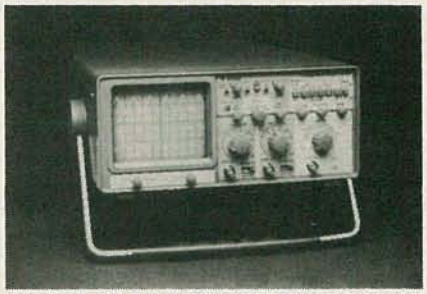
tion of DC or carrier-signal components, or for shifted-baseline comparison, and an active TV sync-separator for video color or broadcast sync-timing—those features typical of more expensive scopes.



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The two input channels of the *model OS300* are indentical in performance, with an accuracy of ± 3%. Sensitivity is continuously variable, with independent adjustment via calibrated controls, from 2 mV/cm to 25 V/cm. Input bandwidth extends from DC to 3-dB down at 20 MHz, permitting examination of fast transients or pulse rises. The 2-mV sensitivity allows the instrument to be used directly with many transducers and low-signal sources.

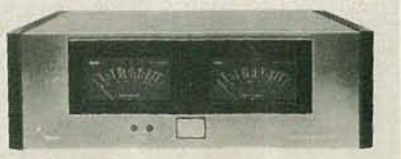
The compact, lightweight *model OS300* has a high-intensity 8 × 10-cm rectangular CRT with either an improved efficiency standard phosphor or an optional long-persistence phosphor. A Z-modulation input is also provided for logic analysis, event markers, or flyback suppression when observing X-Y traces. The primary input power is 110 VAC or 220 VAC at 45-400 Hz.

The *model OS300* is priced at $695.00.—**Gould, Inc., Electronics Division,** 35129 Curtis Boulevard, Eastlake, OH 44094.

POWER AMPLIFIER, *Kyocera model B-901,* uses a triple push-pull MOSFET amplifier with direct coupling from the front end to the speaker terminals. All semiconductors in the power stage are discrete components that are precisely tailored for optimum performance. Transient intermodulation-distortion is virtually eliminated, resulting in clean, crisp sound.

Each amplifier stage is monitored by a DC servocircuit that maintains performance levels. The front-end stages consist of complete complementary circuits with n- and p-channel FET's, a differential push-pull circuit with a cascode bootstrap, and a differential push-pull circuit applied to the second amplifier stage. Two separate power transformers are used, one for each amplifier channel, enabling maximum power to be derived without power-supply interference from channel to channel.

Power output is rated at 150 watts per channel, RMS, into 8 ohms, both channels driven from 20-20,000 Hz developing



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less than 0.01% THD with an overall frequency response of 5-100,000 Hz +0, −1.0 dB and an S/N ratio of 120 dB.

The suggested retail price of the *Kyocera model B-901* is in the $1750.00 range.—**Cybernet International, Inc.,** 7 Powder Horn Drive, Warren, NJ 07060.

CAR STEREOS, *model CAR 312* (shown) and *model CAR 320,* feature exclusive IMS interference-management and CMS continuous-music systems. The interference-management system helps to minimize audible changes in station flutter caused by variations in signal strength. That is made possible by a filter circuit controlling receiver separation and frequency response. The continuous-music system allows listeners to hear music from the AM/FM tuner while the cassette tape is rewinding or fast-forwarding.

Both models have a nose piece designed to be installed in imported cars. Each comes with a reversible faceplate that can display either a simulated wood grain or black lacquer surface. Both models have a frequency response of 40-14,000 Hz and an output power of 4 watts per channel, with a total harmonic distortion of 0.9%.

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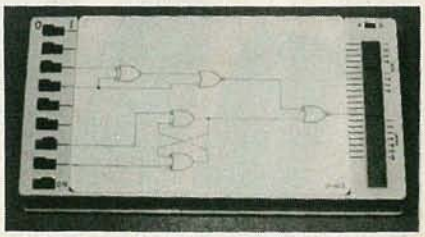
The auto-reverse *model CAR 320* has a suggested retail price of $170. The *model CAR 312* has a special CompuSkip feature allowing users to fast-forward automatically to the next cut on a cassette, as well as bass and treble controls. The suggested retail price of the model CAR 312 is $200.00.—**Marantz,** a subsidiary of Superscope, Inc., 20525 Nordhoff Street, Chatsworth, CA 91311.

LOGIC TRAINER, *model 100,* has reduced the training time required to learn how logic gates and flip-flops function in cir-



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cuits. A new training package has been added to include relay logic, diodes, bipolar transistors, and FET's (non-linear).

The student can solve the trainer problems by correct manipulation of the eight switches that provide inputs to the trainer's internal circuitry. A solved problem turns a designated display bar on. Problems are related to circuits used in communications, word processing, automatic machinery, etc. No component or wire manipulations are needed.

The *model 100* comes with a 9-volt

battery and self-paced instruction manual, and is returnable within 20 days if the purchaser is not satisfied; there is a one-year warranty. The *model 100* is priced at $169.00.—**L.J. Broder Enterprises, Inc.,** 11105 Shady Trail, Suite 115, Dallas, TX 75229.

SOLDERING STATIONS, *model EC3000* and *model EC4000* (shown) use mini-pencil irons that have been introduced for use in miniature and microcircuit applications.

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The two new models correspond in function to the original and continuing *model EC1000* and *model EC2000* stations. Electronically controlled using platinum sensors, their capabilities include maintenance of constant pre-set tip temperatures to within ±10°F through a range of 350° to 850°F. Temperatures are dial-set on all models.

The electronic system eliminates high-voltage spikes, offers power-unit isolation, and a fully-grounded soldering tip. A complete range of tip sizes and shapes is available for all the models in the series.

The *model EC3000* is priced at $125.00. The *model EC4000* has an instant LED temperature read-out, and is priced at $170.00—**Weller, The Cooper Group,** P.O. Box 278, Apex, NC 27502.

THE LEMONAID LOADER is designed to make cassette-tape loading easy and reliable when used with the Radio Shack *TRS-80 Model 1* computer. The loader shapes the cassette output signal, while banishing noise and overshoot, thus almost totally eliminating loading problems for either self-saved or pre-recorded BASIC or system tapes.

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The loader plugs between the cassette earphone jack and the computer and requires no rewiring, adjustments, software, or volume-control settings. It is automatically self-powered by the cassette signal itself.

The *LemonAid Loader* is priced at $12.99 pp.—**Lemons Tech Services,** 325 N. Highway 65, PO Drawer 429, Buffalo, MO 56522.

MINI-DISK SYSTEMS, the *Percom RFD,* first-drive systems are fully compatible with *Atari 400* and *800* computers; they provide double-density storage, and are available with 40- or 80-track drives. A *Percom RFD* first-drive system includes a disk controller, disk-operating software, inter-connecting cable, owner's manual, and 5¼-inch disk drive. The software, which is provided on diskette, adds subroutines to the Atari DOS for handling higher storage capacity features of the Percom system. The Percom disk system may also be operated with the unmodified, single-density Atari DOS.

Besides providing double-density storage, the RFD controller can handle up to four single- or dual-headed mini-disk drives.

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The *Percom RFD* first-drive systems start at $799.00; add-on drives start at $399.00.—**Percom Data Company, Inc.,** 11220 Pagemill Road, Dallas, TX 75243. **R-E**

NEW BOOKS

For more details use free information card inside back cover.

A BUYER'S GUIDE TO VIDEO CASSETTE RECORDERS: How To Buy, Install, & Use Them, by Cathy Ciccolella. Sterling Publishing Co., Inc., 2 Park Avenue, New York, NY 10016. 128pp, including appendices and index; 6 × 9 inches; softcover. $5.95.

Video cassette recorders (VCR's) enable you to record a TV program as you watch it, record one program while you're watching another, or record a program while you're away or asleep, etc. You can build up a library of your favorite movies, sports events, or educational programs. And with a portable video camera you can create your own shows.

This comprehensive handbook provides a thorough introduction to the entire range of video equipment, with the information you will require to select the suitable system for your needs. It discusses the features of all the principal systems on today's market, with 31 photos of the leading video-cassette recorders, video cameras, and big, wide-screen projector-TV systems. You'll find valuable tips on where and how to buy your system, and what your warranty should cover. Recording tapes are compared and all the accessories and other VCR components are examined. There is also important data on installation procedures that you may not find in an owner's manual, as well as on how to handle antenna problems and fringe broadcasting areas.

CIRCLE 111 ON FREE INFORMATION CARD

MASTER HANDBOOK OF MICROPROCESSOR CHIPS, by Charles K. Adams. TAB Books, Inc., Blue Ridge Summit, PA 17214. 378 pp including index; 5 × 8⅛ inches; softcover; $9.95.

Microprocessors are the most exciting thing to hit the electronics market since the calculator; they are an extension of calculators, and have already exceeded calculators in both their range of applications and usefulness. Although the microprocessor field has just started to evolve, there are already devices that can only be called fantastic, and new ones appear in the marketplace month after month. Here is a field where one person can design, build, program, and operate a real computer.

This data-packed sourcebook examines all the most popular microprocessors in use today, with full details on support IC's and their functions. Clearly written and well organized, the handbook will help you to identify instantly all support IC's applicable to specific microprocessors. There are more than 300 illustrations, drawings, and diagrams, plus many tables that pinpoint exactly the information the reader needs. Microprocessor architecture is covered thoroughly, with diagrams of each IC, instruction lists, signal definitions, timing, and other pertinent data. There are also complete descriptions of support IC's, with details needed for using each one.

This is a thorough introduction to microprocessors for the beginning hobbyist and an update on new technological methods for the more advanced experimenter.

CIRCLE 112 ON FREE INFORMATION CARD

A REFERENCE GUIDE TO PRACTICAL ELECTRONICS, by Robert G. Krieger, Sr. Gregg/McGraw-Hill, 1221 Avenue of the Americas, New York, NY 10020. 212pp.; 5⅜ × 8 inches; softcover. $7.50.

This book offers a highly organized and condensed overview of electronics. One hundred carefully selected equations function as keys to five major areas: DC circuits, AC circuits, active devices, circuit analysis, and communications.

Each equation is accompanied by a definition of the terms in the equation, a straightforward expanation of what the equation means, and illustrative examples of how it is used to solve actual problems. In each section, the information progresses logically from page to page.

There is also a bibliography; an index to terms; an index to equation titles, and an index of equations themselves. The guide is useful not only as an effective supplementary learning tool for scholars, but will also be useful to those who are preparing for FCC examinations, and to electronics hobbyists.

CIRCLE 113 ON FREE INFORMATION CARD

HOW TO BUILD A COMPUTER-CONTROLLED ROBOT, by Tod Loofbourrow. Hayden Book Company, Inc., 50 Essex Street, Rochelle Park, NJ 07662. 132 pp including appendix and index; 5¾ × 8¾ inches; softcover; $10.70.

Robotics is one of the most interesting results of today's advanced technology. It combines electronics and mechanics with biology and psychology, raising questions about the definition of "intelligence."

The invention of the IC and the consequent development of microcomputers have revolutionized the field of robotics. With microcomputers, the great amount of logic circuitry previously required for robots can be discarded in favor of software. Thus, the cost of robot-building has gone down considerably. One reason for building a robot, in addition to its potential usefulness (or even just entertainment value) is that it is an exciting way to learn about electronics and microcomputers. The builder will learn the actual limits of our present technology, and there is always a

chance of making improvements in it, or even carrying it a step farther.

This book details step-by-step directions for building a computer-controlled robot, named "Mike." Mike is controlled by a KIM-1 microprocessor. Every step of the construction is explained, with the complete control programs clearly written out. Photographs, diagrams, and tables help direct you in the construction. And, of course, you may use the directions exactly as presented, or as a basis for developing your own design.

CIRCLE 114 ON FREE INFORMATION CARD

APPLE PASCAL GAMES, by Douglas Hergert and Joseph T. Kalash. SYBEX U.S.A., 2344 Sixth Street, Berkeley, CA 94710. 371 pp including appendix; 7 × 9 inches; softcover; $14.95 plus $1.50 for shipping.

Pascal is an elegant, versatile, clearly-structured language that is easier to read, and just about as easy to learn as BASIC.

Each of the Pascal programs in this book is described in two ways. First, in the sections called "The Game," the authors explain what programming does. No previous knowledge of programming is needed; those sections serve as a guide for the reader who wants to type the program in and play the games. A sample run is provided for all but the few games that are exclusively oriented for the screen.

In the sections called "The Program," the reader will find an organization or structure chart for each program, and an explanation of how the program works. After the simple games, and the more advanced games, the reader is introduced to games that use TURTLE-GRAPHICS, the Apple graphics package. The final part presents a single, long program, Cribbage, which is rich in illustrations of how to use the many elements of Pascal.

CIRCLE 115 ON FREE INFORMATION CARD

DIGITAL IC PROJECTS, by F. G. Rayer. Bernard Babani (publishing), Ltd. Available in the USA from Electronic Technology Today, Inc., PO Box 83, Massapequa Park, NY 11762. 91 pp.; 4⅜ × 7 inches; softcover; $4.95.

This book contains a number of simple, and some more advanced, projects for the home constructor. While each project is interesting in itself, the author's intention is also to be of help in developing the constructor's knowledge of the workings of digital circuits.

Various forms of assembling and wiring the integrated circuits on their boards are shown; that aspect of a project can be quite straightforward, and not require the builder to prepare a printed-circuit board. The more ambitious projects have been laid out so that they can be built and tested step by step. That assists the builder to avoid errors, or to correct them easily if any are made, and also brings better understanding of how the devices operate.

THE COMPLETE GUIDE TO CAR AUDIO, by Martin Clifford. Howard W. Sams & Co., Inc., 4300 W. 62nd Street, Indianapolis, IN 46268. 232 pp; including glossary and index; 5¼ × 8½ inches; softcover; $9.95.

Many people who have enjoyed high-fidelity sound in their homes may have wondered why sound-systems for their cars lagged so far behind. The reasons are simple: a car is mobile, so any sound system in it must be subject to constant vibration; there is a space problem, as compared even to a small room in a house; acoustical materials in a car cannot be changed or switched around, as at home, nor can speaker-position be changed much; the temperature ranges in a car's interior can vary from extreme heat to extreme cold, and finally, car-sound equipment must compete with noise from a variety of sources not encountered in the home.

However, most of those problems have now been overcome; as a result, modern car-audio systems are capable of delivering exceptional quality sound from tapes or over-the-air broadcasts.

This fully-illustrated book is a complete guide to car audio. The reader will learn about the various components available and how to plan a system that fulfills the individual need. Information on installation, noise suppression, and theft protection is also included.

CIRCLE 116 ON FREE INFORMATION CARD

THE SMALL COMPUTER IN SMALL BUSINESS: A Guide to Selection and Use, by Brian R. Smith, The Stephen Greene Press, Brattleboro, VT 05301. 143 pages, including appendices, glossary, bibliography, and index; 6¼ × 9¼ inches; hardcover; $12.50.

In one respect, a computer is just another machine that has the *potential* to help conduct your business more efficiently and profitably. One reason why some business owners have been disappointed in their attempts to use a small computer

is that they've just gone out and bought a computer, bought or written some software, then tried to shoehorn both the software and hardware to fit their individual business needs. That is an ideal way *not* to do it!

The right way is to define what it is within the business that needs automating, find the software to do it, then buy a machine to run the software.

It sounds simple, and it *is* simple—after you have a foundation of information about small computers. This book will give you that foundation and help you to decide what type of devices to look for, as well as how to decide whether the best bet for you would be to buy, rent, or lease the computer you decide upon. Any one of those three alternatives might be the right one for *you*.

CIRCLE 117 ON FREE INFORMATION CARD

APPLE II USER'S GUIDE, by Lon Poole with Martin McNiff & Steven Cook. Osborne McGraw-Hill, 630 Bancroft Way, Berkeley, CA 94710. 386 pp including appendices and index; 6½ × 9¼ inches; softcover; $15.00

This book describes the *Apple II* and covers the common peripheral devices and accessories, inlcuding the disk drives and printers. The authors assume that the reader has access to a fully installed *Apple II* system and tells what to do with it from that point.

The first two chapters cover the questions as to just what the *Apple II* is, and how one makes it work. The user will have noticed that the system is made up of several pieces, all strung together with wires and cables. Chapter one identifies them and spells out their uses; chapter two tells how to operate each component part. Once that is learned, the user can turn to any of the "ready to run" programs that are widely available for word processing, financial analysis, bookkeeping, computer-aided instruction, and entertainment.

Chapters three to six teach you how to write your own BASIC programs, starting with the fundamentals of both versions of BASIC that are available on the *Apple II:* Integer BASIC and Applesoft. After that comes advanced programming and BASIC features. The disk drive and screen display graphics have chapters all to themselves.

Chapter seven explains both the standard monitor that supervises BASIC programs on the *Apple II* and the autostart monitor from a BASIC programmer's viewpoint. It also tells you how to incorprate an assembly-language program into your BASIC program. Chapter eight contains a complete description of each statement and function available in both versions of BASIC, including disk statements. Along with the appendices, that serves as a handy reference once the user knows how to program in BASIC. The book is illustrated with many photos, diagrams, and charts.

CIRCLE 118 ON FREE INFORMATION CARD

BEGINNER'S CB and TWO-WAY RADIO PROGRAMMING, by Newt Smelser, Nelson-Hall Publishers, 111 N. Canal St., Chicago, IL 60606. 232 pages, including glossary and index; 8⅛ × 10¼ inches; $29.95 (cloth); $14.95 (paper).

This book has three purposes: to teach a complete beginner in electronics how his CB radio operates, and how to repair it; to teach a beginner how to service CB radios in general, so that he may enter the CB-radio repair business, and to teach a truly ambitious beginner how to service two-way commercial radio equipment as a business. It should also be of value to a TV or auto-radio repairman who might like to take in CB equipment on a part-time basis.

For those wishing only to repair their own equipment, there are many circuits in a CB that can be repaired legally by anyone, whether that person has a technician's 2nd class license from the FCC or not. Those wishing to service CB's as a business are advised to study for and pass the FCC exams, general information about which is given in these pages.

The book is amply illustrated with charts, photos, and layout drawings, providing the beginner with all the technical knowledge needed for skilled radio repair. The author lists specific pieces of shop equipment by brand name and tells how to pool equipment to cut costs. Chapter-review sections and a glossary of technical terms provide convenient aids for the reader.

CIRCLE 119 ON FREE INFORMATION CARD

continued from page 75

sity or energy impinging on the diode doubles, the current in the circuit also doubles. It is that linear relationship that makes the photodiode desirable for picking up audio information from a movie soundtrack.

It is interesting to note that when an ordinary diode is reverse-biased, its saturation current rises with temperature. That is due to the energy added to the diode by heat. In a similar manner, energy is added to the photodiode by the presence of light. Light energy hitting an area is equal to the product of the light intensity and the size of the area involved.

Light-emitting diodes

Heat is generated when current flows through a diode. That heat, as just noted, is a form of energy. It is radiated from the diode. But light is also energy. Light, as well as heat, can thus be radiated from a diode if it is not covered by an opaque material. Diodes that produce light are called LED's (*L*ight *E*mitting *D*iodes).

LED's can be used in numerous different applications. The most common application is as an indicating device. Another application is one of the components required in an opto-isolator. Here, light from the LED is coupled to a light-sensitive transistor. That type of transistor will be detailed in a future article. All you need be aware of here is that the amount of current flowing through a light-sensitive transistor increases as the amount of light striking it increases. Consequently, the LED may be in a circuit completely isolated electrically from that of the transistor. As the LED is turned on, light hits the transistor. Now it conducts more freely than before. Devices of that type can be constructed from two items—an LED and a light-sensitive transistor such as the Sylvania ECG3035. It is also available in one opto-isolator package ECG3042.

Voltage applied to LED's can range from about 1.5 to 2.2 volts. The voltage applied to an LED, as well as the maximum current through an LED, must never exceed the limits set by the manufacturer. In commercially available units, current ratings can vary from 5 to 100 mA. It is best to use a resistor in series with an LED to limit voltage and current to within the specifications.

Transistors

Having completed our discussion of diodes, we now turn our attention to transistor circuits. Two types of transistors are of primary interest to the designer—the bipolar and the field effect. In the next article, we will present methods of using those devices to perform different functions. We will note the various basic circuit arrangements and their characteristics. Also detailed will be the limits that must be observed so as not to reduce the useful life of those devices. **R-E**

SPEECH SYNTHESIZER

continued from page 46

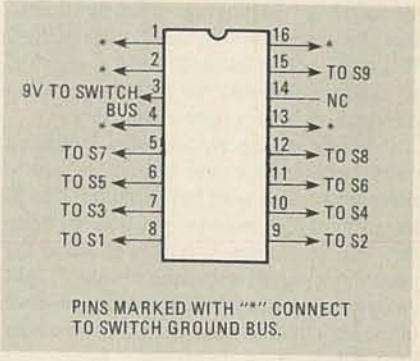

FIG. 6—CONNECTIONS FROM PL1. This same arrangement can be used for connection to a computer's parallel port.

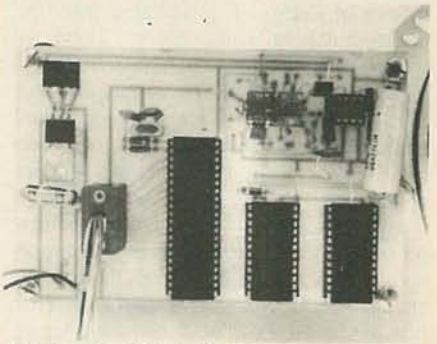

FIG. 7—PROTOTYPE OF the speech synthesizer. DIP header at top of board is not used in version described here.

(Fig. 3) and Fig. 6, using a DIP header for PL1 to mate with SO1 on the board. The completed board is shown in Fig. 7.

Apply power to the circuit and set S1 through S8 in the logic-zero (grounded) position. Now throw switch S9. You should hear a female voice say, "This is *Digitalker*."

Set switch S1 in the logic-one (9-volts) position, throw S9 and you will hear in a male voice say, "One." As you increment the switch address in binary fashion and throw S9 each time, the count will continue, "...two, three, four," etc. Table 1 shows the contents of each binary address; using that table to set the switches, you'll be able to put the synthesizer through its paces.

After you've had enough of throwing switches, you can unplug them and connect the board to your computer via a parallel port. Now, with a simple program your computer will be able to say things like, "TIME IS UP. PLEASE TRY AGAIN." You will quickly learn how to combine *pieces* of the pre-programmed words to form new words, as well; since output stops each time you access the SPC, it is a simple matter to slice phonemes out of several words and recombine them. **R-E**

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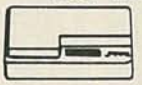

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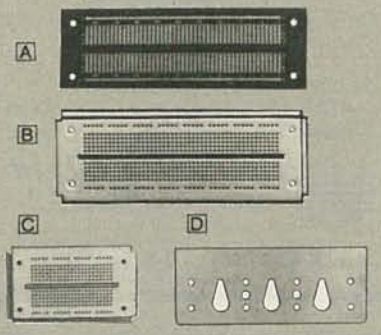

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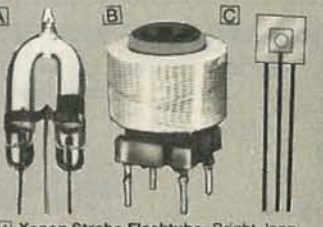

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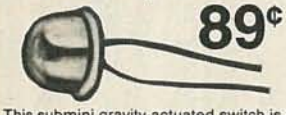

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74LS06	.30	74LS93	.60	74LS190	.90
74LS08	.28	74LS95	.80	74LS191	.90
74LS10	.24	74LS107	.38	74LS221	1.10
74LS11	.33	74LS109	.38	74LS240	.95
74LS12	.33	74LS112	.40	74LS241	.95
74LS13	.45	74LS113	.40	74LS244	.85
74LS14	.89	74LS114	.45	74LS245	1.65
74LS20	.24	74LS122	.40	74LS248	1.00
74LS21	.24	74LS123	.85	74LS249	.90
74LS26	.30	74LS125	.90	74LS251	1.20
74LS27	.28	74LS126	.85	74LS253	.80
74LS28	.32	74LS132	.70	74LS257	.80
74LS30	.24	74LS136	.50	74LS258	.80
74LS32	.32	74LS138	.65	74LS259	1.25
74LS37	.50	74LS139	.65	74LS260	.60
74LS38	.32	74LS145	1.10	74LS273	1.50
74LS42	.50	74LS151	.70	74LS275	3.00
74LS48	.70	74LS153	.70	74LS279	.50
74LS51	.24	74LS157	.70	74LS283	.75
74LS55	.35	74LS158	.70	74LS373	.90
74LS74	.35	74LS161	.85	74LS374	1.50
74LS75	.48	74LS162	.85	74LS377	1.40
74LS76	.38	74LS163	.85		
74LS78	.50	74LS164	.85		

7400 SERIES

7400	.18	7454	.19
7402	.18	7470	.30
7404	.18	7472	.25
7406	.21	7474	.30
7408	.23	7475	.40
7409	.18	7476	.30
7410	.18	7480	.55
7411	.22	7481	1.00
7412	.28	7489	3.95
7413	.32	7490	.30
7414	.45	7491	.35
7416	.24	7492	.45
7417	.24	7494	.60
7420	.18	7495	.50
7421	.30	74100	.90
7425	.25	74107	.45
7427	.25	74122	.60
7430	.18	74123	.40
7432	.25	74144	2.50
7438	.25	74145	.50
7440	.18	74148	1.00
7442	.45	74154	1.00
7443	.60	74157	.45
7444	.60	74160	.80
7445	.60	74161	.80
7447	.60	74166	.90
7448	.60	74174	.80
7450	.18	74181	1.95
7451	.18	74393	1.00
7453	.19		

DYNAMIC RAMs

4027	2.00	8/1.75ea
4116 200ns	1.75	8/13.00
4164 200ns	9.50	

STATIC RAMS

2111	2.85	8/2.50ea
2112	2.85	8/2.50ea
2114	2.00	4/14.00
2114L 200NS	2.25	4/2.00ea
HM6116 200NS	11.50	4/10.50ea

MISC

8T26	1.20
8T28	1.20
8038	2.75
8080A	3.75
8155	10.50
8255	4.50
MC1330	1.65
MC1350	1.15
MC1358	1.50
MC1458	.55
LM380	1.10
LM386	1.40
LM565	.95
LM741	.25
LM1310	2.90
LM1800	2.95
LM1889	1.45

MORE MISC.

8212	1.95
8216	1.80
1103A	.95
UPD765	19.85
AY5-1013A	3.00
1488	.95
1489	.95
MC6802	14.95
MC6821P	4.95
MC6850P	4.50

CPU S

Z80	8.50
Z80A	6.00
Z80A PIO	6.00
6502	6.00
6502A	12.00
6065A	8.50
MC6800	7.75

VOLTAGE REGULATORS

7805, 7806, 7808, 7812, 7818, 7905, 7908, 7912, 7918 — .85

74S SERIES

74S00	.35	74S86	1.10
74S02	.38	74S112	1.45
74S03	.38	74S132	1.10
74S04	.45	74S138	.95
74S05	.65	74S140	1.25
74S08	.40	74S158	1.25
74S10	.55	74S174	.95
74S15	.55	74S175	.95
74S20	.55	74S181	4.00
74S22	.75	74S182	2.75
74S30	.35	74S188	3.50
74S37	1.25	74S240	3.50
74S51	.60	74S244	3.50
74S65	.95	74S471	9.50
74S74	.55	74S472	15.00
74S85	2.00		

EPROMS

1702	4.25	8/3.95 ea
2708	2.95	8/2.65 ea
2716 (5V)	5.00	8/4.50 ea
TMS2716	8.95	8/8.00 ea
2732 (5V)	10.50	8/9.25 ea
TMS2532	11.50	8/10.25 ea

I.C. SOCKETS

ww	p	st
	8	10/1.20
10/5.30	14	10/1.30
10/5.70	16	10/1.40
10/6.70	18	10/1.80
10/9.70	20	10/2.70
10/12.70	22	10/2.70
10/13.70	24	10/2.70
10/14.70	28	10/3.00
10/17.70	40	10/3.90
wirewrap		solder

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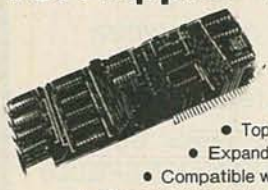
16K Apple™ Ramcard



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ACP $74.95

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- Compatible with Z-80 Softcard™
- Allows system to run with CP/M™, PASCAL, DOS 3.3, COBAL, Visicalc, etc.
- Supplied with extra 16K RAM & has (2) LED's

32K STATIC RAM

2 or 4 MHz Expandable Uses 2114L's

16K 4 MHz Kit	$159.95
16K 4 MHz A&T	217.95
32K 4 MHz Kit	$199.95 ~~269.95~~
• 32K 4 MHz A&T	• 339.00
BARE BOARD	39.95
Bare Bd w/all parts less mem.	99.95

BARE BOARDS

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13 Slot Mother Board (WMC)	32.95
9 Slot Mother Board (WMC)	29.95
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VCEO = 30
IC = 3A
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for COLOR & B/W

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ACP $1.95
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Ibias = 5.0mA
Gain = 40V/mV
(quantity limited)

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Same as TMS4044 but designed specifically for Z-80 based systems. This is a full-spec 4Kx1 RAM, 450nS. Order P/N Zilog 6104-4 while supply lasts.

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Debug prog. $49.95
Plus 6132 companion quasi-static RAM 29.95

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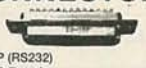
CONNECTORS



DB25P (RS232)	$3.25
DB25S Female	3.75
Hood	1.25
Set with Hood, Sale	7.50
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Z80	9.95	2901A	14.95	8039	12.95
Z80A	11.95	2900JL	49.95	8073N	34.95
F-8 (3850)	16.95	6502	9.95	8755	49.95
2650	16.95	6502A	16.95	8748	49.95
1802	9.75	IM6100	29.95	6809	30.00
8080A	4.75	6800	11.75	8086	49.95
8085	14.95	6800B	19.95	68000	129.95

RAMS

CALL FOR QTY PRICING

6116/2016	$7.95	2147	$5.99	5290	$1.99
8264-64K	8.50	411	5.99	5298	1.49
4116-2	1.99	414	4.69	6508	4.50
4116-2	8/12.95	1101	.99	6518	6.79
2101	3.99	1103	.99	6561	3.79
2102	.79	4027	4.69	6604	3.99
21L02-2	1.49	4044	3.99	6605	7.99
21L02-4	1.29	4050	4.69	9130	8.99
2111	3.49	4060	4.69	9140	8.99
2112	3.49	4096	3.99	93415	6.99
2114	1.99	4115	1.49	93425	6.99
2114L-2	3.25	4200	7.95		
2114L-4	2.29	4402	1.99		
2125	6.99	5280	4.60		

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8155	$9.95	8259	$8.95	68047	$22.95
8156	9.95	8275	19.95	68488	19.95
8202	29.95	8279	9.50	46505	22.95
8205	2.69	6810	4.75	6520	6.95
8212	2.75	6820	6.50	6522	9.95
8214	4.95	6821	6.50	6530-X	24.95
8216	2.75	6828	10.50	6532	17.95
8224	2.95	6834	16.95	6551	19.95
8226	2.95	6845	22.95	Z80-PIO	6.50
8228	3.95	6847	27.95	Z80A-PIO	9.50
8243	9.50	6850	5.25	Z80-CTC	6.50
8250	14.95	6852	5.25	Z80A-CTC	9.50
8251	6.50	6860	10.95	Z80-DMA	19.95
8253	11.95	6862	10.95	Z80A-DMA	27.95
8255	4.50	6875	5.95	Z80-SIO	24.95
8257	9.50	6880	2.49	Z80A-SIO	29.95

MOS PROMS

2764 (8Kx8) TS	$69.95	2708 (450nS)	$5.75
2732 (4Kx8) TS	12.95	2708 (650nS)	5.25
2716/2516; 5V (2Kx8) TS	7.95	1702A	5.75
TMS2716, 5V, 12V	17.95	MM5203AQ	14.50
2758, 5V, (450nS)	3.50	MM5204Q	9.95

HI-TECH

2513-001 (5V) Upper	$9.50	DAC08	$9.95
2513-005 (5V) Lower	10.95	DAC100	9.95
2513-ADM3 (5V) Lower	14.95	8038 Function Generator	4.50
MCM66710 ASCII Shifted	12.95	MC4024 VCO	2.95
MCM66740 Math Symbol	13.95	LM566 VCO	1.95
MCM66750 Alpha Control	13.45	XR2206 Function Generator	5.25
1771-01 8" & Minifloppy	24.95	TR1602B (5V, 12V)	3.95
1781 Dual Floppy	29.95	AY51013 (5V, 12V)	4.95
1791-01 Dual Floppy	36.95	AY51014A/1612 (5-14V)	6.95
1791-02 Dual Floppy	44.95	AY51015A/1863 (5V)	6.95
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1797 DD, DS Floppy	54.95	IM6403	8.95
1691 Data Separator	18.95	2350 USRT	9.95
2143 Clock Generator	18.95	1671B Astros	24.95
8700 8 bit Binary	13.50	MC14411	11.95
8701 10 bit Binary	22.00	4702	14.95
8703 6 bit TS	13.50	WD1941	9.95
9400 Volt to Freq Conv.	7.25	COM5016	16.95
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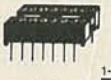
1408L8 8 bit	5.95	AY5-3600	13.75
DAC01 D to A	5.95	MM5740AAC	8.95

SOCKETS



LOW PROFILE SOCKETS (TIN)

	1-24	25-49	50-100
8 pin LP	.16	.15	.14
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.29	.27	.24
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
40 pin LP	.60	.59	.58

3L WIREWRAP SOCKETS (GOLD)

	1-24	25-49	50-100
8 pin WW	.55	.54	.49
10 pin WW (Tin)	.65	.63	.58
14 pin WW	.75	.73	.67
16 pin WW	.80	.77	.70
18 pin WW	.95	.90	.81
20 pin WW	1.15	1.08	.99
22 pin WW	1.45	1.35	1.23
24 pin WW	1.35	1.26	1.14
28 pin WW	1.60	1.53	1.38
40 pin WW	2.20	2.09	1.89

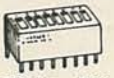
LINEAR

78H05K	$5.95	LM1414N	$1.90
78M06	1.49	LM1458CN/N	.49
78M.G.	1.49	MC1488N	.99
LM108AH	2.95	MC1489N	.99
LM300H	.99	LM1496N	.89
LM301CN	.35	LM1556N	1.50
LM304H	1.95	LM1820N	.95
LM305H	1.89	LM1850N	.95
LM306H	3.25	LM1889N	3.10
LM307CN	.29	LM2111N	1.75
LM308CN	.98	LM2900N	.99
LM309K	1.49	LM2901N	2.50
LM310CN	1.25	LM2917N	2.95
LM311D/CN	.89	CA3013T	2.19
LM312H	1.75	CA3018T	1.99
LM317T	1.70	CA3021T	3.49
LM318CN	1.49	CA3023T	2.99
LM319N/H	1.25	CA3035T	2.75
LM320K-XX*	1.35	CA3039T	1.29
LM320T-XX*	1.39	CA3046N	1.29
LM320H-XX*	1.25	LM3053N	1.49
LM323K	4.95	CA3059N	3.19
LM324N	.95	CA3060N	3.19
LM337K	5.95	CA3062N	4.95
LM338K	6.95	LM3065N	1.49
LM339N	.95	CA3080T	1.29
LM340K-XX*	1.75	CA3081N	1.69
LM340T-XX*	1.25	CA3082N	1.69
LM340H-XX*	1.25	CA3083N	1.55
LM344H	1.95	CA3086N	.80
LM348N	1.20	CA3089N	2.99
LM350K	5.60	CA3096N	3.49
LM358CN	.98	CA3097N	1.99
LM360N	1.49	CA3130T	1.30
LM372N	1.95	CA3140T	1.19
LM376N	3.75	CA3146N	2.49
LM377N	2.75	CA3160T	1.19
LM380CN/N	1.25	CA3190N	1.95
LM381N	1.79	CA3410N	.59
LM383T	1.95	MC3423N	1.49
LM386N	1.25	MC3460N	3.95
LM387N	1.40	SG3524N	3.95
LM390N	1.95	CA3600N	3.39
NE531V/T	3.75	LM3900N	.59
NE555V	.39	LM3905N	1.19
NE556N	.98	LM3909N	.98
NE561T	19.95	LM3914N	3.75
NE565N/H	1.25	LM3915N	3.95
NE566H/V	1.75	LM3916N	3.75
NE567V/H	1.50	RC4131N	2.95
NE592N	2.75	RC4136N	1.10
LM702H	1.99	RC4151N	3.70
LM709N/H	.29	RC4194TK	4.95
LM710N/H	.75	RC4195TK	5.40
LM711N/H	.39	ULN2001	1.25
LM715N	1.95	ULN2003	1.50
LM723N/H	.65	SN75450N	.59
LM733N/H	.98	SN75451N	.35
LM739N	1.15	SN75452N	.49
LM741CN/H	.33	SN75453N	.49
LM741CN-14	.19	SN75454N	.49
LM747N/H	.75	SN75491N	.89
LM748N/H	.39	SN75492N	.89
LM760CN	2.95	SN75493N	.89
LM1310N	1.90	SN75494N	.89
MC1330	1.95	TL494CN	4.20
MC1350	1.95	TL496CP	1.65
MC1358	1.75		

74S00

74S00	$ .39	74S124	3.69	74S244	$2.99
74S02	.43	74S133	.54	74S251	1.35
74S03	.45	74S134	.66	74S253	1.35
74S04	.52	74S135	1.15	74S257	1.29
74S05	.52	74S136	1.69	74S258	1.29
74S08	.49	74S138	1.29	74S260	.75
74S09	.49	74S139	1.29	74S280	2.79
74S10	.42	74S140	.73	74S287	2.99
74S11	.42	74S151	1.29	74S288	2.55
74S15	.42	74S153	1.29	74S373	3.10
74S20	.42	74S157	1.29	74S374	3.10
74S22	.42	74S158	1.29	74S387	2.75
74S30	.42	74S160	2.79	74S471	7.95
74S32	.49	74S174	1.49	74S472	7.95
74S38	1.19	74S175	1.49	74S473	7.95
74S40	.49	74S188	2.69	74S474	9.95
74S51	.42	74S194	1.89	74S475	9.95
74S64	.46	74S195	1.89	74S570	5.75
74S65	.46	74S196	1.89	74S571	5.75
74S74	.69	74S240	2.75	74S572	8.95
74S86	.72	74S241	2.75	74S573	8.95
74S112	.72	74S242	2.99	74S940	2.90
74S113	.72	74S243	2.99	74S941	2.90
74S114	.72				

DIP SWITCHES



2 Position	$ .99	7 Position	$1.39
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7400

7400	$ .19	7475	$ .38	74161	$ .88
7401	.22	7476	.34	74162	.89
7402	.22	7479	4.60	74163	.87
7403	.22	7480	.49	74164	.87
7404	.22	7482	.95	74165	.87
7405	.23	7483	.55	74166	1.20
7406	.35	7485	.65	74167	1.95
7407	.35	7486	.35	74170	1.69
7408	.26	7489	1.75	74172	4.75
7409	.23	7490	.39	74173	.79
7410	.22	7491	.57	74174	.89
7411	.29	7492	.45	74175	.85
7412	.29	7493	.45	74176	.75
7413	.39	7494	.69	74177	.75
7414	.59	7495	.65	74179	1.34
7416	.29	7496	.69	74180	.75
7417	.29	7497	2.90	74181	1.75
7420	.22	74100	2.90	74182	.75
7421	.35	74107	.32	74184	2.25
7422	.29	74109	.37	74185	2.25
7423	.29	74116	1.95	74186	9.95
7425	.29	74121	.29	74188	3.90
7426	.29	74122	.39	74190	1.15
7427	.25	74123	.59	74191	1.15
7429	.45	74125	.39	74192	.85
7430	.23	74126	.44	74193	.85
7432	.29	74128	.59	74194	.85
7437	.25	74132	.69	74195	.68
7438	.29	74136	.75	74196	.85
7439	.29	74139	.95	74197	.85
7440	.19	74141	.79	74198	1.39
7441	.79	74142	2.95	74199	1.39
7442	.57	74143	2.95	74221	1.19
7443	.95	74144	2.95	74251	.95
7444	.95	74145	.62	74273	1.05
7445	.79	74147	1.95	74276	1.89
7446	.79	74148	1.20	74279	.75
7447	.65	74150	1.09	74283	1.40
7448	.79	74151	.67	74284	3.90
7450	.19	74152	.67	74285	3.90
7451	.19	74153	.67	74290	1.25
7453	.19	74154	1.19	74298	.95
7454	.19	74155	.78	74365	.68
7459	.25	74156	.78	74366	.68
7460	.23	74157	.69	74367	.68
7470	.29	74158	1.65	74368	.68
7472	.29	74159	2.49	74390	1.45
7473	.34	74160	.88	74393	1.90
7474	.34			74490	1.90

74LS00

74LS00	$ .26	74LS113	$ .43	74LS245	$2.20
74LS01	.28	74LS114	.43	74LS247	1.10
74LS02	.28	74LS122	.55	74LS248	1.10
74LS03	.28	74LS123	1.19	74LS249	1.19
74LS04	.35	74LS124	1.35	74LS251	1.40
74LS05	.28	74LS125	.89	74LS253	1.40
74LS08	.28	74LS126	.52	74LS257	.85
74LS09	.35	74LS132	.79	74LS258	.98
74LS10	.28	74LS136	.49	74LS259	2.95
74LS11	.39	74LS138	.85	74LS260	.85
74LS12	.33	74LS139	.85	74LS261	2.49
74LS13	.47	74LS145	1.25	74LS266	.59
74LS14	.95	74LS148	1.49	74LS273	1.75
74LS15	.33	74LS151	.79	74LS275	4.40
74LS20	.26	74LS153	.79	74LS279	.59
74LS21	.33	74LS154	1.70	74LS283	.99
74LS22	.33	74LS155	1.19	74LS290	.99
74LS26	.33	74LS156	.99	74LS293	.99
74LS27	.33	74LS157	.85	74LS295	1.10
74LS28	.33	74LS158	.75	74LS298	1.19
74LS30	.26	74LS160	1.05	74LS324	1.75
74LS32	.33	74LS161	1.15	74LS347	1.95
74LS33	.55	74LS162	1.05	74LS348	1.95
74LS37	.45	74LS163	1.05	74LS352	1.19
74LS38	.39	74LS164	1.19	74LS353	1.19
74LS40	.26	74LS165	.89	74LS363	1.49
74LS42	.79	74LS166	2.48	74LS365	.69
74LS47	.79	74LS168	1.15	74LS366	.69
74LS48	.95	74LS169	1.15	74LS367	.69
74LS51	.26	74LS170	1.99	74LS368	.69
74LS54	.29	74LS173	.89	74LS373	1.89
74LS55	.29	74LS174	.89	74LS374	1.89
74LS73	.45	74LS175	.89	74LS375	.69
74LS74	.42	74LS181	2.20	74LS377	1.95
74LS75	.59	74LS190	1.15	74LS385	1.95
74LS76	.45	74LS191	1.15	74LS386	.65
74LS78	.45	74LS192	.98	74LS390	1.95
74LS83A	.79	74LS193	.98	74LS393	1.95
74LS85	1.19	74LS194	1.15	74LS395	1.70
74LS86	.45	74LS195	.95	74LS399	2.35
74LS90	.57	74LS196	.89	74LS424	2.95
74LS92	.75	74LS197	.89	74LS668	1.75
74LS93	.75	74LS221	1.15	74LS670	2.29
74LS95	.88	74LS240	1.69	81LS95	1.69
74LS96	.98	74LS242	1.69	81LS96	1.69
74LS107	.45	74LS243	1.69	81LS97	1.69
74LS109	.45	74LS244	1.49	81LS98	1.69
74LS112	.43				

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4008	1.39	4044	.85	14408	12.95
4009	.45	4046	1.75	14409	12.95
4010	.45	4047	1.25	14410	12.95
4011	.35	4048	.99	14412	12.95
4012	.25	4049	.45	14415	8.95
4013	.45	4050	.69	14419	4.95
4014	1.39	4051	1.10	4501	.39
4015	1.15	4052	1.10	4502	1.65
4016	.59	4053	1.10	4503	.69
4017	1.19	4055	3.95	4505	8.95
4018	.89	4056	2.95	4506	.75
4019	.45	4059	9.25	4507	.95
4020	1.10	4060	1.39	4508	3.75
4021	1.19	4066	.75	4510	1.19
4022	1.15	4069	.35	4511	1.19
4023	.29	4070	.49	4512	1.39
4024	.75	4071	.35	4515	2.75
4025	.25	4072	.35	4516	1.45
4027	.65	4073	.35	4518	1.39
4028	.85	4075	.35	4520	1.25
4029	1.29	4076	1.29	4555	4.95
4030	.45	4077	.35	4556	.99
4031	3.25	4078	.35	4566	2.25
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7403	.19	74143	2.95
7404	.19	74145	.60
7405	.25	74147	1.75
7406	.29	74148	1.20
7407	.29	74150	1.35
7408	.24	74151	.65
7409	.19	74152	.65
7410	.19	74153	.55
7411	.25	74154	1.40
7412	.30	74155	.75
7413	.35	74156	.65
7414	.55	74157	.55
7416	.25	74159	1.65
7417	.25	74160	.85
7420	.19	74161	.70
7421	.35	74162	.85
7422	.29	74163	.85
7423	.29	74164	.85
7425	.29	74165	.85
7426	.29	74166	1.00
7427	.29	74167	2.95
7428	.45	74170	1.65
7430	.19	74172	5.95
7432	.29	74173	.75
7433	.45	74174	.89
7437	.29	74175	.89
7438	.29	74176	.89
7440	.19	74177	.75
7442	.49	74178	1.15
7443	.65	74179	1.75
7444	.69	74180	.75
7445	.69	74181	2.25
7446	.59	74182	.75
7447	.69	74184	2.00
7448	.69	74185	2.00
7450	.19	74186	18.50
7451	.23	74190	1.15
7453	.23	74191	1.15
7454	.23	74192	.79
7460	.23	74193	.79
7470	.35	74194	.85
7472	.29	74195	.85
7473	.34	74196	.79
7474	.35	74197	.75
7475	.49	74198	1.35
7476	.35	74199	1.35
7480	.59	74221	1.35
7481	1.10	74246	1.35
7482	.95	74247	1.25
7483	.50	74248	1.85
7485	.65	74249	1.95
7486	.35	74251	.75
7489	4.95	74259	2.25
7490	.35	74265	1.35
7491	.40	74273	1.95
7492	.50	74276	1.25
7493	.49	74279	.75
7494	.65	74283	2.00
7495	.55	74284	3.75
7496	.70	74285	3.75
7497	2.75	74290	.95
74100	1.00	74293	.75
74107	.30	74298	.85
74109	.45	74351	2.25
74110	.45	74365	.65
74111	.55	74366	.65
74116	1.55	74367	.65
74120	1.20	74368	.65
74121	.29	74376	2.20
74122	.45	74390	1.75
74123	.55	74393	1.35
74125	.45	74425	3.15
74126	.45	74426	.85
74128	.55	74490	2.55
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74C08	.35	4022	1.15
74C10	.35	4023	.35
74C14	1.50	4024	.75
74C20	.35	4025	.35
74C30	.35	4026	1.65
74C32	.50	4027	.65
74C42	1.75	4028	.80
74C48	1.20	4029	.95
74C73	.65	4030	.45
74C74	.85	4034	2.95
74C76	.80	4035	.85
74C83	1.95	4040	.95
74C85	1.95	4041	1.25
74C86	.95	4042	.75
74C89	4.50	4043	.85
74C90	1.75	4044	.85
74C93	1.75	4046	.95
74C95	1.75	4047	.95
74C107	1.00	4049	.55
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74C157	1.75	4060	1.45
74C160	2.00	4066	.75
74C161	2.00	4068	.40
74C162	2.00	4069	.35
74C163	2.00	4070	.35
74C164	2.00	4071	.30
74C165	2.00	4072	.30
74C173	2.00	4073	.30
74C174	2.25	4075	.30
74C175	2.25	4076	.95
74C192	2.25	4078	.30
74C193	2.25	4081	.30
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74C200	5.75	4085	.95
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74C903	.85	14410	12.95
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74C906	.95	14412	12.95
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74C910	9.95	4508	1.95
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74C912	10.00	4511	.95
74C914	1.95	4512	.95
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4000	.35	4538	1.95
4001	.35	4539	1.95
4002	.25	4543	2.70
4006	.95	4555	.95
4007	.29	4556	.95
4008	.95	4581	1.95
4009	.45	4582	1.95
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74S38	1.68	74S251	1.90	74S240	3.98	74S571	7.80
74S40	.44	74S253	7.45	74S257	1.39		
74S51	.78	74S157	1.19	74S258	1.49		
74S64	.79	74S158	1.45	74S260	1.83		
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2147	4096 x 1	(55ns)	9.95	call
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HM6116-4	2048 x 8	(cmos) (200ns)	call	call
HM6116-3	2048 x 8	(cmos) (150ns)	call	call
HM6116-2	2048 x 8	(cmos) (120ns)	call	call
HM6116LP-4	2048 x 8	(LP) (cmos) (200ns)	call	call
HM6116LP-3	2048 x 8	(LP) (cmos) (150ns)	call	call
HM6116LP-2	2048 x 8	(LP) (cmos) (120ns)	call	call
Z-6132	4096 x 8	(Qstat) (300ns)	34.95	call

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MM5298	8192 x 1	(250ns)	1.85	call
4116-120	16384 x 1	(120ns)	8/29.95	call
4116-150	16384 x 1	(150ns)	8/18.95	1.95
4116-200	16384 x 1	(200ns)	8/13.95	call
4116-250	16384 x 1	(250ns)	8/13.90	call
4116-300	16384 x 1	(300ns)	8/13.80	call
2118	16384 x 1	(5v) (150ns)	4.95	call
MK4816	2048 x 8	(5v) (300ns)	24.95	call
4164-200	65536 x 1	(5v) (200ns)	call	call
4164-150	65536 x 1	(5v) (150ns)	call	call

EPROMS

			Each	8 pcs
1702	256 x 8	(1us)	4.95	4.50
2708	1024 x 8	(450ns)	3.75	3.50
2758	1024 x 8	(5v) (450ns)	9.95	8.95
TMS2516	2048 x 8	(5v) (450ns)	6.95	5.95
2716	2048 x 8	(5v) (450ns)	4.95	3.95
2716-1	2048 x 8	(5v) (350ns)	9.00	8.50
TMS2716	2048 x 8	(450ns)	9.95	8.95
TMS2532	4096 x 8	(5v) (450ns)	9.95	7.95
2732	4096 x 8	(5v) (450ns)	9.95	7.95
2732A-2	4096 x 8	(5v) (200ns)	call	call
2764	8192 x 8	(5v) (450ns)	call	call
TMS2564	8192 x 8	(5v) (450ns)	call	call

5v = Single 5 Volt Supply

EPROM ERASERS

	Timer	Capacity Chip	Intensity (uW/CM²)	
PE-14		6	5,200	83.00
PE-14T	X	6	5,200	119.00
PE-24T	X	9	6,700	175.00
PL-265T	X	20	6,700	255.00
PR-125T	X	16	15,000	349.00
PR-320T	X	32	15,000	595.00

JULY SPECIALS

2K x 8 STATIC

TMM-2016 (200NS)

8/6.95 EA.

HM6116 (200NS)

8/7.95 EA.

64K DYNAMIC

4164 (200NS)

8/8.95 EA.

16K DYNAMIC

4116 (200NS)

8/13.95 EA.

16K EPROMS

2716 (450NS)

8/3.95 ea.

32K EPROMS

2532 or 2732 (450NS)

8/7.95 EA.

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PROMS

Order by National Part No.	Function	EQUIVALENT PART NUMBERS TI	SIG	MMI	Harris	
74S188	32x8 OC	18SA030	82S23	6330-1	7602	2.95
74S287	256x4 TS	14S10	82S129	6301-1	7611	3.25
74S288	32x8 TS	18S030	82S123	6331-1	7603	2.75
74S387	256x4 OC	14SA10	82S126	6300-1	7610	2.95
74S471	256x8 TS	18S22		6309-1		10.95
74S472	512x8 TS	18S42	82S147	6349-1	7649	10.95
74S473	512x8 OC	18SA42	82S146	6348	7648	10.95
74S474	512x8 TS	18S46	82S141	6341	7641	12.95
74S475	512x8 TS	18SA46	82S140	6340	7640	12.95
74S478	1Kx8 TS	28S86				19.95
74S570	512x4 OC	27S12	82S130	6305	7620	5.95
74S571	512x4 TS	27S13	82S131	6306-1	7621	5.95
74S572	1kx4 OC	24SA41	82S136	6352-1	7642	9.95
74S573	1kx4 TS	24S41	82S137	6353-1	7643	9.95
87S180	1kx8 OC	28SA86	82S180	6380-1	7680	19.25
87S181	1kx8 TS	28S86	82S181	6381-1	7681	16.25
87S184	2kx4 OC	24SA81	82S184		7684	17.20
87S185	2kx4 TS	24S81	82S185		7685	16.95
87S190	2kx4 OC	28SA166	82S190		76160	39.95
87S191	2kx8 TS	28S166	82S191		76161	39.95

74LS00 SERIES

74LS00	.25	74LS169	1.75
74LS01	.25	74LS170	1.75
74LS02	.25	74LS173	.80
74LS03	.25	74LS174	.95
74LS04	.25	74LS175	.95
74LS05	.25	74LS181	2.15
74LS08	.35	74LS189	9.95
74LS09	.35	74LS190	1.00
74LS10	.25	74LS191	1.00
74LS11	.35	74LS192	.85
74LS12	.35	74LS193	.95
74LS13	.45	74LS194	1.00
74LS14	1.00	74LS195	.95
74LS15	.35	74LS196	.85
74LS20	.25	74LS197	.85
74LS21	.35	74LS221	1.20
74LS22	.25	74LS240	1.29
74LS26	.35	74LS241	1.29
74LS27	.35	74LS242	1.85
74LS28	.35	74LS243	1.85
74LS30	.25	74LS244	1.29
74LS32	.35	74LS245	1.90
74LS33	.55	74LS247	.75
74LS37	.55	74LS248	1.25
74LS38	.35	74LS249	.99
74LS40	.35	74LS251	1.30
74LS42	.55	74LS253	.85
74LS47	.75	74LS257	.85
74LS48	.75	74LS258	.85
74LS49	.75	74LS259	2.85
74LS51	.25	74LS260	.65
74LS54	.35	74LS266	.55
74LS55	.35	74LS273	1.65
74LS63	1.25	74LS275	3.35
74LS73	.40	74LS279	.55
74LS74	.45	74LS280	1.98
74LS75	.50	74LS283	1.00
74LS76	.40	74LS290	1.25
74LS78	.50	74LS293	1.85
74LS83	.75	74LS295	1.05
74LS85	1.15	74LS298	1.20
74LS86	.40	74LS324	1.75
74LS90	.65	74LS352	1.55
74LS91	.89	74LS353	1.55
74LS92	.70	74LS363	1.35
74LS93	.65	74LS364	1.95
74LS95	.85	74LS365	.95
74LS96	.95	74LS366	.95
74LS107	.40	74LS367	.70
74LS109	.40	74LS368	.70
74LS112	.45	74LS373	1.75
74LS113	.45	74LS374	1.75
74LS114	.50	74LS377	1.45
74LS122	.45	74LS378	1.18
74LS123	.95	74LS379	1.35
74LS124	2.99	74LS385	1.90
74LS125	.95	74LS386	.65
74LS126	.85	74LS390	1.90
74LS132	.75	74LS393	1.90
74LS136	.55	74LS395	1.65
74LS137	.99	74LS399	1.70
74LS138	.75	74LS424	2.95
74LS139	.75	74LS447	.37
74LS145	1.20	74LS490	1.95
74LS147	2.49	74LS624	3.99
74LS148	1.35	74LS668	1.69
74LS151	.75	74LS669	1.89
74LS153	.75	74LS670	2.20
74LS154	2.35	74LS674	9.65
74LS155	1.15	74LS682	3.20
74LS156	.95	74LS683	2.30
74LS157	.75	74LS684	2.40
74LS158	.75	74LS685	2.40
74LS160	.90	74LS688	2.40
74LS161	.95	74LS689	2.40
74LS162	.95	74LS783	24.95
74LS163	.95	81LS95	1.69
74LS164	.95	81LS96	1.69
74LS165	.95	81LS97	1.69
74LS166	2.40	81LS98	1.69
74LS168	1.75		

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8279	9.50
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6800 = 1 MHZ

68B00 = 2 MHZ

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6551	11.85

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6522A	11.70
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3.579535	3.95
4.0	3.95
5.0	3.95
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5.185	3.95
5.7143	3.95
5.9904	3.95
6.0	3.95
6.144	3.95
6.5536	3.95
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10.0	3.95
14.31818	3.95
15.0	3.95
16.0	3.95
18.0	3.95
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20.0	3.95
22.1184	3.95
32.0	3.95

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AY5-3600	11.95
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14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39

ST = SOLDERTAIL

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16 pin WW	.69	.58
18 pin WW	.99	.90
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24 pin WW	1.49	1.35
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WW = WIREWRAP

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LM301H	.79	LM350T	4.60	NE571	3.95	LM1812	8.25	TL072	1.19
LM307	.45	LM358	.98	NE592	2.75	LM1815	5.20	TL074	2.19
LM308	.98	LM359	1.79	LM703	.89	LM1818	2.90	TL081	.79
LM308H	1.15	LM376	3.75	LM709	.59	LM1820	3.50	TL082	1.19
LM309H	1.95	LM377	2.29	LM710	.75	LM1830	3.50	TL083	1.19
LM309K	1.49	Lm378	2.50	LM711	.79	LM1871	5.49	TL084	2.19
LM310	1.75	LM379	4.50	LM723	.49	LM1872	5.49	LF347	2.19
LM311	.64	LM380	1.29	LM723H	.55	LM1877	3.25	LF351	.60
LM311H	.89	LM380N-8	1.10	LM733	.98	LM1889	2.49	LF353	1.00
LM312H	1.75	LM381	1.60	LM741N-8	.35	LM1896	1.75	LF355	1.10
LM317K	3.95	LM382	1.60	LM741N-14	.35	LM2877	2.05	LF356	1.10
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LM318	1.49	LM384	1.95	LM747	.79	LM2900	.85		
LM318H	1.59	LM386	1.50	LM748	.59	LM2901	1.00		
LM319H	1.25	LM387	1.40	LM1014	2.75	LM3900	.59		
LM319	1.25	LM389	1.35	LM1303	1.95	LM3905	1.25		
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LM322	1.65	LM392	.69	LM1305	1.49	LM3911	2.25		
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LM324	.59	LM399H	5.00	LM1310	2.90	LM3915	3.95		
LM329	.69	NE531	3.75	MC1330	1.89	LM3916	3.95		
LM331	3.95	NE536	6.00	MC1349	1.89	MC4024	3.95		
LM334	1.30	NE555	.39	MC1350	1.29	MC4044	4.50		
LM335	1.40	NE556	.69	MC1358	1.79	RC4136	1.25		
LM336	1.75	NE558	1.50	LM1414	1.59	RC4151	3.95		
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LM339	.99	LM565	.99	LM1496	.85	LM13600	1.49		
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LM348	1.20	LM567	1.29						

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TL074	2.19
TL081	.79
TL082	1.19
TL083	1.19
TL084	2.19
LF347	2.19
LF351	.60
LF353	1.00
LF355	1.10
LF356	1.10
LF357	1.40

TI

TL494	4.20
TL496	1.65
TL497	3.25
75107	1.49
75110	1.95
75188	1.25
75189	1.25
75450	.59
75451	.39
75452	.39
75453	.39
75454	.39
75491	.79
75492	.79
75493	.89
75494	.89

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CA 3065	1.75
CA 3080	1.10
CA 3081	1.65
CA 3082	1.65
CA 3083	1.55
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7815T	.99	7924T	1.19
7824T	.99		
		7905K	1.49
7805K	1.39	7912K	1.49
7812K	1.39	79LO5	.79
7815K	1.39	79L12	.79
78LO5	.69	79L15	.79
78L12	.69		
78L15	.69		
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LM309K	1.49	LM323K	4.95
LM317T	1.95	LM337K	3.95

T = TO-220 K= TO-3 L = TO-92

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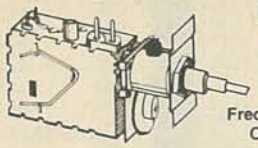

We start with a Mechanical UHF Tuner, add 2 coils and a diode, then peak it on our Spectrum Analyzer for maximum gain.

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Output Channel 3. Available on request: Ch 2 or 4.

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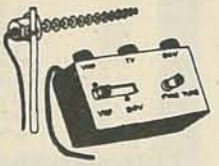
MICROWAVE TV CONVERTERS

MODEL DCV-1-A

DOWN CONVERTER/ANTENNA COMBINATION



- 2 MICROWAVE PREAMP STAGES for maximum gain
- ONE PIECE CONSTRUCTION simplifies installation
- ALUMINUM AND ZINC PLATED STEEL for durability
- BUILT IN A/B SWITCH with more than 95dB isolation
- 2.1–2.6 GHz Covers all ham, commercial and ITFS channels

Years of enjoyment are yours with our model DCV-1-A. Two preamp stages coupled with the yagi antenna/housing provide a typical system gain of 53dB.

YOU GET: 75' downlead
3' jumper
300 ohm matching transformer
detailed instructions

ASSEMBLED & TESTED
LIST – $175.00
ONLY $149.95
INTRODUCTORY PRICE

WE CARRY A COMPLETE LINE INCLUDING PARABOLICS

DEALER INQUIRIES INVITED

TRITON MARKETING CORP.
1933 ROCKAWAY PARKWAY
BROOKLYN, N.Y. 11236
212-531-9004

We accept VISA, MC, C.O.D., CHECK or M.O.

FIRST QUALITY COMPONENTS – NOT MAIL ORDER "SECONDS"

Min. order $10.00 – add 5% Shpg and $1.00 Ins.

ARIES ZERO INSERTION FORCE SOCKETS –

cam actuated, true zero insertion – tin plated solder tail pins – capable of being plugged into dip sockets, including wire wrap.

Stock No.	No Pins	1-24	25	50
11055	24	$ 4.35	$ 3.90	$ 3.60
11056	28	4.50	4.05	3.75
11057	40	5.95	5.35	4.95
11058	64	10.50	9.45	8.70

RESISTOR ASSORTMENT

82508 – 700 pcs (1 each below assorted) **$22.50**

$3.95 each for any assortment

Stock No. 82501 10 ea. of 10-12-15-18-22-27-33-39-47-56 OHM
Stock No. 83502 10 ea. of 68-82-100-120-150-180-220-270-330-390 OHM
Stock No. 82503 10 ea. of 470-560-680-820-1K-1.2K-1.5K-1.8K-2.2K-2.7 OHM
Stock No. 82504 10 ea. of 3.3K-3.9K-4.7K-5.6K-6.8K-8.2K-10K-12K-15K-18K OHM
Stock No. 82505 10 ea. of 22K-27K-33K-39K-47K-56K-68K-82K-100K-120K OHM
Stock No. 82506 10 ea. of 150K-180K-220K-270K-330K-390K-470K-560K-680K- 820K-OHM
Stock No. 82507 10 ea. of IM-1.2M-1.5M-1.8M-2.2M-2.7M-3.3M-3.9M-4.7M-5.6M-OHM

WILD ROVER

Touch switch capsule. Operating motion is .005" without the use of a levered arm. Extremely fast on and off with low noise. Normally open – rated 115 VAC, 1.6 amp-30 milliohm resistance – .615 radius by .160 thick.

Stock No.	1-9	10	25
12098	$ 1.28	$ 1.12	$ .95

60/40 ROSIN CORE SOLDER

Stock No.	Dia.	Length (feet)	Weight (oz.)	Price
50075	062	9	1.5	$3.28
50076	062	25	4	4.36
50077	062	50	8	6.02
50078	032	33	1.5	4.08
50079	032	88.5	4	5.16
50080	032	175	8	6.82

TI WIRE WRAP SOCKETS

Tin plated phosphor bronze contact – 3 wrap

Stock No.	No Pins	1-24	25	100
11301	8	$ .45	$ .40	$ .36
11302	14	.66	.59	.54
11303	16	.72	.64	.58
11304	18	.82	.73	.66
11305	20	1.11	.99	.90
11306	22	1.26	1.12	1.02
11307	24	1.41	1.25	1.14
11308	28	1.71	1.52	1.38
11309	40	2.31	2.05	1.86

TI LOW PROFILE SOCKETS

Tin plated phosphor bronze contact pins with gas tight seal.

Stock No.	No Pins	1-24	25	100
11201	8	$.15	$.13	$.12
11202	14	.18	.15	.14
11203	16	.21	.18	.16
11204	18	.24	.21	.19
11205	20	.27	.24	.21
11206	22	.30	.26	.23
11207	24	.33	.30	.25
11208	28	.38	.34	.29
11209	40	.53	.45	.40

ELPAC POWER SUPPLIES – DC/DC CONVERTERS

Stock No. 13801- "Floppy Disc" Power Supply For Winchester Drives **$109.00**

13801-1 Data Sheet for 13801 ....$.25

SINTEC Stock No. 300 MW Type	ELPAC No.	Input Voltage (VDC)	Output Voltage (VDC)	Output Current (MA)	Dimensions (HxWxD) in Inches	Price
13825	CB3801	3.0-7.0	12±0.6	0-25	48x.51x3.05	$ 7.95
13826	CB3811	3.0-7.0	-12±0.6	0-25	48x51x3.05	7.95
13827	CB3802	3.0-7.0	15±0.7	0-20	48x.51x3.05	7.95
13828	CB3812	3.0-7.0	-15±0.7	0-20	48x.51x3.05	7.95
13829	CB3804	3.0-7.0	28±0.7	0-10	48x.51x3.05	7.95
13830	CB3814	3.0-7.0	-28±0.7	0-10	48x.51x3.05	7.95
1.5 W TYPE:						
13831	CL3801	4.0-7.0	12±0.6	125	.651x1.2x1.77	59.95
13832	CL3811	4.0-7.0	-12±0.6	125	.651x1.2x1.77	59.95
13833	CL3802	4.0-7.0	15±0.7	100	.651x1.2x1.77	59.95
13834	CL3812	4.0-7.0	-15±0.7	100	.651x1.2x1.77	59.95
13835	CL3804	4.0-7.0	28±1.4	50	.651x1.2x1.77	59.95
13836	CL3814	4.0-7.0	-28±1.4	50	.651x1.2x1.77	59.95

13825-1 DATA SHEET FOR DC/DC CONVERTERS 25

ELPAC POWER SUPPLIES – SOLV SERIES FULLY REGULATED

SINTEC Stock No.	ELPAC Part No.	Output Voltage	Output Current Rating	Dimensions (HxWxD) in Inches	OVP	Price
13802	SOLV15-5	5	3.0A	4-7/16x4x2	Fixed included	$39.95
13803	SOLV15-12	12	1.5A	4-7/16x4x2	Fixed included	39.95
13804	SOLV15-15	15	1.2A	4-7/16x4x2	Fixed included	39.95
13806	SOLV15-24	24	0.75A	4-7/16x4x2	Fixed included	39.95
13808	SOLV30-5	5	6.0A	5-5/8x4-7/8x3-3/16	OVP-4	59.95
13809	SOLV30-12	12	4.0A	5-5/8x4-7/8x3-3/16	OVP-4	59.95
13810	SOLV30-15	15	3.3A	5-5/8x4-7/8x3-3/16	OVP-4	59.95
13812	SOLV30-24	24	2.0A	5-5/8x4-7/8x3-3/16	OVP-4	59.95

13802-1 Data Sheet for SOLV Series 25

Special of the Month!

DIGITAL MULTIMETER
Large easy to read .5" 3½ digit display-200 hours operating life with single 9v alkaline battery-low battery + polarity indicators – Five functions (DC Volts, Ohms, DC mA, AC Volts, Diode and transistor junction check in circuit)

Stock No. 62501 **$54.95**

Stock No. 62502 **$49.95**
Kit Form, with instructions

PIN FORMING TOOL

puts IC's on their true row to row spacing. One side is for .300 centers, Flip tool over for devices on .600 centers. Put device in tool and squeeze.

ONE TOOL DOES 8 Thru 40 PINS!
Stock No. 11059 **$12.95**

MODUTEC

Miniclamp AC Volt-Ammeter
allows singling one conductor out of many without disarrangement.

SET of THREE $99.00

Stock No.	AC Amperes	Price
13730	0-25A	$39.50
13731	0-50A	39.50
13732	0-100A	39.50

ACCESSORY LINE SPLITTER
allows fast readings of AC power consumption of plug in equipment without separation of leads.
Stock No. 13727 **$9.95**

POCKET SIZED BATTERY TESTER
for all types of small batteries from 1.35v to 4.5v
Stock No. 13733 **$13.95**

VOLT-I-CATOR
automotive diagnostic meter plugs into lighter socket and indicates battery condition and charging rates.
Stock No. 13736 **$12.95**

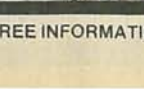
AC VOLTAGE TESTER
plugs into any 110v service receptable to check time voltage over 50-150 VAC
Stock No. 13735 **$9.95**

VOM-MULTITESTER
versatile Volt-Ohm-Milliammeter in small package
Stock No. 13729 **$13.95**

HUNTER TOOLS

8 Blades, sizes .050, 1/16", 5/16", 3/32", 7/64", 1/8", 9/64", 5/32"
STOCK NO. 51002 **$3.45**

7 most popular sizes – 3/16", 7/32", 1/4", 9/32", 5/16", 11/32", 3/8"
Nutdriver Kit STOCK NO. 51001 **$21.95**



CRIMPS #10 – #24 wire
STRIPS solid #12-22 and stranded #14-24
SCREW CUTTER for 6 most common screw sizes
CUTTER and **PLIERS**
THE PIKE 5 in 1 Tool STOCK NO. 51005 **$12.95**

SINTEC CO. Drawer Q Milford NJ 08848-9990

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FREE in NJ (201) 996-4093

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CIRCLE 69 ON FREE INFORMATION CARD

ramsey the first name in Counters !

9 DIGITS 600 MHz $129.95 WIRED

PRICES

CT-90 wired, 1 year warranty	$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack +AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally; an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	0.1% basic DC volts
Power:	4 'C' cells

AUDIO SCALER

For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

ACCESSORIES

Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

ramsey electronics, inc.
2575 BAIRD RD. • PENFIELD, NY 14526

PHONE ORDERS
CALL 716-586-3950

TERMS Satisfaction guaranteed - examine for 10 days, if not pleased return in original form for refund. Add 5% for shipping + insurance to a maximum of $10. Overseas add 15%. COD add $2. Orders under $10., add $1.50. NY residents add 7% tax.

QUALITY parts at DISCOUNT PRICES

STEREO 8 TRACK HOME UNIT

BRAND NEW UNITS... ASSEMBLY INCLUDES; TAPE HEAD, MOTOR BELT, 110VAC MOTOR, PRE-AMP, LIGHTS, SWITCHES, SOLENOID AND OTHER USEFUL PARTS.... AN EXCEPTIONAL BUY!

$7.25 PER ASSEMBLY

MINI BSR AUTOMATIC RECORD CHANGER

- B.S.R. MODEL C136R/C/3
- PLAYS 33/45/78 RECORDS
- MINI SIZE: 8 1/4" X 12"

INCLUDES DUST COVER AND PLASTIC CASE (NOT PICTURED) WITH FRONT CUT OUT TO FIT STEREO UNIT (NOT INCLUDED).

$17.50 each

JOYSTICK

PRECISION DEVICE... CONTAINS 4 50K CENTER TAPPED ALPS POTS. **$4.75 ea**

BLACK PLASTIC CASE

PAC-TEC SERIES C

BLACK PLASTIC ENCLOSURE ADJUSTABLE HEIGHT FROM 1.63" TO 2.93"; WIDTH 6.85"; DEPTH 8". BUILT-IN STAND OFFS FOR P.C. BOARDS..FRONT AND BACK PANELS NOT INCLUDED...

$5.25 PER CASE

VARACTOR DIODES

BB-103 3 FOR $1.00, 100 FOR $30.00

MV2205 3 FOR $1.00, 100 FOR $30.00

COMPUTER GRADE CAPACITOR

1700 mfd. 150 VDC $2.00
2 1/2" DIA X 4 3/4" HIGH

3,600 mfd. 40VDC $1.00
1 3/8" DIA. X 3" HI

6,400 mfd. 60VDC $2.50
1 3/8" DIA X 4 1/4"

12,000 mfd. 40 VDC $3.00
2" DIA X 4 1/4" HIGH

18,000 mfd. 75 VDC $4.00
2 1/2" DIA X 4 1/2" HIGH

22,000 mfd. 15 VDC
2" DIA X 2 1/2" HIGH $2.00

22,000 mfd. 40 VDC
2" DIA. X 6" HIGH $3.00

25,000 mfd. 75 VDC $4.50
3" DIA X 4 3/8" HIGH

45,000 mfd. 25 VDC
2" DIA. X 4" HIGH $3.50

72,000 mfd. 15 VDC
2" DIA. X 4" HIGH $3.50

CLAMPS TO FIT CAPACITORS 50¢ ea.

TRANSFORMERS

120 volt primaries

5.6 VOLTS at 750 MA	$3.00
6 VOLTS at 150 mA	$1.25
12 V.C.T. at 500 mA	$2.50
16.5 V. at 3 AMPS	$6.50
18 VOLTS at 350 MA	$2.00
18 VOLTS at 1 AMP	$4.50
18 V.C.T. at 2 AMP	$5.50
25.2 VCT at 2.8 AMP	$5.50
35 V.C.T. at 1 AMP	$3.50
42 V.C.T. at 1.2 AMP	$4.50
65 V.C.T. at 2 AMP	$5.50

MITSUMI MODEL UES-A55F VARACTOR UHF TUNER

FREQ RANGE 470 - 889 MHZ
ANTENNA INPUT 300 OHMS

$25.00 each
10 for $220.00

PHOTO FLASH CAPACITORS

170 MFD 330 VOLT
1 1/2" X 7/8"
2 FOR $1.50
10 FOR $7.00

600 MFD 360 VOLT
3 3/4" HIGH X 1" DIA.
$1.00 EA. 10 FOR $9.00

750 MFD 330 VOLT
2" HIGH X 1 3/4"
$1.25 EACH 10 FOR $11.00

2 MHz CRYSTAL

CASE STYLE HC33/U
$3.50 EACH

L.E.D.'s

STANDARD JUMBO DIFFUSED
RED 10 FOR $1.50
GREEN 10 FOR $2.00
YELLOW 10 FOR $2.00

FLASHER LED
5 VOLT OPERATION
JUMBO SIZE
2 FOR $1.70

BI POLAR LED
2 FOR $1.70

SUB MINI LED
.079" X .098"
20mA at 1.75v
10 FOR $1.00
200 FOR $18.00
QUANTITY PRICES AVAILABLE

MINI SIZE BUZZERS

1½ to 3 volts 75¢ ea WITH WIRE LEADS

1½ to 3 volts 75¢ ea WITH PIN TERMINALS

3 to 7 volts WITH PIN TERMINALS 75¢ each

8' LINE CORD

18 - 3 SJT M/E
ROUND GRAY COLOR
$2.00 EACH 10 FOR $18.50

L-PAD

STANDARD 8 OHM
50 DB L-PAD...
$1.50 EACH
10 FOR 13.50

BLACK LIGHT (ULTRAVIOLET)

G.E. # F6T5BL $2.50 each

FREE! SEND FOR OUR NEW 40 PAGE CATALOG FREE!

CONNECTORS

WEATHERPROOF 2 CONDUCTOR

POLARIZED SET, 18 GA. WIRE..$1.00 / SET

4 CONDUCTOR $1.50 PER SET

WEATHER-PROOF SOCKET AND CONNECTOR SET...

EDGE CONNECTOR

ALL ARE .156" SPACING

15/30 GOLD
SOLDER EYELET $2.00 EACH

18/36 GOLD
SOLDER EYELET $2.00 EACH

22/44 GOLD
SOLDERTAIL (P.C. STYLE)
$2.50 EA 10 FOR $22.50

22/44 TIN
SOLDERTAIL (P.C. STYLE)
$1.35 EA 10 FOR $12.50

42/84 GOLD
SOLDER EYELET $4.00 EACH

CANNON XLRA-3-13 CONNECTOR

3 PRONG CHASSIS MOUNT CONNECTOR
$2.00 EACH
10 for $19.00

2" ALLIGATOR CLIPS

7 clips for $1.00
100 clips for $12.00
500 clips for $50.00

4PDT RELAY

- 14 pin style
- 3 amp contacts
- 24 volt d.c. or 120 volt a.c. coil
- Used but fully tested

$1.70 EACH
specify coil voltage
LARGE QUANTITIES AVAILABLE
SOCKETS FOR RELAY 50¢ each

6 VDC RELAY

MINIATURE D.P.D.T.
3 AMP CONTACTS
FUJUITSU # FBR321D006
$1.75 EA 10 / 16.00

SONALERT

MALLORY MODEL # SNP-428
SNAP-IN STYLE
OPERATES FROM 4 - 28 VDC
$5.00 EACH

0-10 MINUTE TIMER

ADJ. TIMING MOTOR FROM 0 - 10 MIN.
RATED 10 AMPS. 125 VAC MOUNTS ON 1" CENTERS....
$4.75 EACH

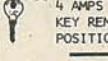
75 ohm CO-AX

12 FOOT
R.C.A. PLUGS BOTH ENDS..USED FOR VIDEO GAMES, ETC $1.25 EA

MICROWAVE TRANSISTORS

N.P.N. SILICON
SPECIAL PRICE
$2.50 EACH

KEY SWITCH



S.P.S.T.
4 AMPS @ 125 VAC
KEY REMOVES BOTH POSITIONS $3.50 EA

4 POSITION

4 AMPS @ 125 VAC

USED FOR CASH REGISTERS
COMES WITH THREE KEYS
#1 OPERATES 2 POSITIONS
#2 OPERATES 3 POSITIONS
#3 OPERATES 4 POSITIONS
KEY REMOVES ONE POSITION ONLY $4.50 EACH

6volt 9amp/hr RECHARGEABLE

ELPOWER # EP690
SOLID GEL CELL
5 1/2" X 4 1/4" X 2 3/4"..... $15.00 EACH

MICROPHONE

COMMUNICATION STYLE MIKE W/ PUSH TO TALK BUTTON ON SIDE.
$3.50 EACH

16.5 VAC 1 AMP CLASS 2 XFMR

$3.00 EACH

MULTI-SWITCH

8 STATION

INTERLOCKING ASSEMBLY
4-D.P.D.T./4-4.P.D.T.
6 1/2" MOUNTING CENTERS
$3.00 PER ASSEMBLY

5 STATION

INTERLOCKING ASSEMBLY
3-4.P.D.T./2-D.P.D.T.
4 1/8" MOUNTING CENTERS
$2.50 PER ASSEMBLY

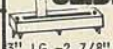
3 STATION

NON-INTERLOCKING
2-D.P.D.T./1-4.P.D.T.
PUSH ON/PUSH OFF STYLE
2 1/2" MOUNTING CENTERS
$1.50 PER ASSEMBLY

LIGHTED PUSH BUTTON

RED LIGHTED 120 VAC 10 AMP. S.P.S.T. "POWER" PRINTED ON FACE. MOUNTS IN 7/8" SQUARE HOLE..
$1.50 EA 10/ $13.50

SLIDE POTS



1K linear
3" LG.-2 7/8" TRAVEL 75¢ EA

50K audio taper
3" LG.-2 7/8" TRAVEL 75¢ EA

500K linear taper
2 7/8"LG.-1 3/4" TRAVEL 75¢ EACH 10/ $7.00

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MANUFACTURERS - WE WILL PURCHASE YOUR EXCESS INVENTORY (213) 380-8000

CIRCLE 64 ON FREE INFORMATION CARD

120VAC VARIABLE STROBE LIGHT KIT
Complete variable rate strobe light kit produces brilliant flashes of light. Operates from standard 120VAC. Reliable design — thousands of these are in use throughout the world. Overall size of completed board: 3"L x 2"W x 3"H.
C3071 $7.50

3VDC ELECTRONIC WARNING FLASHER KIT
This portable battery operated device continuously emits bursts of intense light at a fixed repetition rate. Can be seen for great distances making it a great safety device. Features xenon flashtube. Operates on 3VDC (two 1.5V Batteries). Size of board: 2⅛"L x 2"W
C3207 $7.95

FASCINATION STAR KIT
Produces an "exploding star" visual effect using 25 LEDS and IC circuitry. The center LED lights first then the next group of LEDS light and then another set of lights until the outer edge of the star lights up. The process then reverses itself. Operates from 9V battery. C4432 $10.95

ELECTRONIC WHEEL OF FORTUNE KIT
Push the start button and a bright red ball (LEDS) appear to spin around ten numbers. When you release the button the electronic ball appears to slow down and finally comes to a stop on one number. As the ball spins a small speaker emits a ticking sound in synchronization. Unit operates from 9V battery. Size of board: 2.9" x 2.6". C3806 $9.99

SOUND EFFECTS GENERATOR KIT
Exciting sound effects kit uses the popular TI76477 chip to develop phasor, locomotive, siren, tweeting bird, organ. Model T, etc. sounds. Uses dip switch for simple programming of the generator. Operates from 9V battery. Size of board: 3.25" x 2".
C4422 $12.95

3CHANNEL COLOR ORGAN
Very popular 3 channel color organ causes lights of your choice to flash to beat of music. Features level control and 3 separate AC outlets to connect Christmas lights, lamps, etc. Operates from 120VAC. Size of board: 3" x 5" C4530 $8.50

POPULAR ITEMS

GREEN NEONS (same as NE2 but glows bright green)
C4551 8/$1.00

3" 750ma SOLAR CELL
C4637 $3.50

3.6V 100ma NICAD (removed from new equipment)
C4665 $2.50

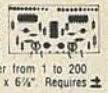
KESTER 60/40 PC SOLDER 6 ft. coil
C4456 $1.00

C106B1 SCR 200V 4A
C4426 .89

100WS ROUND FLASHTUBE
C4666 $7.95

PC TO PC SYNC CORD
C4667 $2.00

LED STEREO POWER METER KIT
Features attractive "moving" jumbo LED display with 20 LEDS (10 per channel) indicating RMS output of amplifier. Connects to speaker leads. Can be used with any amplifier from 1 to 200 watts. Size: 2¼" x 6¼". Requires ± 8VDC at 500 ma
C4662 $17.95



DUAL VOLTAGE POWER SUPPLY KIT
Power supply for above kit. Output ± 8 VDC at 500 ma-input 120 VAC. Size 2" x 2¼"
C4663 $5.95

Combination of both kits
C4664 $22.95

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CIRCLE 83 ON FREE INFORMATION CARD

AMAZING DEVICES

PHASORS

PHASOR PAIN FIELD — Patented and recently developed in our labs is being tested by Gov't for riot control. Soon to come under weapons restrictions as an infernal machine. Easily hand-held. Hazardous IF NOT USED WITH DISCRETION.
PPF-1 PLANS (sold for animal control) $15.00

INVISIBLE PAIN FIELD GENERATOR — Produces a directional field of moderately intense pain to back of head up to 50'. Cigarette pack size enclosure is easily hidden.
IPG-3 PLANS . . . $7.00 IPG-3K KIT & PLANS . . . $44.50
IPG-30 (assembled for animal control) $59.50

PHASOR STUN/BURNING WAND — Produces sufficient electrical energy capable of burning flesh. Intended as a personal defense device.
PSW-3 PLANS . . $8.00 PSW-3K KIT & PLANS . . $59.50

LASERS

RUBY LASER RAY PISTOL — Intense visible red, burns, hazardous, with parts sources.
RUBY PLANS (includes all part sources) $15.00

CARBON DIOXIDE LASER — Generates 20-40 watts of continuous power capable of burning, cutting, hazardous. (with all part sources) $15.00

LASER RIFLE — Produces 200-3000 pulses of 30 watt optical energy. Portable and easily hand-held.
LRG-3 PLANS $10.00
LRG-3K KIT PLANS (minus diode) $129.50

POCKET LASER — For the beginner, visible red "optical version", non-hazardous.
LHC-2 . . . . $5.00 LHC-2K KIT & PLANS $24.50

HIGH POWERED PORTABLE ENERGY SOURCE FOR LASERS AND MAGNETIC WEAPONS — Exploding wires, shockwave, etc. Miniature size.
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INF-1 PLANS $15.00

SEE IN DARK — Long range, total darkness.
SD-4 PLANS $10.00

LONG RANGE WIRELESS MIKE — Crystal clear quality — miniature.
FBT-7 PLANS . . . $7.00 FBT-7K PLANS & KIT . . . $34.50

WIRELESS TELEPHONE TRANSMITTER — Long range, automatic.
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Send for **FREE** catalog descripton of above plus hundreds more plans, kits and completed items. We accept MC or Visa or when ordering, send check or money order. We pay shipping charges on orders over $50.00, otherwise include 10% with remittance.

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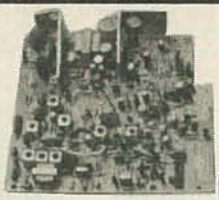
"TANK BATTLE" TV GAME

In just a short time and with a few minor parts, the most novice hobbiest can complete this exciting Tank Battle game. Create a fun-filled evening for the whole family. Two independent tanks rumble thru land mine fields, shoot shells and fragment when hit. Four distinct engine sounds are produced for the different speeds. Sounds of gunfire, shell bursts and tank explosions are realistic. Automatic on-screen scoring. Supplied with schematic drawing.

SOLD AS IS **$9.95** ea.

BUY ONE, GET THE SECOND FOR ONLY **$1.00** (WITHOUT CONTROL HANDLES)



C.B. SPECIAL

CONVERT THESE TO 10 METER FM

New HY-GAIN printed circuit board assembly with PLL02A chip and 3 crystals. (Squelch pot, volume control and channel switch not included.) Boards sold as is, the way we bought them from the manufacturer. Board dimensions 6"x 6½".

1-9 **$7.50** 10-49 **$6.50** 50-99 **$6.00** 100-UP **$5.50**

40 CHANNEL C.B. SWITCH $3.00 ea.
BRAND NEW HY-GAIN OR E.F. JOHNSON SWITCH

COPPER CLAD BOARD

(Double Side)

Size 9.25 x 10.75
Thickness .062

$2.00 ea.

ERIE TRIMMER CAP

513-002
.196" Dia. .080" High
3.5-20pf

$.75 ea.

SMALL ENOUGH TO FIT IN YOUR WATCH

AMP METERS

$2.50 ea.

2¼" square, no shunt required. Easy-to-read dial.

Movements: 0-6, 0-10, 0-17

4 CHANNEL 8 TRACK HOME UNIT

Brand New, 110 VAC motor with pre amp. instructions included.

$7.95 ea.

NICAD RECHARGEABLE BATTERY

NEW. Replaces the popular 9V Transistor Battery.

$4.75 ea.

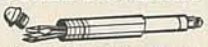
MAHOGANY PROJECT BOX

$1.50 ea.

4⅝" w x 7⅜" l x ¾" to 1½" h

Has a lip for recessed face plate and a felt bottom

SCREW DRIVER KIT



Handle stores four blades
2 single slot 5/32" & 3/32"
1 phillips 1 scratch awl
6" long with one blade inserted **$1.00** ea.

SUPER SMALL PHOTO FLASH

35 MFD 330 VOLT

1"x 6/8"
2 for **$1.00**
10 for **$4.50**

130 MFD 330V PHOTO FLASH

1-3/8"x 5/8"

$1.25 each
10 for **$10.00**

WHISTLE ACTIVATED SWITCH

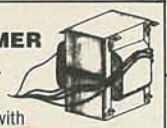
$2.50 ea.

Your whistle from a distance of 30' max. is picked up by an FET condenser mic. which turns on the switch. (Sensitivity can be adjusted.) Match your whistle again and turns off.

Schematic Diagram Supplied

POWER TRANSFORMER

$14.95 ea.



Primary – 115 vac
Secondary – 32 v with 24 v tap at 15 amps
Dim. 4½" h X 3¾" w X 4" deep

SOLID GEL BATTERY

6 volt @ 8 a.h. with Charger

$14.95

Elpower EP 680 may be charged constant voltage or constant current. Battery is self-contained and requires no maintenance. Connections made with quick connect lugs. All plastic case size 5½ h x 2¾ w x 4½ l, weight 4 lbs.

TELEPHONE & TTY INTERFACE MODEM

MFG by Anderson Jacobson
DAA Modem Model DC 230 with A-36 Telephone Coupler

$69.95

Rated 300 Baud, half or full duplex. DAA level adjustable 0 to – 3, – 4 to – 6, – 7 to – 10. TTY and DAA outputs brought out to 15 pin Molex connectors. FSK oscillator sends 1070 Hz space and 1270 Hz mark. Receives 2025 Hz space and 2225 Hz mark. Telephone coupler has 4-ft. cord and plug. Size 4¼" W x 15 L x 3" Dp. designed to be recessed in desk or panel. Electronics in case, 6⅞ W x 12 x 2¾" Dp. with 8-ft., 3-wire U-ground cord and plug. Operates on 115 vac, 50/60 Hz, ⅛ Amp. Supplied with connection sheet. Removed from equipment, excellent condition, guaranteed.

COMPUTER GRADE ELECTROLYTICS

VALUE/MFD		VOLTS	DIAM./LGTH.	PRICE
63,000	@	15V	3" x 5½"	**$4.00** ea.
10,000	@	20V	1½" x 5¾"	**$3.00** ea.
2,700	@	25V	1¼" x 2¼"	**$2.00** ea.
2,900	@	25V	1¼" x 2"	**$2.00** ea.
100,000	@	30V	3" x 5½"	**$6.00** ea.
39,000	@	30V	1" x 5¾"	**$4.00** ea.
34,000	@	30V	3" x 5½"	**$3.00** ea.
450	@	75V	1¼" x 2¼"	**$2.00** ea.
500	@	100V	1½" x 3¼"	**$2.00** ea.
50	@	450V	1¼" x 2"	**$2.00** ea.

AXIAL LEAD ELECTROLYTIC CAPACITORS

2 uF @ 15V 12/**$1.00**
10 uF @ 15V 12/**$1.00**
20 uF @ 15V 12/**$1.00**
50 uF @ 15V 12/**$1.00**
2.2 uF @ 25V 12/**$1.00**
3.3 uF @ 25V 12/**$1.00**
1 uF @ 35V 12/**$1.00**
2 uF @ 150V 12/**$1.00**
25 uF @ 25V 15/**$2.00**
3 uF @ 50V 15/**$2.00**
5 uF @ 50V 15/**$2.00**
10 uF @ 50V 15/**$2.00**
250 uF @ 25V 10/**$2.00**

SUB-MINI 10K POT

with On-Off ¼" hole mount, ⅛" D shaft, ¾" thread section.

5/$1.00

24-Volt POWER SUPPLY

5.4 AMPS

MFG by ACDC Electronics Inc. Model OEM 24N5.4-1

10" l x 5" h x 5" w

Input 105-125 vac 50/60 Hz. Has volt adj and O.L. adj. Output terminals contain + out, + sen, – sen, – out, ac neut, ac line and GND. 13 LBS.

$45.00

SAME AS ABOVE EXCEPT 24 VOLT 7 AMP. **$65.00**

REMOTE 40 CH. C.B. SPECIAL

NEW HYGAIN 16 MODEL 2716 HANDSET, HAS DIGITAL CLOCK.

PLASTIC CASE FOR REMOTE NOT INCLUDED. SOLD AS IS **$29.95**

EDGE CONNECTORS

Double Row / Wire Wrap .100
22 pins **$3.49** 10/**$30.00**
30 pins **$3.96** 10/**$32.00**
50 pins **$5.43** 10/**$45.00**

Double Row / Solder Eyelet .156
6 pins **$1.10** 10/**$ 9.00**
15 pins **$1.65** 10/**$12.50**
22 pins **$2.08** 10/**$17.00**
43 pins **$3.66** 10/**$30.00**

SPEAKER

3" Diam.,
8 OHM,
5 Watts.

$2.00 ea.

POWER SUPPLY

$3.95 ea.

+ 12 vdc .1 amps
+ 5 vdc .4 amps

E. F. JOHNSON "S" METER

Edge Meter 250 UA, fits in ⅝"x 1⅜" hole. Black background.

Scale 1-20 Top, 0-5 Bottom.

$1.25 ea. **5/$5.00**

TRIMMER CAP

1.5-20pF

(ARCO PC-402) **50¢** ea.

DIP SOLDER IC SOCKETS

14 pin **$.14**
16 pin **.16**
18 pin **.18**
20 pin **.20**
24 pin **.24**
40 pin **.40**

IC SOCKETS GOLD-PLATED WIRE WRAP

14 pin **40c** ea.
16 pin **45c** ea.

TEXAS INSTRUMENT KEYBOARD

$1.95 ea.
5/**$8.00**

Has 3 slide switches, 26 different keys, key pad removable by 4 screws

MODEM CABLE ASSEMBLIES

$5.50 ea.

Conn & Hood	22 AWG # Cond	Length
25 S	14	15'
25 P	10	17'

7' POWER CORD

HEWLETT PACKARD TYPE

Molded 3 Prong Plug with molded receptacle Belden 16 AWG

$3.00 ea.

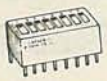
MUFFIN FANS

MFG By Rotron Inc.
3 Blades 4¾" Square

USED
110 VAC **$5.95** ea.

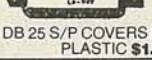
NEW
110 VAC Model MU2A1
$12.00 ea.

DIP SWITCH



5 POSITION **$1.00** ea.
8 POSITION **$1.50** ea.
10 POSITION **$2.00** ea.
12 POSITION **$2.50** ea.

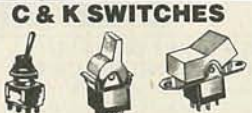
DB CONNECTORS



25 P **2.50**
25 S **3.50**

DB 25 S/P COVERS DB-51226-1 PLASTIC **$1.25**

C & K SWITCHES



L-3 J-60 J-3

Part #		Movement
J-60	7101	SPDT
L-3	7108	SPDT (momentary)
J-3	7201	DPDT (special large rocker)

$1.00 ea. **6/$5.00**

TERMS: All material guaranteed unless otherwise stated. If you are not satisfied with our product, it may be returned within 10 days for a refund (less shipping). Please add $4.00 for shipping and handling on all orders. COD's accepted for orders totaling $50 or more. All orders shipped UPS unless otherwise specified. Florida residents please add 4% sales tax. Minimum order, $15.00. Foreign orders – US funds only, add 20% for shipping and handling.

7/82

FORMULA INTERNATIONAL INC.

12603 CRENSHAW BOULEVARD • HAWTHORNE, CALIFORNIA 90250 • (213) 973-1921

Send $1.00 For Detailed Catalogue

LOW TIM DC STEREO PRE-AMP KIT TA-10 20

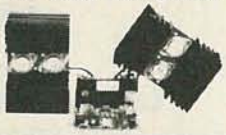
Incorporates brand-new D.C. design that gives a frequency response from 0Hz-100KHz ± 0.5dB! Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation!
Specifications: • T.H.D. less than .005% • T.I.M. less than .005% • Frequency response: DC to 100KHz ± 0.5dB • RIAA deviation: ± 0.2dB • S/N ratio: better than 70dB • Sensitivity: Phono 2MV 47K/Aux. 100MV 100K • Output level: 1.3V • Max output: 15V • Tone control: bass ± 10dB @ 50Hz/treble ± 10dB @ 15Hz • Power supply: ± 24 D.C. @ 0.5A
Kit comes with regulated power supply, all you need is a 48V C.T. transformer @ 0.5A

ONLY $44.50
X'former
$4.50 ea.

100W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:
- Output power: 100W RMS into 8-ohm
  125W RMS into 4-ohm
- Frequency response: 10Hz - 100 KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: ±40V @ 5 amp



TA-1000 KIT $51.95
Power transformer $18.00 each

50 WATTS AUTO STEREO BOOSTER BY VERTRONIX

Model V-Amp 500

Specifications: • 50 watts RMS total (25W + 25W)
- Frequency Response: ± 0.5dB, 20Hz ~ 20KHz
- T.H.D.: 0.2% at full rated output
- Input Impedance: 20K ohms
- Crosstalk: Better than 90dB
- Sensitivity: 1.5V for full rated output
- S/N Ratio: Greater than 95dB
- Speaker Load: 2 ~ 8 ohms
- Voltage Supply: 9 ~ 18V D.C.

REG. PRICE $119.00 EACH
OUR SPECIAL PRICE $45.00 EACH

SOLID STATE STEREO GRAPHIC EQUALIZER PRE AMP KIT TA-2500

Specifications:
- Total Harmonic Distortion: Less than 0.05%
- Intermodulation Distortion: (70Hz:7KHz = 4:1 SMPTE Method) Less than 0.03%
- Frequency Response: Overall 10Hz ~ 100KHz +0.5dB, −1dB
- RIAA Curve Deviation: (Phono) +0.2dB, −0.2dB (30Hz ~ 15KHz)
- Channel separation (at rated output 1KHz)
- Phono, Tuner, Aux and Tape Monitor better than 70dB
- Input sensitivity and impedance (1KHz for rated output)

Phono: 2MV 47K ohms Aux: 130MV 50K ohms
Tuner: 130MV 50K ohms Tape: 130MV 50K ohms
Graphic Equalizer control: 10 Band Slide Control
Frequency Bands: 31.5Hz, 63Hz, 125Hz, 250Hz, 500Hz, 1KHz, 2KHz, 4KHz, 8KHz, 16KHz also with on panel selector for Phono, Tuner, Aux 1 and Aux 2.
Power Supply: 117 VAC
Kit comes with all electronic components, transformer, instructions and a 19" rack mount type metal cabinet.

MODEL TA-2500

$119.00 PER KIT

1 WATT AUDIO AMP

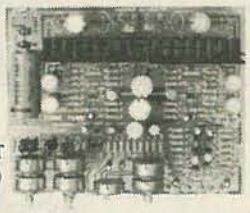
All parts are pre-assembled on a mini PC Board. Supply Voltage 6 ~ 9V D.C.

SPECIAL PRICE $1.95 ea.

TA-323 6 WATTS TOTAL 30W + 30W STEREO AMP KIT

This is a solid state all transistor circuitry with on board stereo pre-amp for most microphone or phone input. Power output employs 2 pairs matching Darlington Transistors. Driven by the popular 2N3053 Driver Transistors. Four built on board controls for; volume, balance, treble and bass. Power supplies requires 48 VCT 2.5 amp transformer. T.H.D. of less than 0.1% between 100 Hz and 10 KHz at full power. (30 Watts + 30 Watts loaded by 8~).

★ SPECIAL ★ EXCELLENT PRICE!



MODEL 001-0034
$29.50 PER KIT
Transformer (Optional)
$10.50 EACH

200 WATTS CLASS 'A' STEREO POWER AMP KIT TA-2600 (WITH LED POWER LEVEL DISPLAY AND RACK MOUNT TYPE CABINET)

TA-2600 is a kit that combines two sets of TA-1000 class A power amplifiers that can give you 100 watts of true power per channel. The kit also has the latest "V" shape LED power level display with memory Peak Hold on the front panel. For speaker protection it also has separate electronic speaker protection circuits. Kit comes with the 19" rack mount type metal cabinet with a professional quality black anodized front panel; all electronic parts and components; P.C. boards; filter capacitors and a heavy duty transformer.
Specifications:
- Power Level Display: Electronic LED type, 12 LED per channel from − 18 dB to 0 dB with Peak Hold memory
- Power Amplifier: Output power 100 Watts per channel into 8 Ohm load, 125 Watts into 4 Ohm load. Total Music power output 250 Watts Max.
- Frequency Response: 10 Hz to 100 KHz
- Total Harmonic Distortion: Less than 0.008% at full power
- Signal Noise Ratio: better than 80 dB
- Input Sensitivity: 1V Max.

MODEL TA-2600
$225.00 KIT FORM $325.00 ASSEMBLED

"FISHER" 30 WATT STEREO AMP

Super Buy Only $18.50

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

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Suply 6 18V DC
ONLY $6.00 EACH

FLUORESCENT AUDIO LEVEL MONITOR

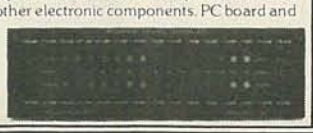
This is the kind of VU monitor that is being used by most amplifier manufacturer. I.Cs are used to simplify circuit layout. Easy to assemble and can be used with all power level amplifiers. Power requirement 12V DC.

TE-221 KIT
For just $28.50
(Limited stock)

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from −36dB +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6 12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!
Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.

MARK IV KIT
$31.50



ELECTRONIC DUAL SPEAKER PROTECTOR

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

KIT FORM **$8.75 EA.**

PROFESSIONAL REGULATED VARIABLE D.C. POWER SUPPLY KIT

All solid state circuitry with high efficiency power transistor 2SD388 and I.C. voltage regulator MC1733. Output voltage can be adjusted from 0-30V at 1 amp current limited or 0-15V at 2 amp current limited. Internal resistance is less than 0.005 ohm; ripple and noise less than 1 MV, dual on panel meter for voltage and amp reading, also with on board LED and audible over load indicator. Kit comes with predrilled P.C. board, instructions, all necessary electronic components, transformer and a professional look metal cabinet. The best project for school and the most useful instrument for repairman. Build one today!
MODEL TR 88A 0 ~ 15V D.C. 2 amp
MODEL TR 88B 0 ~ 30V D.C. 1 amp

$59.50 PER KIT

REGULATED DUAL VOLTAGE SUPPLY KIT

±10 - 30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.

$12.50 PER KIT

POWER SUPPLY KIT

0-30V D.C. REGULATED
Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts. Tranformer for Power Supply. 2 AMP 24V x 2 **$9.50**

0-30 Power Supply
$10.50 each

FOR COMMERCIAL FREE TV BOX BUILDERS

MC 1358	$2.50	LM 7815	$1.20
MC 1350	$2.00	NE 565	$2.00
MC 1330	$3.00	Connectors Set	$1.00
LM 1458	$1.00	I.C. Socket Set	$2.00
LM 380	$2.00	Matching Transformer	$1.40
Sanyo UHF Tuner	$35.00	Tolriod Coils	
Capacitors Set	$12.50	(Set of 4)	$3.00
Resistors Set	$2.00	Speaker Cabinet	$12.95
Trim Pots:		Transformer	
Trim Caps Set	$13.50	18V 800MA	$3.00
Pots and Knobs	$2.00		

We sell you all the above components in a package for **$125.00** and you will receive a free predrilled P.C. board and instructions at no charge!

SANYO UHF VARACTOR TUNER

For UHF CH 14 - 83

Tuning voltage +1V ~ +28V D.C. Input impedance 75 OHM I.F. band width 7 ~ 16 MHz. Noise figure 11.5dB MAX. Size 2⅜" x 1¼" x ¾" Supply voltage 15V D.C.

Sound I.F. = 58.0 MHz
Model 115-B-403A
Video I.F. - 62.5 MHZ
Model 115-B-405A
Video I.F. - 45 MHZ

$35.00 EA.

Tuner is the most important part for the circuit. Don't let these $19.00 tuners fool you!
All units are brand new from Sanyo. When ordering, please specify model number.

MODEL 115-B-405A
$35.00 EACH

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MJ15003 NPN MJ15004 PNP	250 Watts I.C.=20 A	BV=140 V	**$12.00** per pair

All above parts guaranteed to be prime and come with data sheets.

HYBIRD AUDIO POWER AMPLIFIER I.C.

70 WATTS 100 WATTS

Typical ratings. Operating case temp. 85° C. T.H.D. = 0.5% f= 20~20KHZ. Input resistance Po = 0.1W 30KΩ Power band width 20HZ~20KHZ. Freq. response 10HZ~100KHZ. Output resistance = 8Ω. With built in protection circuit. All units come with data sheet.

Part No.	Output	Vcc	Unit Price
STK040	10W+10W	±16V	**$14.50**
STK041	15W+15W	±20V	**$18.50**
STK050	50W	±35V	**$26.50**
STK054	23W	±19V	**$13.50**
STK056	30W	±22V	**$18.50**
STK070	70W	±42V	**$32.50**
STK415	7W+7W	30V	**$8.50**
STK439	15W+15W	39V	**$18.50**
STK465	30W+30W	±28V	**$25.50**
STK0105	100W	±50V	**$36.50**

ELECTRONIC MUSIC KIT

This kit is originally designed to be used as background music for phone call you put on hold. But it has a lot of other applications such, as a door charm, an audible indicator and for many other sound projects. The special custom made I.C. is pre programmed with 4 musical tunes. Kit comes with a nice looking plastic case, pre-drilled. P.C. board, volume control, special sound I.C. speakers and all electronic components and instructions. Ideal for home or school projects.

MODEL FIH-3000

BUY NOW! SPECIAL PRICE! ONLY

$9.95 PER KIT

SANYO ANTENNA SIGNAL BOOSTER

This Booster is specially designed for UHF Channels (14-83). After installed this unit (between the antenna input cable and the UHF tuner) will have a minimum of 10dB gain, that is approximately 2 times better than what you are seeing now. Ideal for those who live in apartments that cannot put up an outdoor antenna. Size is so small; only 2" x 1½" x 1". Supply voltage is 15 VDC.

★ NEW ITEM ★

MODEL 001-0076

$12.50 EACH

WEM-36 FM WIRELESS MICROPHONE

TEET MODEL WEM-36 is a factory assembled FM wireless microphone powered by two AA size batteries. Transmits in the range of 88-108 MHz with 3 transistor circuits to meet with F.C.C. part 15 regulations. Element is built in a plastic tube type case with an omni-directional electret condenser microphone unit. By using a standard FM radio, signal can be heard anywhere on a one-acre lot. Sound quality was judged "very good."

MODEL WEM-36

$16.50 EACH

ELECTRONIC PIN BALL MACHINE

That sounds and plays like the real thing. All units are brand new but without the case. Functions of the game include double flipper control, kicker control, 1-4 players, 3 speed ball control, tilt switch, automatic score, extra bonus cave and many more. All solid state with LED panel, no moving parts. Requires 9V battery to operate, speaker not included.

A perfect gift for yourself or friends.

SPECIAL **$8.99** EACH SPEAKER **$1.25** EACH

SOLAR CELLS

0.5V 200MA

Ideal for all kinds of solar projects, cells can be put in series to double voltage or parallel to double current.

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FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED

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

$6.50 Per Kit

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EXCLUSIVE! **$3.95 ea.**

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

No FCC license required.

OUR PRICE

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ADDITIONAL MICROPHONE (TRANSMITTER) AVAILABLE AT **$28.00** EACH

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Transmitter: FET mic for flat 30 ~18 KHz response extra controlled 49MHz AM Band for drift-free performance. 100 MW output (range approx. ¼ mile) for reliable long range transmission. Powered by a 9V radio battery (included).

Receiver: Extra controlled locks on 49MHz transmitter signal. With on panel VU meter monitors the signal strength from the microphone. Standard phone jack outlet connection to a P.A. or other phone input. 9V battery included. This professional set is ideal for on stage, in field, church, in house or outdoor use.

MURA WMS-49

WHISTLE ACTIVATED SWITCH BOARD

All boards are pre-assembled and tested. Your whistle to its FET condenser microphone from a distance, as far as 30 feet away (sensitivity can be easily adjusted) will turn the switch on, then match your whistle to it again, then it turns off. Ideal for remote control toys, electrical appliance such as lights, coffee pots, TV, Hi-Fi, radio or other projects. Unit works on 9V D.C.

MODEL 968

$4.50 EACH

MICROPROCESSOR COMPONENTS

Z80-8.75	Z80ASIO-29.50	2114-2.95	2716-9.60
Z80A-9.25	Z80ACTC-8.50	2114L-2.95	2516-11.95
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SPECIAL OF THE MONTH

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$9.95 LIMITED QUANTITY

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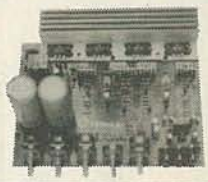
28-pin 5/2.10	5/5.87
40-pin 5/3.02	5/6.89

TA-800 120W PURE D.C. POWER STEREO AMP KIT

Getting power hungry from your small amp? Have to watch your budget? Here's a good solution! The TA-800 is a pure D.C. amplifier with a built in pre-amp. All coupling capacitors are eliminated to give you a true reproduction of the music. On board tone and volume controls combined with built in power supply making the TA-800 the most compact stereo amp. available. Specification: 60W x 2 into 8Ω Freq. range 0-100KHZ ±3db. THD .01% or better S/N ratio: 80db. Sensitivity: 3mV into 47K. Power Requirement: ± 24-40V.

A GOOD BUY at **$65.00**



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MODEL MF505

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SUPER FM WIRELESS MIC KIT— MARK III

FMC-105

$11.50 PER KIT

This new designed circuit uses high FEQ. FET transistors with 2 stages pre amp. Transmits FM Range (88-120 MHz) up to 2 blocks away and with the ultra sensitive condensor microphone that comes with the kit, allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, OSC coils, and P.C. Board. Power supply 9V D.C.

ULTRASONIC SWITCH KIT

$15.50

Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC.

ELECTRONIC SWITCH KIT

CONDENSER TYPE Touch On Touch Off uses 7473 I.C. and 12V relay

$5.50 each

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BUY 2 BAND PRINTER / TERMINALS FOR THE PRICE OF 1!

You Get **2 GENERAL ELECTRIC (GE) TERMINET 1200's**

Features:
•RS32 ASCII Input •Fully Formed Type
•Up to 1200 Baud (120 cps) for almost 60 lpm
•120 Columns at 10 'pitch' •Changeable Print Band
•Ultra Reliable •94 Characters (Upper & Lower Case)
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These unique, off-lease and used GE "Terminets" offer 3 input Baud rates for 3 print speeds, table-top operation. Continuous print band provides fast, fully formed characters far superior to Dot Matrix. LETTER QUALITY print at DOT MATRIX speed!! One unit is fully tested and operational, cleaned and ready to use. The other is clean and whole but UNTESTED (use as a spare or as parts machine). Line Cord & Forms Tractor NOT included (available from GE direct!) Tractor GE Part No. 44C414730-G02.

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G.E. TERMINET 340 LINE PRINTER

These excellent off-lease, used BAND-type Line Printers feature:

•230 to 340 lines per minute.
•PARALLEL (TTL) Input.
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•Includes Stand & Sound Hood!
•TESTED & OPERATIONAL
•Schematics & I/O Data Included

Each machine *includes* Print Band, Parallel Input I/O Board, Schematics & info.
Each Printer is shipped tested and fully operational!! Nationwide service by General Electric. Original Price over $4,000.00 Most are unused or new!!!

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BUY OF THE YEAR!!!

PARALLEL, TTL INPUT I/O SELECTRIC*

(Printer Only)

The manufacturer put them into storage to depreciate them. Now they are *FINALLY AVAILABLE!!* Removed from *working systems*, these fantastic machines have built-in driver and decoder circuitry and take TTL level, 6-bit character plus 4-bit functional input signals. Easily driven by *most any micro*. Use as a typewriter (with additional 'repeat' circuitry) or as a KSR I/O printer, or both. Requires 115, 60 Hz for typewriter motor. 5 VDC for TTL and 24 VDC for solenoids. "Table Top" style case. Each "Selectric"* I/O machine is complete and in *operational condition*. Includes schematics, data, case, platen and ribbon. (Type element not included.)

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- CRYSTAL CLOCK
- BUFFERED SYM-AIM BUS

PRICE 81-260A **$199.95** ASSM.
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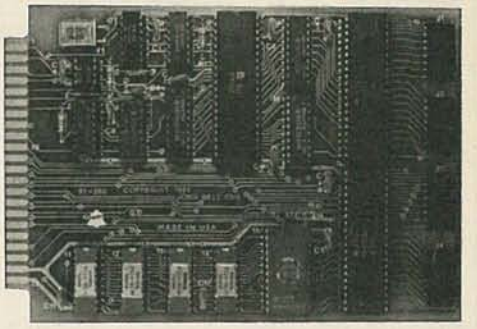
81-260B **$ 39.95** BARE BOARD



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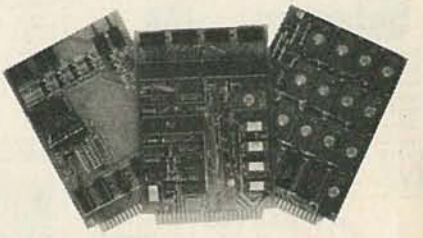

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Model 2830 List Price $89.95 ..... **$34.95**

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2¼" Round — 8 Ohm
.25 Watt (4" Leads)
Size: 2¼" x ¾"

Part No.	Price
A0201	$1.25 or 2/1.98

2½" Square — 16 Ohm
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Large Ceramic Magnet
Size: 2⅜" x 2⅜" x ¾"

Part No.	Price
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- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
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UVS-11EL Replacement Bulb $16.95

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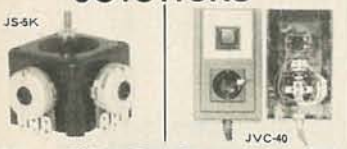

JS-5K	5K Linear Taper Pots $5.25
JS-100K	100K Linear Taper Pots $4.95
JS-150K	150K Linear Taper Pots $4.75
JVC-40	40K (2) Video Controller in case ... $4.95

Pertec Computer Corp.

5¼" Mini-Floppy Disc Drive

FOR TRS-80 MODEL I, III (Industry Standard)

Features single or double density. Recording mode: FM single, MFM double density. Power: +12VDC (±0.6V) 1.6 amps max., 5VDC (±0.25V) 0.8 amps max. Unit as pictured at left (does not incl. case, power supply or cables). 30-page data book included. Weighs 3½ pounds. Size: 5¼"W x 8"D x 3¼"H

Part No.	Limited Quantity!	Price
FD200		$179.95
	Single-sided, 40 tracks, 250K bytes capacity	
FD250		$199.95
	Double-sided, 35 tracks, 438K bytes capacity	

NEW!

JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) .. $24.95

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp) ..	$14.95
JE205 Adapter Brd. (to JE200) ±5, ±9 & ±12V.	$12.95
JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp.	$19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	4.95
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
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DP8275	Prog. CRT Controller	39.95
DP8279	Prog. Keyboard/Display Interface	9.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95
DP8310	Octal Latched Peripheral Driver	5.25
DP8311	Octal Latched Peripheral Driver	5.25

6800/6800 SUPPORT DEVICES

MC6800	MPU	7.95
MC6802CP	MPU with Clock and RAM	14.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	17.95
MC68301L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	11.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	13.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901A	DC CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MCS6502	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N-4	MPU—8-Bit (6MHz)	7.95
INS8039N-4	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	9.95
INS8040N-4	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	9.95
TMS9900JL	MPU—16-Bit	39.95

1173AN-1 30 Tune Musical MPU Chip 8.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM501H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402N	256-Bit Dynamic	2.95
MM5013N	1024-Bit Dynamic/Accumulator	1.95
MM5016N	500/512-Bit Dynamic	1.95
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	1.95
2511N	MOS Dual 200-Bit Static	.99
2532V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

DC10	Mostek DC/DC Convert. +5V to -9V	$2.95
MCJ470P	Floppy Disc Read AMP System	4.95
MC1408L7	7-Bit D/A Converter (DAC0807LCN)	4.95
MC1408L8	8-Bit D/A Converter (DAC0808LCN)	5.75
AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Band Filter	19.95
AF122-1CJ	Touch Tone High Band Filter	19.95
LM308CH	Super Gain Op Amp	1.15
LM334Z	Constant Current Source	1.30
LM335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1060LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	6.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.79
21L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	2.25
2114L	1024x4 Static 450ns Low Power	2.49
2114-3	1024x4 Static 200ns	2.49
2114L-3	1024x4 Static 200ns Low Power	2.95
745200	256x1 Static	6.95
4116N-4 (UPD416)	16K Dynamic 250ns (MM5290N-4)	1.95
4164N-3	64K Dynamic 200ns	14.95
MM2147N	4096x1 Fast 70ns	4.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.49
MM5280/2107	4096x1 Dynamic	4.95
MM5290N-2 (4136)	16K Dynamic 150ns (UPD416C-3)	2.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	1.95
HM6116-4	16K (2Kx8) Static 200ns	14.95
82S25	64 Bit RAM (16x4OC)	3.49
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	9.95
TMS4045	1024x4 Static	9.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	4.95
TMS2716	16K EPROM (-5V, +5V, +12V)	9.95
2716 Intel (2516) TI	16K EPROM (Single +5V)	8.95
2732 Intel TI	32K EPROM	17.95
2758	8K EPROM (450ns) (Single +5V)	7.49
2764Q	64K EPROM (Hitachi HN462764)	49.95
5203	2048 PROM	14.95
82S23 (74S188)	32x8 PROM (Open Collector)	3.95
82S115	4096 Bipolar PROM	14.95
82S123 (74S288)	32x8 Tri-State Bipolar PROM	3.95
82S185	8K PROM	16.95

— Over 30 More PROMS Listed in Our Catalog —

ROM'S

2513 (2140)	Character Generator (Upper Case)	9.95
2513 (3021)	Character Generator (Lower Case)	9.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha, Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS8051N	Communication Chip	19.95
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	6.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD6365-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53200N	Push Button Pulse Dialer	7.95
MM57409N	96/144-Key Serial Keyboard Encoder	8.95

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- 36cfm free air delivery
- 3.125" sq. x 1.665" depth
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- 115V 50/60Hz
- For Apple users

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MU2A1-U Cleaned & tested (used) ..... $9.95 ea.
MU2A1-N New ..... $14.95 ea.

KEYBOARDS

MICRO SWITCH 69-KEY KEYBOARD *Limited Quantity!*
Uses AMI SW20350K Chip. Size: 16⅝"L x 5¼"W x 1⅝"H Metal Frame. Light and dark grey key caps (no data sheet).
Part No. KB69SD12-2 ..... **$19.95 each**

DATANETICS 74-KEY KEYBOARD *Limited Quantity!*
Uses EA20134 Chip (Electronic Array). Size: 16¼"L x 5½"W x 1⅜"H. White, black, blue, grey key caps. Data sheets not available.
Part No. KB354 ..... **$29.95 each**

STACKPOLE 62-KEY ASCII KEYBOARD *Standard Stocked Item!*
SPST Switching (Mechanical). Size: 13"L x 3¼"W X 1½"H. Grey key caps. Data sheets are available.
Part No. K-62 ..... **$34.95 each**
(ASCII Encloded Keyboard Kit — JE610K ..... **$79.95)**

MICRO SWITCH 88-KEY KEYBOARD
Uses SD 25010K Chip (AMI). Size: 18¼"L x 5¾"W x 1⅝"H. Dark and light gray key caps. Used in a Diablo 1640 Terminal (schematic avail.)
Part No. 88SD22 ..... **$69.95 each**

POWER SUPPLIES

POWER SUPPLY — 5VDC @ 1 AMP REGULATED Transaction Tech
Output +5VDC @ 1 amp (also +30VDC) reg. Input 115VAC 60Hz. Two-tone (black/beige) self-enclosed case. 6 foot, 3 conductor black power cord. Size: 6½"W x 7"D x 2¼"H — Wt. 3 lbs.
Part No. PS51194 ..... **$19.95 each**

POWER SUPPLY — 5VDC @ 1 AMP REGULATED B Industries
Output +5VDC @ 1 amp, +36-42VDC Adjusted. 400mA or less, 30VAC (isolated) @ 1.5 amp. Input 115VAC 60Hz. Circuit breaker re-set button. Black self-enclosed case with 4 rubber feet, 6 foot, 3 conductor black power cord. On/off switch. Size: 6¼"W x 7¾"D x 3⅝"H — Wt. 7 lbs.
Part No. PS407D ..... **$24.95 each**

POWER PAC Heavy Duty Multi-Voltage Power Supply — 5VDC, 12VDC & 24VDC
Output: +5VDC @ 30A, +12VDC @ 2A, -12VDC @ 4A and +24VDC @ 3A. Input: 115VAC, 7A, 220VAC, 3.5A. Regulation: ± .15% line and load combined. Ripple: 10MV peak to peak (3MV RMS). Overvoltage protection: 5V, + 12V, -12V. Overcurrent protection included. Size: 15½"L x 6"H x 11⅝"D — Wt. 40 lbs.
Part No. 285-016 ..... **$119.95 each**

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National Semiconductor — Intersil — Intel

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30002	National Interface Data Book (704 pages) DP, DS8000, DS3900, DS75000, etc.	$6.95
30003	National Linear Data Book (1376 pages) LM, LF, ADC, DAC, LH Series	$11.95
30004	National Series 80 — Board Level Computer (224 pages)	$4.95
30005	National TTL Logic Data Book (624 pages) 7400, LS, L, H, S, and DM8000 Series	$6.95

30006 Above (3) 30001,3,5 as set $24.95/lot

010400	Intel Component Data Catalog Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1328 pages)	$14.95
205610	Intel Peripheral Design Handbook Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$9.95

AC and DC Wall Transformers

Part No. DC6912

With Universal Plug and 9V Battery Snap

Selective voltages: 6,9,12VDC. Polarity selection (+/-). six-foot line from adapter to plugs — six-inch line from adapter to battery snap. 120V/60Hz. 300mA.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12VAC 250mA	$3.95
AC 500	117V/60Hz	12VAC 500mA	$4.95
AC1000	117V/60Hz	12VAC 1 amp	$5.95
AC1700	117V/60Hz	9VAC 1.7 amp	$3.95
DC 800	120V/60Hz	8VDC 400mA (batt. charger)	$1.95
DC6912 (above)	120V/60Hz	6,9,12VDC 300mA	$9.95
DV9200	117V/60Hz	9VDC 200mA	$3.25
DC9900	120V/60Hz	9VDC 500mA	$3.95
DC1200	120V/60Hz	12VDC 300mA	$2.95

CONNECTORS

Computer Users!

DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K
Kit comes complete with:
- **8 ea. MM5290 (UPD416/4116) 16K Dyn. Ram (*ns)**
- **Documentation for conversion**

TRS-16K2 *150ns	$19.95
TRS-16K3 *200ns	$16.95
TRS-16K4 *250ns	$14.95

Mostek DC/DC Converter

+5 VOLTS TO -9 VOLTS

Input: +5V. Output: -9V (regulated) @ 30mA. Printed circuit mounting.
DC10 ..... **$2.95 ea. or 2/$4.95**

JE610 ASCII Encoded Keyboard Kit

The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and -12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK	(After assembled as pictured above)	$124.95
JE610 Kit	62-Key Keyboard, PC Board, & Components (no case)	$ 79.95
K62	62-Key Keyboard (Keyboard only)	$ 34.95
DTE-AK	(case only — 3¾"Hx11"Wx8¾"D)	$ 49.95

NEW!

JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT
Provides -12VDC from incoming 5VDC .. **$9.95**

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¾"W x 8¾"D

JE600/DTE-HK	(After assembled as pictured above)	$99.95
JE600 Kit	19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case)	$59.95
K19	19-Key Keyboard (Keyboard only)	$14.95
DTE-HK	(case only — 3½"Hx8¾"Wx8¾"D)	$44.95

7400

SN7400N	.20	SN7472N	.29	SN74156N	.79
SN7401N	.20	SN7473N	.35	SN74157N	.69
SN7402N	.25	SN7474N	.35	SN74160N	.89
SN7403N	.25	SN7475N	.49	SN74161N	.89
SN7404N	.25	SN7476N	.35	SN74162N	.89
SN7405N	.29	SN7479N	5.00	SN74163N	.89
SN7406N	.35	SN7480N	.50	SN74164N	.89
SN7407N	.35	SN7482N	.99	SN74165N	.89
SN7408N	.29	SN7483N	.69	SN74166N	1.25
SN7409N	.29	SN7485N	.89	SN74167N	2.79
SN7410N	.25	SN7486N	.35	SN74170N	1.95
SN7411N	.29	SN7489N	1.75	SN74172N	4.95
SN7412N	.35	SN7490N	.49	SN74173N	1.39
SN7413N	.40	SN7491N	.59	SN74174N	.99
SN7414N	.69	SN7492N	.45	SN74175N	.89
SN7416N	.29	SN7493N	.45	SN74176N	.79
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SN7420N	.25	SN7495N	.69	SN74179N	1.49
SN7421N	.29	SN7496N	.69	SN74180N	.79
SN7422N	.45	SN7497N	3.00	SN74181N	2.25
SN7423N	.29	SN74100N	1.49	SN74182N	.79
SN7425N	.29	SN74104N	.89	SN74184N	2.49
SN7426N	.29	SN74105N	.89	SN74185N	2.49
SN7427N	.25	SN74107N	.35	SN74190N	1.25
SN7428N	.49	SN74109N	.39	SN74191N	1.25
SN7430N	.25	SN74116N	1.95	SN74192N	.89
SN7432N	.29	SN74121N	.39	SN74193N	.89
SN7437N	.25	SN74122N	.55	SN74194N	.89
SN7438N	.40	SN74123N	.59	SN74195N	.69
SN7439N	.25	SN74125N	.49	SN74196N	.89
SN7440N	.20	SN74126N	.49	SN74197N	.89
SN7441N	.89	SN74132N	.75	SN74198N	1.49
SN7442N	.59	SN74136N	.75	SN74199N	1.49
SN7443N	1.10	SN74141N	.99	SN74221N	1.25
SN7444N	1.10	SN74142N	3.25	SN74251N	.99
SN7445N	.89	SN74143N	3.49	SN74276N	1.95
SN7446N	.79	SN74144N	3.49	SN74279N	.79
SN7447N	.69	SN74145N	.79	SN74283N	1.49
SN7448N	.79	SN74147N	1.95	SN74284N	3.95
SN7450N	.20	SN74148N	1.29	SN74285N	3.95
SN7451N	.20	SN74150N	1.25	SN74365N	.69
SN7453N	.20	SN74151N	.69	SN74366N	.69
SN7454N	.20	SN74152N	.69	SN74367N	.69
SN7459A	.25	SN74153N	.79	SN74368N	.69
SN7460N	.20	SN74154N	1.25	SN74390N	1.49
SN7470N	.29	SN74155N	.79	SN74393N	1.49

74LS

74LS00	.29	74LS92	.75	74LS192	1.15
74LS01	.29	74LS93	.75	74LS193	1.15
74LS02	.29	74LS95	.99	74LS194	1.15
74LS03	.29	74LS96	1.15	74LS195	1.15
74LS04	.35	74LS107	.45	74LS197	1.19
74LS05	.35	74LS109	.45	74LS221	1.19
74LS08	.35	74LS112	.45	74LS240	1.49
74LS09	.35	74LS113	.49	74LS241	1.49
74LS10	.35	74LS114	.49	74LS242	1.49
74LS11	.39	74LS122	.89	74LS243	1.49
74LS12	.35	74LS123	1.25	74LS244	1.49
74LS13	.59	74LS125	.59	74LS245	2.95
74LS14	.99	74LS126	.59	74LS247	1.19
74LS15	.35	74LS132	.99	74LS248	1.19
74LS20	.35	74LS133	.89	74LS249	1.19
74LS21	.35	74LS136	.49	74LS251	.99
74LS22	.35	74LS138	.89	74LS253	.99
74LS26	.35	74LS139	.89	74LS257	.89
74LS27	.35	74LS151	.89	74LS258	.69
74LS28	.35	74LS153	.89	74LS260	.69
74LS30	.35	74LS154	1.75	74LS266	.69
74LS32	.35	74LS155	.89	74LS273	1.95
74LS33	.59	74LS156	.89	74LS279	.89
74LS37	.45	74LS157	.89	74LS283	.89
74LS38	.39	74LS158	.89	74LS290	.99
74LS40	.35	74LS160	1.15	74LS293	.99
74LS42	.89	74LS161	1.15	74LS298	1.25
74LS47	.89	74LS162	1.15	74LS352	1.29
74LS48	1.15	74LS163	1.15	74LS353	1.29
74LS49	1.15	74LS164	1.15	74LS365	.69
74LS51	.35	74LS165	1.15	74LS366	.69
74LS54	.35	74LS168	1.19	74LS367	.69
74LS55	.35	74LS169	1.19	74LS368	.69
74LS73	.45	74LS170	1.95	74LS373	1.95
74LS74	.45	74LS173	.99	74LS374	1.95
74LS75	.59	74LS174	.99	74LS375	.89
74LS76	.45	74LS175	.99	74LS386	.69
74LS78	.49	74LS181	2.95	74LS393	2.49
74LS83	.89	74LS190	1.25	74LS399	2.49
74LS85	1.25	74LS191	1.25	74LS670	2.49
74LS86	.49			81LS95	1.95
74LS90	.69			81LS97	1.95

74S

74S00	.45	74S124	3.95	74S243	3.25
74S02	.45	74S133	.55	74S244	3.25
74S03	.45	74S134	.69	74S251	1.45
74S04	.55	74S135	1.19	74S253	1.45
74S05	.55	74S136	1.75	74S257	1.35
74S08	.50	74S138	1.35	74S258	1.35
74S09	.50	74S139	1.35	74S260	.79
74S10	.45	74S140	.79	74S280	2.95
74S11	.45	74S151	1.35	74S287	3.25
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74S20	.45	74S157	1.35	74S373	3.49
74S22	.45	74S158	1.35	74S374	3.49
74S30	.45	74S160	2.95	74S387	2.95
74S32	.55	74S174	1.59	74S471	10.95
74S38	1.25	74S175	1.59	74S472	10.95
74S40	.50	74S188	2.95	74S473	10.95
74S51	.45	74S194	1.95	74S474	12.95
74S64	.50	74S195	1.95	74S475	12.95
74S65	.50	74S196	1.95	74S570	5.95
74S74	.75	74S240	2.95	74S571	5.95
74S86	.79	74S241	2.95	74S572	9.95
74S112	.79	74S242	3.25	74S573	9.95
74S113	.79			74S940	3.15
74S114	.79			74S941	3.15

CA—LINEAR

CA3010H	.99	CA3060N	3.25	CA3089N	3.75
CA3013H	2.15	CA3080H	1.25	CA3096N	3.95
CA3023H	3.25	CA3081N	2.00	CA3130H	1.39
CA3035H	2.49	CA3082N	2.00	CA3140H	1.25
CA3039H	1.35	CA3083N	1.60	CA3160H	1.25
CA3046N	1.30	CA3086N	.85	CA3401N	.59
CA3059N	3.25			CA3600N	3.50

CD—CMOS

CD4000	.39	CD4041	1.49	CD 4098	2.49
CD4001	.39	CD4042	.99	CD4506	.75
CD4002	.39	CD4043	.89	CD4507	.99
CD4006	1.19	CD4044	.89	CD4508	3.95
CD4007	.25	CD4046	1.79	CD4510	1.39
CD4009	.49	CD4047	2.50	CD4511	1.29
CD4010	.49	CD4048	1.35	CD4512	1.49
CD4011	.39	CD4049	.49	CD4514	3.95
CD4012	.25	CD4050	.69	CD4515	2.95
CD4013	.49	CD4051	1.19	CD4516	1.49
CD4014	1.39	CD4052	1.19	CD4518	1.79
CD4015	1.19	CD4053	1.19	CD4519	.89
CD4016	.59	CD4056	2.95	CD4520	1.29
CD4017	1.19	CD4059	9.95	CD4526	1.79
CD4018	.99	CD4060	1.49	CD4528	1.79
CD4019	.49	CD4066	.79	CD4529	1.95
CD4020	1.19	CD4068	.39	CD4543	2.79
CD4021	1.39	CD4069	.45	CD4562	11.95
CD4022	1.19	CD4070	.55	CD4566	2.79
CD4023	.29	CD4071	.49	CD4583	2.49
CD4024	.79	CD4072	.49	CD4584	.75
CD4025	.23	CD4073	.39	CD4723	1.95
CD4026	2.95	CD4075	.39	CD4724	1.95
CD4027	.69	CD4076	1.39	MC14409	17.95
CD4028	.89	CD4078	.55	MC14410	18.95
CD4029	1.49	CD4081	.39	MC14411	15.95
CD4030	.49	CD4082	.39	MC14412	15.95
CD4034	3.49	CD4093	.99	MC14419	7.95
CD4035	.99			MC14433	15.95
CD4040	1.49			MC14538	2.49
				MC14541	1.95

OPTO ELECTRONICS

A-AMBER R-RED — LEDS — Y-YELLOW G-GREEN C-CLEAR

DIFFUSED BI-COLOR/TRI-STATE · POINT SOURCE (RED) · DIFFUSED · DIFFUSED · WIDE ANGLE DIFFUSED · DIFFUSED · POINT SOURCE · DIFFUSED · DIFFUSED TRIANGLE · DIFFUSED RECTANGULAR

[illegible]

LED Mounting Hardware

Mounts in panels up to .125" thick. Drill .250" diameter hole (F Drill). Can be used with XC22, XC111, XC526, XC554 and XC556 Series (from .160" to .200 Dia.) Black plastic clip and ring.

Part No.		
LMH 200	8/.99	100+ .08 ea.

—DISPLAY LEDS—

Part No.	Size	Color	Description	Price
MAN 1	.270	Red	C.A. (LHDP)	[illegible]
MAN 2	.300	Red	5x7 Alphanumeric (TIL305)	4.95
MAN 52	.300	Green	[illegible]	[illegible]
MAN 72	.300	Red	C.A. (LHDP)	[illegible]
MAN 74	.300	Red	C.C. (RHDP)	[illegible]
NSN 74L	.300	Red	C.C. (LHDP)	[illegible]
MAN 82	.300	Yellow	C.A. (LHDP)	[illegible]
MAN 84	.300	Yellow	C.C. (RHDP)	[illegible]
MAN 3620	.300	Orange	[illegible]	[illegible]
MAN 3630	.300	Orange	[illegible]	[illegible]
MAN 4610	.400	Orange	[illegible]	[illegible]
MAN 6610	.560	Orange	[illegible]	[illegible]
MAN 6630	.560	Orange	[illegible]	[illegible]
MAN 6640	.560	Orange	[illegible]	[illegible]
MAN 6650	.560	Orange	[illegible]	[illegible]
MAN 6660	.560	Orange	[illegible]	[illegible]
MAN 6710	.560	Red	[illegible]	[illegible]
MAN 6740	.560	Red	[illegible]	[illegible]
MAN 6750	.560	Red	[illegible]	[illegible]
DL 34M	.110	Red	[illegible]	[illegible]
DLO 304	.300	Orange	[illegible]	[illegible]
DLO 307	.300	Orange	[illegible]	[illegible]
DLG 505	.500	Green	[illegible]	[illegible]
DLG 507	.500	Green	[illegible]	[illegible]
DL 704	.300	Red	[illegible]	[illegible]
DL 707	.300	Red	[illegible]	[illegible]
DL 747	.630	Red	[illegible]	[illegible]
DL 750	.630	Red	[illegible]	[illegible]
FND 359	.357	Red	[illegible]	[illegible]
FND 357	.357	Red	[illegible]	[illegible]
FND 500	.500	Red	[illegible]	[illegible]
FND 507	.500	Red	[illegible]	[illegible]
TIL 308	.270	Red	[illegible]	[illegible]
TIL 311	.270	Red	[illegible]	[illegible]
5082-7300	.600	Red	[illegible]	[illegible]
5082-7302	.600	Red	[illegible]	[illegible]
5082-7304	.600	Red	[illegible]	[illegible]
5082-7340	.600	Red	[illegible]	[illegible]
5082-7430	.110	Red	[illegible]	[illegible]
HDSP-3401	.800	Red	[illegible]	[illegible]
HDSP-3403	.800	Red	[illegible]	[illegible]
HDSP-3406	.800	Red	[illegible]	[illegible]

Many Other Displays Available — Send for New Catalog

OPTO-ISOLATORS

H11C3	SCR Output Opto Isolators	[illegible]
LIT-1	Single Chan. 20% CTR, 2500V (MCT 2/4N25)	[illegible]
4N28	Single Chan. 10% CTR, 500V (Photo Transistor)	[illegible]
4N33	Single Chan. 500% 1500V (Photo Darlington)	[illegible]
MOC3010	Optically Isolated Triac Driver	1.25

LITRONIX-NATIONAL Stick Display Sale

LIMITED QUANTITY!

LED NUMERIC ARRAYS

[illegible]

MULTI-DIGIT LED NUMERIC DISPLAYS

[illegible]

COMPUTER GRADE CAPACITORS

1¢ SALE!

MFD	WVDC	PRICE	MFD	WVDC	PRICE	MFD	WVDC	PRICE
250	150	1.95	7,000	60	4.95	27,000	10	2.95
500	200	2.49	10,000	15	2.95	32,500	25	4.95
1,250	3	.99	10,000	16	3.95	40,000	25	5.95
1,500	25	1.95	11,000	10	4.95	42,000	10	4.95
1,500	50	2.95	13,000	16	2.95	43,000	10	5.95
2,000	10	2.95	14,000	13	2.95	45,000	5	5.95
2,100	200	2.95	14,000	35	3.95	52,000	20	5.95
2,250	100	3.95	18,000	10	3.95	55,000	15	5.95
2,300	33	2.95	20,000	20	2.95	58,000	20	5.95
2,500	15	2.95	21,000	15	3.95	65,000	10	7.95
3,000	25	1.95	22,000	15	4.95	73,800	5	7.95
3,600	40	3.95	23,000	7	1.95	80,000	15	9.95
4,500	50	3.95	23,000	10	2.95	90,000	10	8.95
5,500	25	4.49	23,000	20	3.95	120,000	15	10.95
6,100	40	2.49	24,000	20	2.95	160,000	10	8.95

OVER 200 OTHER VALUES AVAILABLE — BUY ONE, THE SECOND UNIT IS 1¢ MORE

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

JUMPER AND CABLE ASSEMBLIES

Custom Jumpers! *Custom Cables!*

STANDARD DIP JUMPERS

All jumpers use low profile dip plugs with heavy duty pins for repeated disconnect applications.

JAMECO Part No.	AP Cross Reference	No. Pins	Description	Wire Length	Price
DJ14-1	924102-12	14	single end	12"	$1.79
DJ14-2	924102-24	14	single end	24"	2.05
DJ14-3	924102-36	14	single end	36"	2.35
DJ14-1-14	924106-12	14	double end	12"	3.20
DJ14-2-14	924106-24	14	double end	24"	3.49
DJ14-3-14	924106-36	14	double end	36"	3.79
DJ16-1	924112-12	16	single end	12"	1.85
DJ16-2	924112-24	16	single end	24"	2.19
DJ16-3	924112-36	16	single end	36"	2.59
DJ16-1-16	924116-12	16	double end	12"	3.35
DJ16-2-16	924116-24	16	double end	24"	3.69
DJ16-3-16	924116-36	16	double end	36"	4.05
DJ24-1	924122-12	24	single end	12"	2.69
DJ24-2	924122-24	24	single end	24"	3.39
DJ24-3	924122-36	24	single end	36"	3.95
DJ24-1-24	924126-12	24	double end	12"	4.79
DJ24-2-24	924126-24	24	double end	24"	5.29
DJ24-3-24	924126-36	24	double end	36"	5.89
DJ40-1	924132-12	40	single end	12"	5.89
DJ40-2	924132-24	40	single end	24"	6.79
DJ40-3	924132-36	40	single end	36"	7.69
DJ40-1-40	924136-12	40	double end	12"	10.95
DJ40-2-40	924136-24	40	double end	24"	11.89
DJ40-3-40	924136-36	40	double end	36"	12.79

STANDARD DB25 SERIES CABLES

Now you can order DB25 P or S connectors with the cable necessary to fit your application. Choose from our standard flat cable in 4 foot lengths. **Call today.**

STANDARD CABLES

Part No.	Cable Length	Connectors	Price
DB25P-4	4 feet	1-DB25P	$ 9.95 ea.
DB25S-4	4 feet	1-DB25S	10.95 ea.
DB25P-4-P	4 feet	2-DB25P	16.95 ea.
DB25P-4-S	4 feet	1-DB25P/1-DB25S	17.95 ea.
DB25S-4-S	4 feet	2-DB25S	18.95 ea.

$10.00 Minimum Order — U.S. Funds Only
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7/82

INTERSIL

*Evaluation Kits

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter CA	12.95
7217AIPI	4-Digit LED Up/Down Counter CC	14.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

74C00	.39	74C95	1.59	74C221	1.95
74C02	.39	74C107	1.89	74C240	2.25
74C04	.39	74C151	2.95	74C244	2.25
74C08	.39	74C154	3.95	74C373	2.49
74C10	.39	74C157	2.25	74C374	2.59
74C14	.75	74C160	1.69	74C901	.69
74C20	.39	74C161	1.60	74C903	.69
74C30	.39	74C162	1.49	74C911	10.95
74C32	.39	74C163	1.69	74C912	10.95
74C42	1.39	74C164	1.59	74C915	1.69
74C48	1.95	74C173	1.39	74C917	10.95
74C73	.79	74C174	1.39	74C922	5.49
74C74	.79	74C175	1.19	74C923	5.75
74C85	1.95	74C192	1.69	74C925	7.50
74C86	.99	74C193	1.69	74C926	7.50
74C89	6.95	74C195	1.59	80C95	.79
74C90	1.29			80C97	.79
74C93	1.29				

LINEAR

LH0002CN	6.85	LM340T-5	1.25	NE571N	3.95
LM10CLH	4.50	LM340T-12	1.25	LM703CN	.89
LM11CLH	4.75	LM340T-15	1.25	LM709N	.29
LH0070-OH	4.95	LM341P-5	.75	LM710N	.79
TL071CP	.79	LM341P-12	.75	LM711N	.79
TL072CP	1.39	LM341P-15	.75	LM723N	.69
TL074CN	2.49	LM342P-5	.69	LM733N	1.00
LH0082CD	35.80	LM342P-12	.69	LM739N	1.19
TL082CP	1.19	LM342P-15	.69	LM741CN	.35
TL084CN	2.19	LM348N	1.25	MC1741SCG	3.00
LH0094CD	36.80	LM350K	5.75	LM747N	.79
LM300H	.99	LF351N	.60	LM748N	.59
LM301CN	.35	LF353N	1.00	LM1014N	2.75
LM302H	1.95	LF355N	1.10	LM1310N	1.95
LM304H	1.95	LF356N	1.10	LM1458CN	.59
LM305H	.99	LM358N	1.00	LM1488N	1.25
LM307CN	.45	LM359N	1.79	LM1489N	1.25
LM308CN	1.00	LM370N	4.49	LM1496N	1.95
LM309H	1.95	LM373N	3.25	LM1556V	1.75
LM309K	1.25	LM377N	2.95	LM1800N	2.95
LM310CN	1.75	LM380N	1.25	LM1871N	5.49
LM311/CN	.90	LM381N	1.95	LM1872N	5.49
LM312H	2.49	LM382N	1.79	LM1877N-9	3.25
LM317MP	1.15	LM384N	1.95	LM1889N	3.20
LM317T	1.75	LM386N-3	1.29	LM1896N	1.75
LM317K	3.95	LM387N	1.45	LM2002T	1.49
LM318CN	1.95	LM389N	1.35	LM2877P	2.05
LM319N	1.95	LM392N	.69	LM2878P	2.25
LM320K-5	1.35	LF398N	4.00	LM2896P-1	2.25
LM320K-12	1.35	LM399H	5.00	LM3189N	2.95
LM320K-15	1.35	TL494CN	4.49	LM3900N	.69
LM320T-5	1.25	TL496CP	1.75	LM3905CN	1.25
LM320T-12	1.25	NE510A	6.00	LM3909N	1.15
LM320T-15	1.25	NE529A	4.95	LM3914N	3.95
LM323K	5.95	NE531H	3.95	LM3915N	3.95
LM324N	.99	NE536H	6.00	LM3916N	3.95
LM329DZ	.65	NE540H	6.00	RC4136N	1.25
LM331N	3.95	NE544N	4.95	RC4151NB	3.95
LM334Z	1.30	NE550A	1.30	RC4194TK	6.95
LM335Z	1.40	NE555V	.39	RC4195TK	5.49
LM336Z	1.75	LM556N	.99	LM4500A	3.25
LM337T	1.95	NE564N	3.95	ICL8038B	4.95
LM337MP	1.15	LM565N	1.25	LM13080N	1.29
LM338K	6.95	LM566CN	1.95	LM13600N	1.49
LM339N	.99	LM567V	1.25	75138N	1.95
LM340K-5	1.35	NE570N	4.95	75450N	.89
LM340K-12	1.35			75451CN	.39
LM340K-15	1.35			75492	.89

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
,01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
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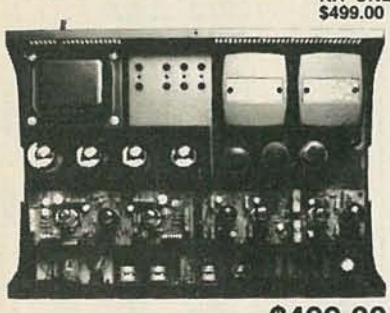

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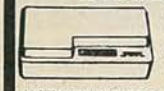

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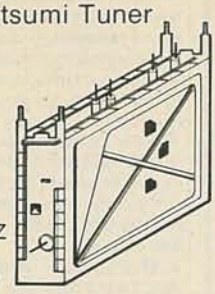

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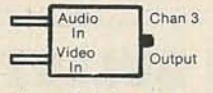

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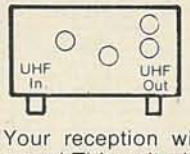

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Your reception will dramatically improve! This unit will enable you to pull in signals you never knew were there!

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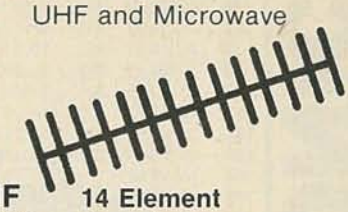

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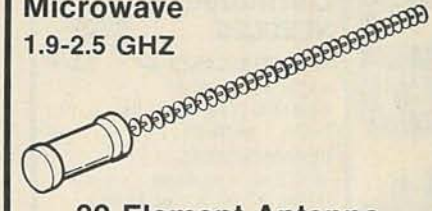

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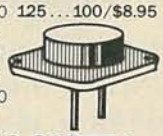

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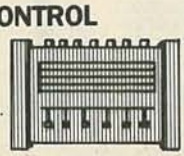

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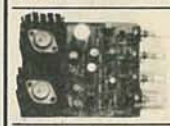

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Sound Effects Kit $18.50

The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new **Texas Instruments SN76477 Sound Chip**, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator, Level Comparator, and Multiplex Oscillator for even more versatility. The 3 ½" x 5" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate **Explosions, Phasor Guns, Steam Trains,** or almost an infinite number of **other sounds**. The unit has a multiple of applications. The low price includes all parts, assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100MW amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included). **76477 is included.** Available separately for **$3.15** each.

7 Watt Audio Amp Kit $6.95

SMALL, SINGLE HYBRID IC AND COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP. LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT.

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SEE SPECIAL WINTER PRICES BELOW

The Super Music Maker
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$24.95
(Basic Kit)
Does not include speaker, switches or 2708 ROM.

Now you can play hundreds of songs using the Bullet **Super Music Maker.** The unit **features a single factory programmed microprocessor IC** that comes with 20 pre-programmed short tunes. By adding the additional PROMS (2708's) the system can be expanded to play up to **1000 notes per PROM.** Just think ... a compact electronic instrument that will play dozens, hundreds or even thousands of selections of music. The kit comes with **all electronic components (less the PROM),** and a drilled, plated and screened PC Board which measures 4" x 4¾". The **7 watt amplifier** section is on the same PC board and drives an 8 ohm speaker (not included), from a whisper to ear splitting volume. Since the unit works on **12 VDC** or **12 VAC**, vehicle or portable operation is possible. **What do you get for $24.95? Everything but a speaker, transformer, case, switches,** and **PROM.** Additional 2708 albums containing popular tunes are available for **$9.95** each or you can program your own PROMS using information provided with the kit instructions. Lists of available PROM albums are available on request. *(Note: Unit plays electronic music one note at a time, it is not possible to play chords or a melody with harmony simultaneously.)*

- Envelope control gives decay to notes.
- On board inverter allows single voltage (+12) operation.

OPTIONAL ACCESSORIES

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(Can be **directly soldered** to PC Bd. to access tunes)
Rotary Switches Two 5 position 2.50/set
(For **remote wiring** to PC Bd. to access tunes)
Attractive Tan Plastic Case 6.50
Wallplug Transformer 3.00
(For operation on 117VAC house voltage)

SPECIAL WINTER PRICES

1. Super Music Maker with case and two 5-position rotary switches $32.00
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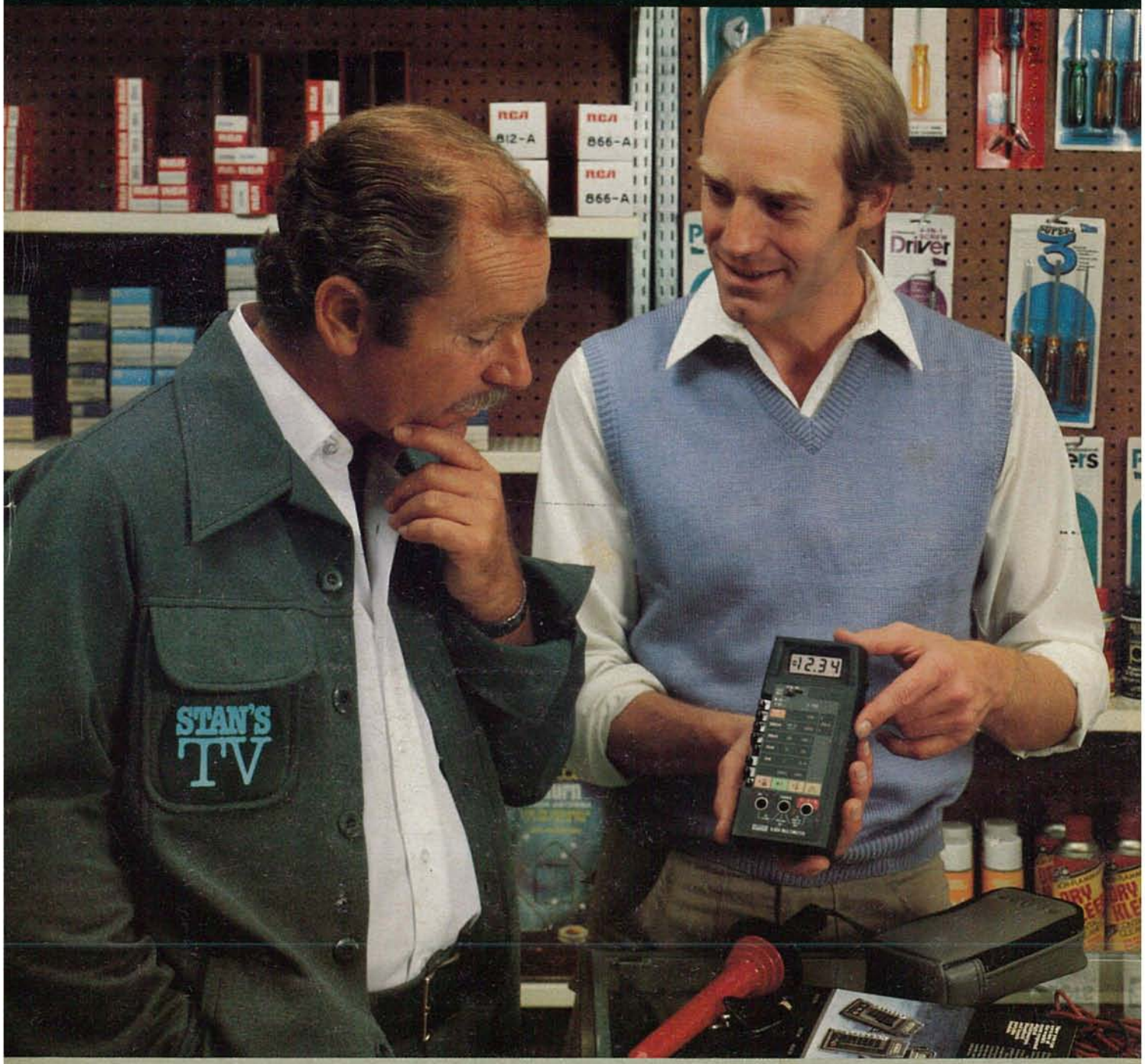

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