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ON APRIL 24TH 1981 A PROFESSIONAL INDEPENDENT TESTING LABORATORY PROVED K40 THE HIGHEST PERFORMANCE RADAR DETECTOR IN THE WORLD!

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2 THE BRAND NEW K40 RADAR DETECTOR USING A UNIQUE WAVE GUIDE COUPLED DIE CAST ANTENNA DETECTED X BAND RADAR AN AVERAGE OF 54% FURTHER THAN ALL OTHER DETECTORS AND 67% FURTHER ON THE K BAND FREQUENCY.

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K40	2.96 MILES
ESCORT	2.30 MILES
GUL	2.28 MILES
BEL	2.52 MILES
RADAR INTERCEPTOR	1.92 MILES
WHISTLER Q1000	1.43 MILES
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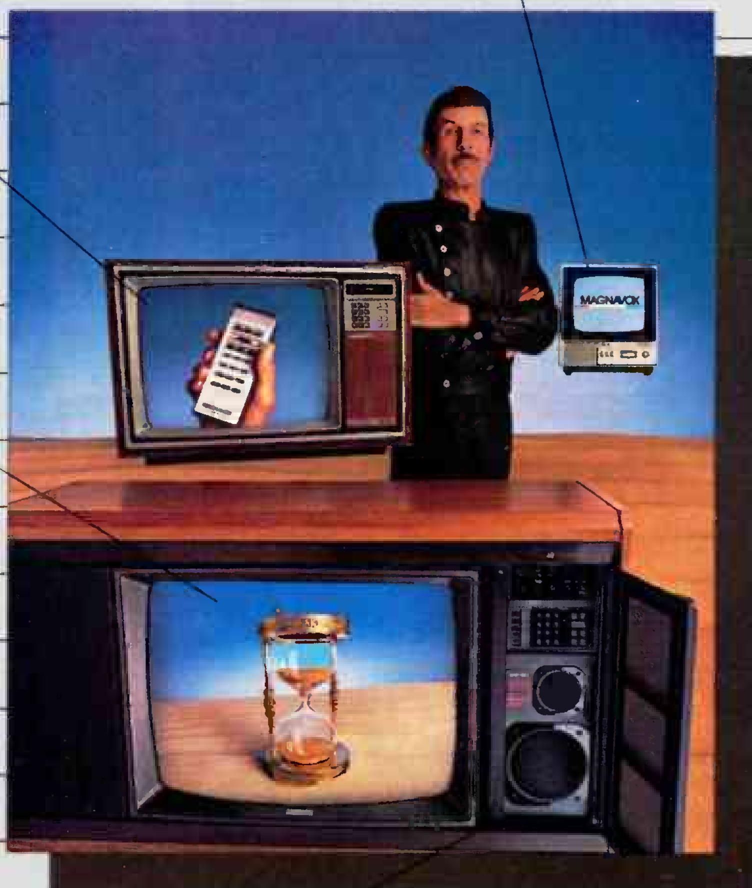
Magnavox model 4012, 9-inch diagonal measurement AC/DC color portable with electronic tuning wheel and dial scale indicator.

Magnavox model 4265, 19-inch diagonal measurement Star System. All Star System sets give you infrared remote control, 105-channel capability, automatic switching between two channels, display time of day and channel number on TV screen.

Magnavox. A picture you can rely on time after time.



TELEVISIONARY.

Magnavox sees the next stage of televiewing with you as the participant as well as the recipient.

For that, you will need the most reliable color television possible.

And now Magnavox Star* System color television sets combine advanced design concepts, high technology and new manufacturing systems to deliver the highest level of reliability in Magnavox history.

Magnavox. Television as visionary as tomorrow. With a picture as reliable as it is bright and clear.

Time after time.

Magnavox model 5260, 25-inch diagonal measurement Star System. This set even has expanded range high-fidelity sound.

TV pictures and wood-grain cabinets simulated.
All models shown are Star Systems except model 4012.

MAGNAVOX

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Synthesized Hand-Held Scanner!

Chances are the police, fire and weather emergencies you'll read about in tomorrow's paper are coming through on a scanner right now. All scanners sold by **Communications Electronics** bring the real live excitement of action news into your home or car. With your scanner, you can monitor the exciting two-way radio conversations of police and fire departments, intelligence agencies, mobile telephones, energy/oil exploration crews, drug enforcement agencies and more.

Some scanners can even monitor aircraft transmissions! You can actually hear the news *before* it's news. If you do not own a scanner for yourself, now's the time to buy your new scanner from **Communications Electronics**. Choose the scanner that's right for you, then call our *toll-free* number to place your order with your Master Card or Visa. A scanner is an excellent holiday gift.

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

NEW! Bearcat®† 350

The Ultimate Synthesized Scanner!

Allow 30-60 days for delivery after receipt of order due to the high demand for this product.

List price $599.95/**CE price $419.00**

7-Band, 50 Channel • Alpha-Numeric • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC

Bands: 30-50, 118-136 AM, 144-174, 421-512 MHz.

The new *Bearcat* 350 introduces an incredible breakthrough in synthesized scanning: Alpha-Numeric Display. Push a button—and the Vacuum Fluorescent Display switches from "numeric" to word descriptions of what's being monitored. 50 channels in 5 banks. Plus, Auto & Manual Search, Search Direction, Limit & Count. Direct Channel Access. Selective Scan Delay. Dual Scan Speeds. Automatic Lockout. Automatic Squelch. Non-Volatile Memory. Reserve your *Bearcat* 350 today!

Bearcat® 300

List price $549.95/**CE price $339.00**

7-Band, 50 Channel • Service Search • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC

Bands: 32-50, 118-136 AM, 144-174, 421-512 MHz.

The *Bearcat* 300 is the most advanced automatic scanning radio that has ever been offered to the public. The *Bearcat* 300 uses a bright green fluorescent digital display, so it's ideal for mobile applications. The *Bearcat* 300 now has these added features: Service Search, Display Intensity Control, Hold Search and Resume Search keys, Separate Band keys to permit lock-in/lock-out of any band for more efficient service search.

NEW! Bearcat® 350

Bearcat® 250

List price $429.95/**CE price $269.00**

6-Band, 50 Channel • Crystalless • Searches Stores • Recalls • Digital clock • AC/DC Priority Channel • Delay • Count Feature

Frequency range 32-50, 146-174, 420-512 MHz.

The *Bearcat* 250 performs any scanning function you could possibly want. With push button ease you can program up to 50 channels for automatic monitoring. Push another button and search for new frequencies. There are no crystals to limit what you want to hear. A special search feature of the *Bearcat* 250 actually stores 64 frequencies and recalls them, one at a time. Overseas customers should order the *Bearcat* **250FB** at $379.00 each. This model has 220 V AC/12 V DC power supply and 66-88 MHz low band coverage.

NEW! Bearcat® 20/20

List price $449.95/**CE price $279.00**

7-Band, 40 Channel • Crystalless • Searches AM Aircraft and Public Service bands • AC/DC Priority Channel • Direct Channel Access • Delay

Frequency range 32-50, 118-136 AM, 144-174, 420-512 MHz.

The *Bearcat* 20/20 automatic scanning radio replaces the *Bearcat* 220 and monitors 40 frequencies from 7 bands, including aircraft. A two-position switch, located on the front panel, allows monitoring of 20 channels at a time.

Bearcat® 210XL

List price $349.95/**CE price $219.00**

6-Band, 18 Channel • Crystalless • AC/DC

Frequency range: 32-50, 144-174, 421-512 MHz.

The *Bearcat* 210XL scanning radio is the second generation scanner that replaces the popular *Bearcat* 210 and 211. It has almost twice the scanning capacity of the *Bearcat* 210 with 18 channels plus dual scanning speeds and a bright green fluorescent display. Automatic search finds new frequencies. Features scan delay, single antenna, patented track tuning and more!

Bearcat® 160

List price $299.95/**CE price $184.00**

5-Band, 16 Channel • AC only • Priority Dual Scan Speeds • Direct Channel Access

Frequency range: 32-50, 144-174, 440-512 MHz.

Would you believe...the *Bearcat* 160 is the least expensive *Bearcat* crystalless scanner.

This scanner presents a new dimension in scanning form and function. Look at the smooth keyboard. No buttons to punch. No knobs to turn. Instead, finger-tip pads provide control of *all* scanning operations, including On/Off, Volume and Squelch. Of course the *Bearcat* 160 incorporates other advanced *Bearcat* features such as Priority, Direct Channel Access, Dual Scan Speeds, Lockout, Scan Delay and more.

NEW! Bearcat® 100

The first no-crystal programmable handheld scanner.

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

List price $449.95/**CE price $299.00**

8-Band, 16 Channel • Liquid Crystal Display Search • Limit • Hold • Lockout • AC/DC

Frequency range: 30-50, 138-174, 406-512 MHz.

The world's first no-crystal handheld scanner has compressed into a 3" x 7" x 1¼" case more scanning power than is found in many base or mobile scanners. The *Bearcat* 100 has a full 16 channels with frequency coverage that includes all public service bands (Low, High, UHF and "T" bands), the 2-Meter and 70 cm. Amateur bands, *plus* Military and Federal Government frequencies. It has chrome-plated keys for functions that are user controlled, such as lockout, manual and automatic scan. Even search is provided, both manual and automatic. Wow...what a scanner!

The *Bearcat* 100 produces audio power output of 300 milliwatts, is track-tuned and has selectivity of better than 50 dB down and sensitivity of 0.6 microvolts on VHF and 1.0 microvolts on UHF. Power consumption is kept extremely low by using a liquid crystal display and exclusive low power integrated circuits.

Included in our low CE price is a sturdy carrying case, earphone, battery charger/AC adapter, six AA ni-cad batteries and flexible antenna. For earliest delivery from CE, reserve your *Bearcat* 100 today.

Bearcat® 5

List price $134.95/**CE price $94.00**

4-Band, 8 Crystal Channels • Lockout • AC only

Frequency range: 33-50, 146-174, 450-508 MHz.

The *Bearcat* 5 is a value-packed crystal scanner built for the scanning professional — at a price the first-time buyer can afford. Individual lockout switches. Order one crystal certificate for each channel.

Bearcat® Four-Six ThinScan™

List price $189.95/**CE price $124.00**

Frequency range: 33-47, 152-164, 450-508 MHz.

The incredible, *Bearcat* Four-Six Thin Scan™ is like having an information center in your pocket. This four band, 6 channel crystal controlled scanner has patented Track Tuning on UHF. Scan Delay and Channel Lockout. Measures 2¾ x 6¼ x 1." Includes rubber ducky antenna. Order crystal certificate for each channel. Made in Japan.

TEST ANY SCANNER

Test any scanner purchased from **Communications Electronics**™ for 31 days before you decide to keep it. If for any reason you are not completely satisfied, return it in original condition with all parts in 31 days, for a prompt refund (less shipping/handling charges and rebate credits).

Fanon Slimline 6-HLU

List price $169.95/**CE price $109.00**

Low cost 6-channel, 4-band scanner!

The *Fanon* Slimline 6-HLU gives you six channels of crystal controlled excitement. Unique Automatic Peak Tuning Circuit adjusts the receiver front end for maximum sensitivity across the entire UHF band. Individual channel lockout switches. Frequency range 30-50, 146-175 and 450-512 MHz. Size 2¾ x6¼ x 1." Includes rubber ducky antenna. Order crystal certificates for each channel. Made in Japan.

Fanon Slimline 6-HL

List price $149.95/**CE price $99.00**

6-Channel performance at 4-channel cost!

Frequency range: 30-50, 146-175 MHz.

If you *don't* need the UHF band, get this model and save money. Same high performance and features as the model HLU without the UHF band. Order crystal certificates for each channel. Made in Japan.

OTHER SCANNERS & ACCESSORIES

NEW! **Regency**®‡ **D810** Scanner	$319.00
NEW! **Regency**® **D300** Scanner	$219.00
NEW! **Regency**® **D100** Scanner	$169.00
NEW! **Regency**® **H604** Scanner	$129.00
Regency® **M400** Scanner	$259.00
Regency® **M100** Scanner	$199.00
Regency® **R1040** Scanner	$149.00
SCMA-6 Fanon Mobile Adapter/Battery Charger	$49.00
CHB-6 Fanon AC Adapter/Battery Charger	$15.00
CAT-6 Fanon carrying case with belt clip	$15.00
AUC-3 Fanon auto lighter adapter/Battery Charger	$15.00
PSK-6 Base Power Supply/Bracket for SCMA-6	$20.00
SP50 *Bearcat* AC Adapter	$9.00
SP51 *Bearcat* Battery Charger	$9.00
SP58 *Bearcat* 4-6 ThinScan™ carrying case	$12.00
MA506 *Regency* carrying case for H604	$15.00
FB-E Frequency Directory for Eastern U.S.A.	$12.00
FB-W Frequency Directory for Western U.S.A.	$12.00
FFD Federal Frequency Directory for U.S.A.	$12.00
TSG "Top Secret" Registry of U.S. Government Freq.	$10.00
B-4 1.2 V AAA Ni-Cad batteries (set of four)	$9.00
A-135cc Crystal certificate	$3.00

Add $3.00 shipping for all accessories ordered at the same time.

INCREASED PERFORMANCE ANTENNAS

If you want the utmost in performance from your scanner, it is essential that you use an external antenna. We have six base and mobile antennas specifically designed for receiving all bands. Order **#A60** is a magnet mount mobile antenna. Order **#A61** is a gutter clip mobile antenna. Order **#A62** is a trunk-lip mobile antenna. Order **#A63** is a ¾ inch hole mount. Order **#A64** is a ⅜ inch snap-in mount, and **#A70** is an all band base station antenna. All antennas are $35.00 and $3.00 for UPS shipping in the continental United States.

BUY WITH CONFIDENCE

To ***get the fastest delivery from CE*** of any scanner, send or phone your order directly to our Scanner Distribution Center™ Be sure to calculate your price using the CE prices in this ad. Michigan residents please add 4% sales tax. Written purchase orders are accepted from approved government agencies and most well rated firms at a 10% surcharge for net 10 billing. All sales are subject to availability, acceptance and verification. All sales on accessories 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. Most products that we sell have a manufacturer's warranty. Free copies of warranties on these products are available prior to purchase by writing to CE. International orders are invited with a $20.00 surcharge for special handling *in addition* to shipping charges. All shipments are F.O.B. Ann Arbor, Michigan. No COD's please. Non-certified and foreign checks require bank clearance. Minimum order $35.00.

Mail orders to: **Communications Electronics**,™ Box 1002, Ann Arbor, Michigan 48106 U.S.A. Add $7.00 per scanner or phone product for U.P.S. *ground* shipping and handling, or $14.00 for faster U.P.S. *air* shipping to some locations. If you have a Visa or Master Card, you may call anytime and place a credit card order. **Order toll free** in the U.S.A. Dial 800-521-4414. If you are outside the U.S. or in Michigan, dial 313-994-4444. **Dealer inquiries invited**. Order without obligation today!

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SPECIAL FEATURES

BUILD THIS

TECHNOLOGY

COMPUTERS

VIDEO

AUDIO

EQUIPMENT REPORTS

DEPARTMENTS

SEASON'S GREETINGS

The editors and staff of Radio-Electronics join in sending holiday greetings and our best wishes for a happy new year

ON THE COVER

CBS's new CX noise-reduction system for records is the latest happening in hi-fi—and the system works! Build our CX decoder and take advantage of the new CX records. They're available now and more are being introduced every day. Turn to page 43.

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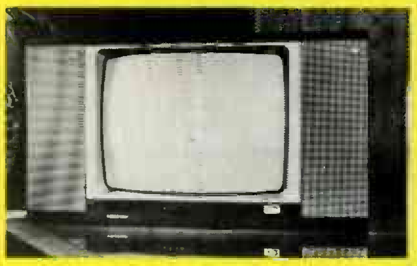
VIDEO ELECTRONICS

DAVID LACHENBRUCH
CONTRIBUTING EDITOR



STEREO TV

A preview of what may be in store for the U.S. occurred in West Germany Sept. 4, when television broadcasting with dual-channel sound began simultaneously with the opening of the huge Internationale Funkausstellung (audio-video) show in Berlin. The new sound system uses two discrete (non-multiplexed) channels, for left-plus-right and 2 × right signals, with 60-dB separation for either stereo, or two completely separate sound channels, and no measurable crosstalk. Currently, dual-channel sound is broadcast on only one of the three West German networks but its coverage extends to about 65% of the population.

That didn't prevent every German TV-manufacturer from introducing a wide variety of TV models with dual-sound capability. Of 21 new color sets introduced by Blaupunkt (see left photo), for example, 19 featured dual sound. Some manufacturers' deluxe TV's had audio amplifiers with outputs of up to 20 watts-per-channel. Designs varied widely from "compact" dual-speaker models no larger than standard monophonic sets, to furniture-styled sets with detachable speakers, and component video systems with floor-standing speakers and high-wattage outputs.

Although "converters" for existing mono sets aren't available as such, most manufacturers offer stereo TV-sound tuners designed for use with a mono TV and a home stereo system, that accomplish the same purpose. Philips added small-screen portable "boom boxes" in both black-and-white and color, with speakers surrounding a central screen. Most of the dual-channel TV's also have earphone jacks that work independently of the speakers. With a dual-language broadcast, one viewer can listen to German sound through the loudspeaker, while another hears the English translation through headphones; who hears which channel depends on the adjustment of the balance control.

Philips, Grundig, and other manufacturers using the European-designed *Video 2000* VCR-format, already have added stereo video-recorders to their lines. The German stereo system differs from the multiplex technique used in Japan—as a matter of fact, it's being used as a weapon against Japanese imports. Patents on the system are held jointly by the seven West German TV manufacturers, who have decided not to license imports before 1983. However, Sony stereo TV's are appearing on the German market; that is because Sony owns a plant in West Germany and is also one of the seven patent-holders.

SELF-PROGRAMMING VCR

Programmable VCRs are great, but even technically proficient viewers have a problem setting them up. So how about an attachment that simply "reads" the program listing in newspaper or magazine? That's exactly what ITT's German consumer electronics subsidiary, Standard Elektrik Lorenz was showing at the Berlin fair. The program-reader is a small box, with a set of LCD displays, that has an attached small light-pen. Each program listing in a magazine or newspaper is followed by a series of vertical lines resembling the product codes used for supermarket checkout. If the viewer comes across a program he wishes to tape, he merely runs the light pen across the code and the VCR is set up (see right photo). To check the setting, the attachment has readouts showing date, channel, and program starting and ending time. The ending time can be extended manually in case the program runs longer than expected. ITT says it has applied for U.S. patents, and that both Philips and Grundig also hope to manufacture the program reader.

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NEW "ILLUMINATOR"™* MOBILE CB ANTENNA

Hats-off to another engineering/styling breakthrough from Armstrong . . . the brand new "ILLUMINATOR"™ CB antenna.

This lighted antenna looks classy . . . like a luxury car coach lamp. It hooks up to your car's tail light in seconds with a nifty connector. It has a 5000 hour lamp, plus all the engineering extras from Armstrong like a quiet shunt-fed coil . . . copper plated stainless steel whip . . . UNI-AXIS™ balljoint tilts, 45° in all directions . . . water-tight quick disconnect load with protective rain cap . . . triple-chrome-plated solid machined brass fittings . . . a 24 month Warranty on even consumer installations.

Your new "ILLUMINATOR"™ antenna will refuse to light-up if it isn't properly grounded. Proper grounding is essential for optimum antenna operation, so the "ILLUMINATOR"™ offers a visual check on your installation.

CLEAR-FLEX™ coax...

Another styling first from Armstrong . . . eighteen feet of CLEAR-FLEX™ 58-AU type coax cable is furnished with every "ILLUMINATOR"™ antenna. It looks as highly engineered as it really is with a stranded inner conductor and in-line coax connectors for simple, solderless installation.

Just call our toll free number 800-435-1855 for the name of your local dealer and see the new "ILLUMINATOR"™ today.

*Patent pending

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WHAT'S NEWS

Video bank service tested in California

Selected customers of the First Interstate Bank of California are participating in a Day and Night Video Banking Service, a six-month electronic home-banking pilot program of the bank.

Customers can use the system to transfer funds between any number of their accounts. They can also pay bills, authorizing the bank to transfer funds from their accounts direct to those of merchants registered with the service. The customer can also receive immediate information on balances of check-accounts, savings accounts, or certificates of deposit. The bank also posts general information, incuding certificate-of-deposit interest rates and locations of its automated teller machines.

Customers use Radio Shack TRS-80 Videotex terminals and videotex-equipped TRS-80 Color Computers, on free loan from the bank. According to a bank spokesman, the equipment was selected for its off-the-shelf availability and nationwide maintenance network, and because it is equipment that an average bank customer would consider buying.

Individual account security is maintained with one-way password coding and individual-customer ID numbers. To increase security, repeated unsuccessful attempts to access an account result in an automatic lockout that requires manual resetting to put the account back into action.

IBM's entry in market boosts small computers

IBM's recent announcement of a personal desktop computer—and thereby placing its seal of approval on small computers—is expected by some to spark growth in the personal-computer field. That field is divided roughly into two levels—small business computers priced from $5,000 to $20,000, and personal computers, priced under $10,000.

IBM now has a 26% share in the small business computer market, and a 2.6% share of the worldwide personal computer market; but it may be some time before it can increase its portion of the small personal computer market significantly. According to market research analyst Karen Horowitz, of Venture Development Corp., Wellesly, MA, "IBM will have to strengthen its positions in distribution channels and applications software before Radio Shack and Apple have anything to worry about."

IBM will sell the little computers through its own direct sales force, IBM's retail stores, and independent retailers. The direct sales force is geared to selling to large corporations, and IBM will have to set up a network of dealers. That will take time. Both Apple and Radio Shack have elaborate channels of distribution that have taken several years to establish.

A shortage of software may be another weakness, says Karen Horowitz. Applications programs will have to be made available for the small business, educational institutions, and the home, as well as for large companies.

RCA VideoDiscs to use CX noise reduction

The new RCA "CED" stereo videodisc system, scheduled for introduction in 1982, will use the CX noise-reduction system, under license from CBS. The stereo discs will be fully compatible with the monophonic "CED" player models introduced in 1981. Earlier in the year MGM/CBS Home Video announced that it will use the CX process in its stereo "CED" discs.

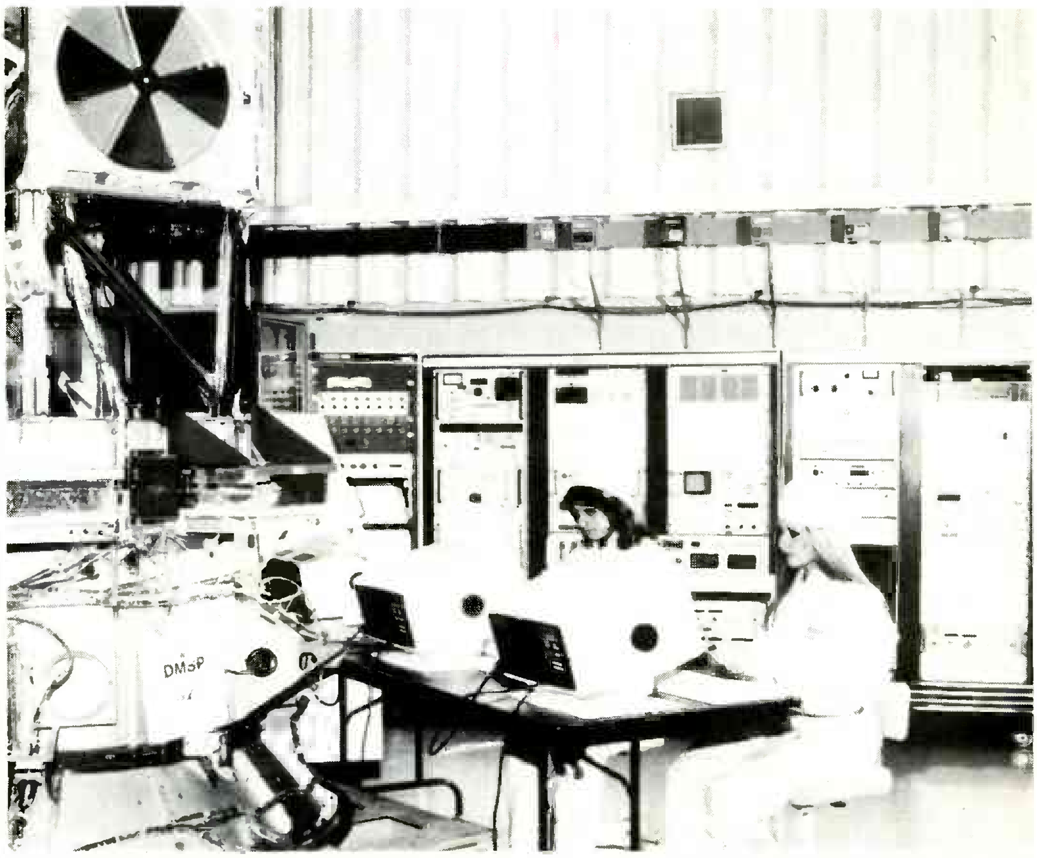
CX is a compatible audio system that eliminates surface noise and increases the dynamic range of audio recordings by 20 dB, resulting in a range of nearly 85 dB—comparable to the sound of a live concert.

For more on CX, see page 63 of the November 1981 issue of Radio-Electronics and page 43 in this issue.

Performance specifications for videodisc applications of CX will

continued on page 8

WEATHER SATELLITE



RCA ENGINEERS JANISE BALDO AND PAT SAITTA MAKE ELECTRICAL TESTS on a Block 5D-a spacecraft (left). The spacecraft will become part of the Air Force's Defense Meteorological Satellite Program, which provides weather information for the U.S. military and civilian users. The site is the RCA Astro-Electronics laboratory in Princeton, NJ, where RCA recently added a wide range of data-processing equipment to its testing facilities.

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YOU ALREADY OWN HALF OF THE WORLD'S MOST ADVANCED HOME ENTERTAINMENT SYSTEM.

You're already halfway to Magnavision® right now. Because all you have to do is plug it into your present color TV set.

Magnavision is a turntable. A *video* turntable as well as an audio one. It plays discs that show pictures on your TV. With stereo sound capability.

And what pictures. Magnavision delivers a picture that's clearer and crisper than video tape TV, even TV itself. And the Magnavision picture lasts, because the discs are impervious to wear.

See the buttons on the front of the Magnavision unit? They give you total control over what you watch and how you watch it. Consider the possibilities: Reverse. Slow motion. Individual frame-by-frame indexing. More. And you can exercise control from anywhere in the room, since Magnavision Model 8005 (shown here) gives you a full-feature remote control.

AMAZING: PICTURES WITH STEREO SOUND.
Magnavision even gives you high-fidelity stereo sound.

Just run it through your present stereo system and choose from one of the many stereo videodiscs (concerts, musicals, shows). You can't get stereo with video tape, and stereo TV is years away. Imagine, now you can see Liza Minnelli,* for example, as well as hear her in stereo concert!

All of this wonderwork comes from Magnavision's laser-optical scanner. It is a beam of light that works like an audio player's "needle." But Magnavision's laser-optical scanner has none of the archaic limitations of a needle.

Magnavision is full of ideas. It can be a learning machine as well as an entertainment source. Many of the discs are interactive. You can carry on a dialogue with them. *How To Watch Pro Football*†, *The First National Kidisc*†—games, puzzles, questions and answers for your children, *The Master Cooking Course*†, and *Jazzercise*† are just four examples.

You can put as many different kinds of programs on your television screen with Magnavision as you can imagine. Choose from over 120 videodisc albums now. They range from classic movies to new releases. From sports instruction to art gallery tours. From cartoons to concerts. And new programs are continually being developed exclusively for videodiscs.

So put your half of the world's most advanced home entertainment system together with Magnavision soon. *For the name of your nearest dealer, please call toll-free 800-447-4700 (in Illinois, 800-322-4400).*

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MAGNAVISION

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WHAT'S NEWS

continued from page 6

be finalized at the time of product introduction, an RCA spokesman noted.

Digital TV standard for worldwide use?

The European Broadcast Union submitted to the September, 1981, meeting of the International Radio Consultative Committee (CCIR) a proposed set of digital-television standards for studio equipment. The Union hopes that it will be adopted throughout the world. Such a standard is needed because more and more television equipment is going digital. Both picture quality and economy of operation in international transmissions would be enhanced if all units were compatible.

The EBU believes that a world standard would mean less expensive equipment, would benefit international program exchange, and would lead to improvement in the technical quality of programs transmitted from one country to another country with a different system.

In the EBU system, the separate components would be coded, with the luminance component sampled at 13.5 MHz and the two color-difference signals at 6.75 MHz. Thus the system would be called "13.5: 6.75: 6.75."

The Third World Conference of Broadcasting Unions suggested a worldwide standard at its 1980 meeting in Tokyo. In this country, the Society of Moving Picture and Television Engineers has been studying the problem, and the EBU has been coordinating its work with that of the SMPTE. The Organization de la Television Iberoamericana also supports the proposed EBU system. That is considered especially important, because the OTI area contains both the 525- and the 625-line systems.

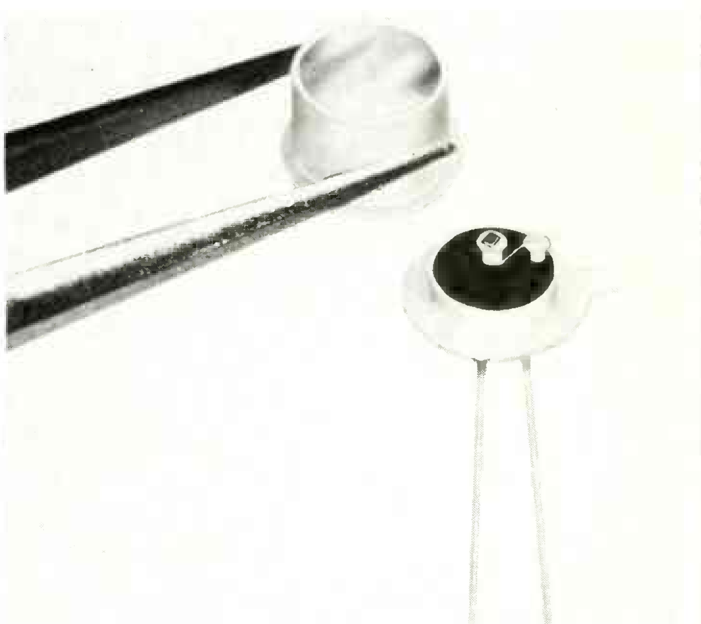
New adapter sleeves make AA cell universal

A solution to the problem of maintaining or replacing large numbers of throwaway batteries of different sizes on toys or appliances is offered by a Long Island inventor. Bert Trattner of Coram, NY, has patented a system consisting of a rechargeable A cell, a recharger, and plastic sleeves that fit the cells to applications that require C or D cells.

The system is said to offer advantages both in economy and convenience. Some high-current motorized toys, says Trattner, will run longer on a single charge of his battery than the complete life of a throwaway D-cell. And whichever device goes dead, the rechargeable cell can replace it, whether AA, C, or D.

Further information may be obtained from Burton Products Corp., 416 Clubhouse Court, Coram, NY 11727.

THE "UNIVERSAL AA CELL" SYSTEM.



THE RCA C30979E PHOTODIODE.

New photodiode detector for optical communications

RCA Electron Optics and Devices has announced a new indium-gallium-arsenide photodiode, developmental type C30979E, for reception between 900 and 1650 nanometers. The new device provides high-speed responsivity and is optimized for detection of 1300 and 1550 nanometer sources. It is intended for use in advanced prototype fiber-optic systems.

The new device is fitted with a removable cap that permits optimum coupling of the fiber to the photosensitive surface of the detector. The expected price will be $450.00 each, with delivery 30 days after receipt of order. Those desiring further information may obtain it by writing to RCA, Box 3200, Somerville, NJ 08876.

Electronic newspaper to fill special gaps

The "electronic newspaper," (teletext, viewdata, and systems of the future) will be confined during the next several years to less than 10% of present newspaper readers—more than 90% will continue with their present "paper" versions, in spite of the number of systems proposed or already being put into use. That is the opinion of International Resource Development, Inc. (IRD)—a Norwalk, Connecticut, consulting and publishing firm—which has published a 186-page report, selling at $985, on the subject.

One of the chief potentials for the electronic news services, IRD believes, lies in providing information in greater depth than the regular newspaper. Thus a subscriber with a videotex terminal or home computer could key in a request for more detailed information on an event than is provided by his regular newspaper. Another possibility is that the terminal user could be provided with a wide range of news on a subject previously selected for special coverage.

The 10% will consist in large part of those who already have viewdata equipment or home computers. However, IRD expects that during the 1980's the market will expand to about $500 million annually, divided about equally between consumer-oriented and business-oriented services.

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Product Family	Product Description	Memorex Part Number (3201-)	CE quant. 100 price per disc ($)	Athana	BASF	Dysan	IBM	Maxell	Nashua	Scotch 3M	Shugart	Syncom	Verbatim	Wabash	Control Data
Flexible Disc 1s	IBM Compatible (128 B/S 26 Sectors)	3060	1.99	473071	53428	800506	2305830	FD1-128	FD-1	740-0	S/A 100	15002	FD34-9000	F111111X	421802
Single-Headed Drives	IBM Compatible (128 B/S 26 Sectors) w/ W.P.N	3062	2.04	—	—	—	—	—	—	740-0	—	—	FD34-9000	—	—
Single-Density Media	IBM Compatible (128 B/S, 26 Sectors) w/ W.P.N. & Hub Ring	3064	2.39	—	—	—	—	—	—	—	—	—	FD34-8000	—	—
	IBM Compatible (128 B/S, 26 Sectors) REVERSIBLE	1729	3.19	473072	54431	—	—	—	FD-2	740/2-0	—	15150	FF34-9000	F171111X	—
	IBM System 6 Compatible	3066	2.04	473077	54561	800509	1669959	—	—	740-0 056	—	15003	FD60-9000	F161111X	—
	IBM Compatible (256 B/S, 15 Sectors)	3109	1.99	473073	—	800584	2305845	—	—	740-3600	—	15005	FD36-9000	F112111X	—
	IBM Compatible (512 B/S, 8 Sectors)	3110	1.99	473074	—	800585	1669954	—	—	—	—	15004	FD60-9000	F113111X	—
	Shugart Compatible, 32 Hard Sector	3015	1.99	470901	53802	101/1	—	FH1-32	FD-132	740-32	S/A-101	15025	FD32-9000	—	421322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3087	2.49	—	54491	—	—	—	—	740-32RH	—	—	—	F37A411X	—
	CPT 8000 Compatible	3045	2.69	—	—	—	—	—	—	—	—	15226	—	—	—
Flexible Disc 1d	IBM Compatible (128 B/S, 26 Sectors)	3090	2.69	474071	54568	3740/1D	—	FD1-128/M2100	FD 1D	741-0	—	—	FD34-8000	F131111X	423002
Single Headed Drives	Soft Sector (128 B/S, 26 Sectors) REVERSIBLE	3093	3.69	—	—	—	—	—	—	—	—	—	—	—	—
Double Density Media	Shugart Compatible 32 Hard Sector	3091	2.69	470801	54598	101/1D	—	FH1-320	—	741 32	S/A-103	15075	FD32-8000	F33A411X	423322
	Wang Compatible 32 Hard Sector w/Hub Ring	3088	3.09	—	—	—	—	—	—	—	—	—	—	—	—
Flexible Disc 2s	Soft Sector (128 B/S 26 Sectors)	3113	3.09	—	54428	800814	1766870	—	—	—	S/A-150	15153	FD10-4026	F121111X	—
Double-Headed Drives	Soft Sector (256 B/S, 15 Sectors)	3106	3.09	473477	54226	800815	2736700	FD2-256D	—	742-0	—	15154	FD10-4015	F122111X	424812
Single Density Media															
Flexible Disc 2d	Soft Sector (Unformatted)	3102	3.09	473485	—	D1150	—	FD2-XDM	FD-2D	743-0	—	15103	DD34 4001	—	425002
Double Headed Drives	Soft Sector (128 B/S, 26 Sectors)	3115	3.09	—	—	—	—	—	—	—	S/A-150	—	—	—	—
Double-Density Media	Soft Sector (256 B/S, 26 Sectors)	3103	3.09	473471	54325	800817	1766872	FD2-256D	—	743 0/256	—	15101	DD34 4026	F144111X	425802
	Soft Sector (512 B/S, 15 Sectors)	3114	3.09	473472	54479	800818	1669044	—	—	743 0/512	—	15100	DD34 4015	F145111X	425612
	Soft Sector (1024 B/S, 8 Sectors)	3104	3.09	473473	54485	800819	1669045	—	—	743-0/1024	—	15102	DD34-4008	F147111X	425622
	32 Hard Sector	3105	3.09	470851	—	101/2D	—	FH2-320	—	743-32	S/A-151	15125	DD32-4000	F34A411X	425322
	Burroughs B 80 Compatible, 32 Hard Sector	3092	3.09	—	—	—	—	—	—	—	—	—	—	F34A611X	—
	Soft Sector (1024 B/S 8 Sectors) w/ Hub Ring	3118	3.49	—	—	—	—	—	—	—	—	—	—	—	—
	Shugart Compatible, 32 Hard Sector	3181	3.39	—	—	—	—	—	—	—	—	—	DD32-4000	—	—
Flexible Disc FD Memorex 651 or Equiv Drive Compatible	FD VI (Vinyl Jacket)	30712003	2.69	470651	—	FDIV	—	—	FD-165	511-0	—	15026	FD65-1000	F61A111X	—
Mini Flexible Disc 1s	Soft Sector (Unformatted)	3401	1.94	475001	54256	104/1	—	MD1	MD 1	744-0	S/A-104	15300	MD525-01	M11A211X	441002
5¼" Single-Headed Drives	10 Hard Sector	3403	1.94	475010	54257	107/1	—	—	MD 110	744-10	S/A-107	15325	MD525-10	M41A211X	441102
Single-Density Media	16 Hard Sector	3405	1.94	475016	54258	105/1	—	MH1	MD 116	744-16	S/A-106	15328	MD525-16	M51A211X	441182
	Soft Sector (Unformatted) w/Hub Ring	3431	2.14	—	—	—	—	—	—	—	—	—	MD525-01	—	—
	10 Hard Sector, w/Hub Ring	3433	2.14	—	—	—	—	—	—	—	—	—	MD525-10	—	—
	16 Hard Sector w/Hub Ring	3435	2.14	—	—	—	—	—	—	—	—	—	MD525-16	—	—
Mini Flexible Disc 1d	Soft Sector (Unformatted)	3417	2.14	—	54646	104/1D	—	—	—	—	—	—	MD525-01	—	—
5¼" Single-Headed Drives	10 Hard Sector	3418	2.14	—	54649	107/1D	—	—	—	—	—	—	MD525-10	—	—
Double Density Media	16 Hard Sector	3419	2.14	—	54652	106/1D	—	—	—	—	—	—	MD525-16	—	—
	Soft Sector (Unformatted) w/Hub Ring	3481	2.34	—	—	—	—	—	—	—	—	—	MD525-01	—	—
	10 Hard Sector w/Hub Ring	3483	2.34	—	—	—	—	—	—	—	—	—	MD525-10	—	—
	16 Hard Sector w/Hub Ring	3485	2.34	—	—	—	—	—	—	—	—	—	MD525-16	—	—
Mini Flexible Disc 2d	Soft Sector (Unformatted)	3421	2.59	—	54624	104/2D	—	—	—	—	S/A-154	—	MD550-01	—	—
5¼" Double-Headed Drives	10 Hard Sector	3423	2.59	—	54627	107/2D	—	—	—	—	S/A-157	—	MD550-10	—	—
Double Density Media	16 Hard Sector	3425	2.59	—	54630	105/2D	—	—	—	—	S/A-155	—	MD550-16	—	—
	Soft Sector (Unformatted) w/Hub Ring	3491	2.79	—	—	—	—	—	—	—	—	—	MD550-01	—	—
	10 Hard Sector w/Hub Ring	3493	2.79	—	—	—	—	—	—	—	—	—	MD550-10	—	—
	16 Hard Sector w/Hub Ring	3495	2.79	—	—	—	—	—	—	—	—	—	MD550-16	—	—

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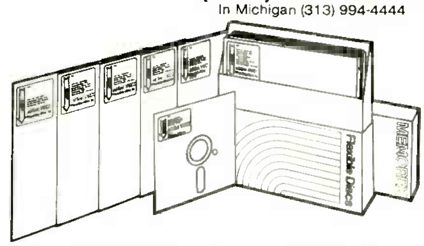

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EDITORIAL

Another New Year

As you read this, 1981 is about to come to its end. In looking back over the last 12 issues of **Radio-Electronics**, I'm amazed at how much technology has advanced, how much of an effect it has had on our day-to-day lives during this past year, and how much potential it has to affect our lives in the future.

Simply looking at the last 12 covers of **Radio-Electronics** is a journey in and of itself. We covered Golka's recreation of Tesla's original high-voltage experiments; flat-panel television; an affordable satellite-TV antenna; cordless telephones; an inside look at videodisc players, and presented a series covering electronics in your next car. We concluded the series describing how to build the Unicorn 1 robot and started a series describing the proposal for a videotex service that is before the FCC. Construction projects included a pay-TV decoder, an analog reverb for your hi-fi, a $60 modem that lets you use your computer to call the time-sharing networks, an experimenter's design station, and many more. We showed you how to explore the 100-GHz region and took a historical look at the development of the integrated circuit. We even presented a comprehensive guide on buying your own computer. Indeed, those are just a sampling of the many articles we published.

Whatever 1982 may bring, you can be sure that **Radio-Electronics** will be there to cover it. And we hope that you will share it with us. For starters, our January issue will contain a comprehensive special section covering video entertainment, including projection TV, videogames, videocassette recorders, videodisc, video accessories, and more.

Our editors and staff, the people who create each issue of **Radio-Electronics**, would like to extend to all of our readers and associates Seasons Greetings and a wish for a happy and prosperious New Year.

Art Kleiman

ART KLEIMAN
Managing Editor

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Cover photo by Robert Lewis

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

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200 Park Ave. S., New York, NY 10003
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ADVERTISING SALES 212-777-6400
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The new Panasonic RF-6300 Command Series PLL synthesized 8-band portable communications receiver, lets you hear the world. The RF-6300 has features such as microcomputer pre-set tuning and PLL quartz synthesized digital tuner. Microcomputer stores up to 12 different frequencies for push-button recall. FM/MW/LW/SW1-5 reception. Manual tuning knob. Wide/Narrow bandwidth selector. Double superheterodyne system. Fast/Slow manual tuning. Built-in quartz digital alarm clock. 5 inch dynamic PM speaker. 3 antennas. Multi-voltage. Detachable AC cord. Operates on 6 "D" batteries (not included). Made in Japan.

RF-4900

Panasonic® RF-4900

List price $549.95/**CE price $389.00**

Bands: MW 525-1610 KHz., SW1-8 1.6-30 MHz. FM 88-108 MHz.

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Panasonic® RF-3100

Allow 30-120 days for delivery after receipt of order due to the high demand for this product.

List price $369.95/**CE price $269.00**

Bands: MW 525-1610 KHz., SW1-29 1.6-30 MHz. FM 88-108 MHz.

The Panasonic RF-3100 portable 31-Band portable radio has PLL Quartz-Synthesizer tuning that "locks" onto SW stations. Operates on AC or battery. SW frequencies from 1.6 to 30 MHz. are in 29 bands. All-band 5-digit frequency readout. Horizontal design with front mounted controls for shoulder strap operation. Double superheterodyne for clean SW reception. BFO pitch and RF gain controls. Separate bass and treble controls. Wide/Narrow bandwidth selector. Meter for tuning and battery strength. LED operation indicator. Meter light switch. 3½" PM dynamic speaker. Comes with detachable shoulder belt. Battery power (8 "D" batteries not included). Made in Japan.

Panasonic® RF-2900

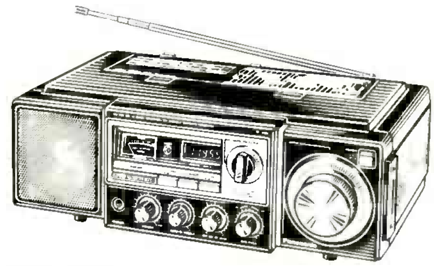
List price $349.95/**CE price $249.00**

Bands: MW 525-1610 KHz., SW1-3 3.2-30 MHz. FM 88-108 MHz.

The Panasonic RF-2900 is a portable five-band shortwave radio with digital five digit fluorescent frequency display. Full coverage from 3.2 to 30 MHz. on SW. Covers SSB and CW. Double superheterodyne receiver. Fast/slow two speed tuning. AFC switch on FM, narrow/wide selectivity switch for AM and SW. FET RF circuit. BFO switch and pitch control. RF gain control. Tuning battery meter. Separate bass/treble tone control. SW calibration control. Dial light switch. Digital display on/off switch. Separate power switch. Detachable dial hood included. Rack type handle. Includes whip antenna and ferrite core antenna, speaker, earphone, recording output jacks, AC line and detachable adjustable shoulder belt. Made in Japan.

Panasonic

Command series



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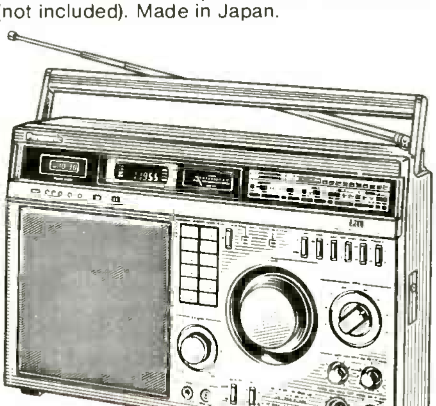

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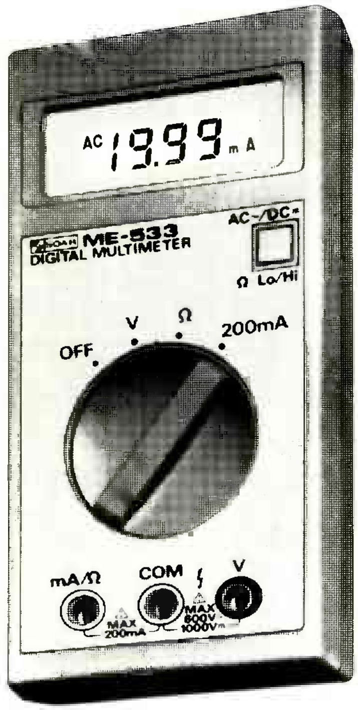

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LETTERS

VERSATILE LIGHT SEQUENCER

I was very pleased to see David Holmes's article on the versatile light sequencer in your June and July 1981 issues of **Radio-Electronics.**

The overall construction was quite simple and straightforward, though one feature—sound-sync-controlled light intensity—could be rewired so that each channel corresponds to a specific range of audio frequencies: channel 1, highs; channel 2, mid-highs; channel 3, mid-lows, channel 4, lows.

To accomplish that, the commons of each opto-isolator (IC8-IC11) should be isolated from each other as shown in Fig. 1 below. Four individual PNP transistors should be used, each with its own filter network for the corresponding frequency.

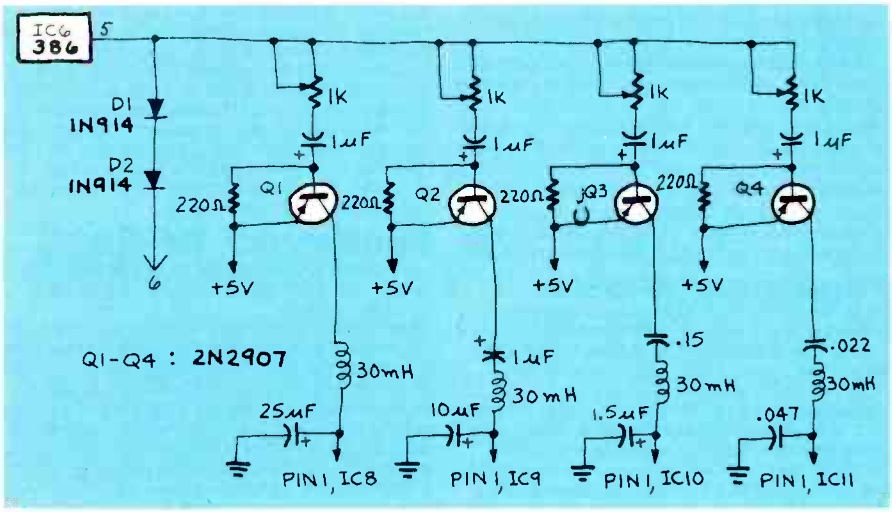

FIG. 1

I hope that suggestion will help make the versatile light sequencer even more versatile for your readers.
JOHN FLEMING,
Turlock, CA

NEGATIVE ION GENERATOR

Thanks for your excellent article on building a negative ion generator (**Radio-Electronics,** July 1981). I have built several, to find out what made them tick. Two points need to be emphasized.

First, the major problem with a negative ion generator is ozone production. Ozone, by and large, seems to be produced by internal high-voltage arcs due to sloppy construction. Any sharp solder joints, wire ends, etc., will tend to discharge to the nearest ground and produce ozone. All solder joints need to be quite round and smooth; all connections need to be as far as possible from ground. The sealed case will help to contain the ozone produced.

Ozone can be quite dangerous. Prolonged exposure, as you may know, can result in serious diseases, such as emphysema.

Second, ordinary sewing needles will not work for long: Early ionizers used them, and they tended to give out in about a year, because the needles become blunt. Surgical stainless steel needles work far better and last much longer. They can be bought at surgical supply houses at a low cost.

Experimenters may be tempted to use other kinds of emitters, such as copper mesh or fuzz. Be careful. You can easily create an ionizer that is spraying off copper, tin, iron, and other molecules, which you might then breathe in. Most manufacturers now use stainless steel needles. There's a good reason: They seem to be both cheap and safe.
GERALD GROW, PhD.
Tallahassee, FL

Many thanks for another fine project ("Negative Ion Generator," July 1981 **Radio-Electronics)**, an interesting research idea that I've had pegged on the board a long while now. I immediately threw one together from loose parts, having all but the high-voltage rectifier, though, as of this writing I cannot comment on its usefulness. The devious simplicity of the unit design is a delight, as I was not enthusiastic about extracting a flyback coil from a junk black-and white TV, which had been my previous intention. Some thoughts occurred during construction, which other readers may find useful.

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The ECG513 HV diode stack appears to cost approximately twice that of a GE-513 equivalent, and SK3443 is an exact replacement, also.

Use a regular number-eight cylinder spark plug wire to connect the coil to the diode. The diode ends fit rather nicely, and if you leave access to the wire through a removable panel or otherwise, the ion generator makes an excellent spark plug dynamic tester and cleaning accessory. Be careful, though; I think that about one minute of higher-frequency discharge will pit the electrodes greatly. That is how I tested the oscillator coil before completing the diode assembly.

Even though free air flow around the emitter needle is essential, the needle should still be isolated from accidental touch by a wire cage at a radius greater than one inch. (Take a lesson from cattle prods and laser guns; an arc shock should not be lethal, but under the skin where body resistance may be less than 100 ohms, it could be pretty rough.)

Output voltage depends heavily upon frequency and duty cycle, as well as the coil ratio, and the transistor life expectancy is dependent as such also.

Your greenhouse plants may like this project.

One question: Does any reader know where to obtain a TI SN76489 sound generator controller? That appears to be an extremely useful microprocessor support IC, which I've had the applications notes to for a long time—but I haven't been able to find one.

STAN K. STEPHENSON II,
Tampa, FL

PIRATE BROADCAST STATIONS

I am mystified by Ben Lane's letter (**Radio-Electronics,** August 1981) commenting upon Robert Grove's well-written and informative article on pirate broadcasting stations, which appeared in the May issue. Nowhere in the article did I find the "leftist rhetoric" that Mr. Lane attributes to it; on the contrary, the article seemed to be in the American spirit of freedom for the individual.

Mr. Lane should remember that it is in the Soviet Union, and other similar countries, that people risk arrest and imprisonment for listening to unauthorized broadcasts. That is not the case in the United States—at least, not yet.

There are two different viewpoints from which to evaluate the FCC: the purely technical, and the political. In the technical coordination of frequency allocation and equipment, they have done a very good job on the average. However, whenever a central agency is given authority to regulate the allocation of anything at all—whether it be airwave usage or street repairs—the possibility of abuse of individual rights will be there.

Consider Mr. Lane's remark: "...amateurs have earned their right to a portion of the spectrum." The hidden point of view lies in the word "earned." Mr. Lane does not sound like someone who believes in inalienable rights, but rather in privileges that must be "earned" before being granted by a benevolent central authority. Now that is a leftist point of view.

If Mr. Lane has been in this game for "almost half a century," he should be aware that it was the amateurs who were using airspace that no one else wanted, and it was they who developed the equipment to open up that airspace—only to have it taken away from them through political considerations involving the FCC. "Earned" indeed!

R.A. (Bob) de FOREST,
McMinnville, OR

UHF-TV RECEPTION

I welcomed your article on improving UHF-TV reception (**Radio-Electronics,** July 1981), but a number of important points were not mentioned. Among them:

1. Never use MIL or JAN RG-59/U or RG-6/U coaxial cable. It is far too lossy and leaky. Use only RG "type" cable having a foam dielectric insulation and a 100% shield made of aluminum foil.

2. Never use cheap coax bought at a discount. Some of the stuff sold in electronics-hobbyist stories is incredibly poor in quality. Spend a few dollars extra for a 100%-sweep-tested coax, such as Belden 9243.

3. Always wrench-tighten connectors for a positive mating and low VSWR.

4. Keep lead-ins as short as possible.

5. Use an antenna having a 75-ohm output whenever possible. That saves the loss of a balun, and eliminates the potential problems thereof.

6. Don't buy an antenna based on meaningless claims of sensitivity based on mileage. Use an accurate field-strength meter to determine the signal intensity, and build the system accordingly.

7. Don't scrimp on quality! A professional-quality UHF antenna system costing $200 will outperform and outlast *any* jury-rig system. If you are in a remote area, you can't afford to be "penny-wise and pound foolish."

Antenna systems share a characteristic in common with lawn-sprinkler systems: If you try to "get by" with a mediocre installation, you'll spend more money in the long run than you would if you had put in a top-quality system in the first place.

ERIC G. LEMMON, Chief Engineer,
VideoTel Enterprises,
Lompoc, CA

USER'S GROUP

I am a subscriber and would like to say how much I enjoy your magazine every month. I work in the industry, and find **Radio-Electronics** very supportive.

I have recently become an owner of the "Dyna Micro" 8080 microcomputer described in the May, June, and July 1976 issues. In the May 1976 issue, a user's group was mentioned, and an address given for those interested. Well, I am interested; but the address is no longer valid.

Do you, or any of your readers know if the user's group still exists and, if so, how to get in touch with it. Any help would be greatly appreciated.

MARK KLAFTER,
St. Petersburg, FL

RADAR DETECTORS

Ordinarily, I would have ignored Mark Recob's reply (**Radio-Electronics,** Sep-

continued on page 107

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CIRCLE 63 ON FREE INFORMATION CARD

SATELLITE/TELETEXT NEWS

GARY ARLEN
CONTRIBUTING EDITOR

GOING UP

Most satellite users don't care where the video goes up, as long as it comes down to their antennas. Nonetheless, there's an increasing eagerness to have a close-to-home satellite uplink especially for business video-users. With that in mind, there are more and more satellite uplinks being built. Several have just gone into service in the Washington DC area, and they will be used for business communications as well as for an increasing number of broadcast and cable-TV network programs, including news and entertainment.

Another new uplink is in Salt Lake City, where Bonnevile Satellite Corp. has installed a steerable 10-meter dish (see photo) in a canyon that is several miles from local TV studios.

TELETEXT STANDARD

Efforts to create a U.S. technical standard for teletext got a substantial boost recently when Telidon Videotex Systems Inc., the American agents for Canada's teletext technology, filed a proposal with the FCC for a "North American Standard." At the same time, a proposal filed last year by CBS, using France's Antiope system, was modified to fall in line with the Telidon format. Technically, some accommodations were made—but it boils down to a compatible system. The revised Antiope proposal and the new Telidon system will also work with the AT&T videotex system unveiled earlier.

The FCC is still considering all of the proposed teletext technologies, including a system suggested by the United Kingdom Teletext Industry Group, based on British technology. A final decision may be months away.

The Canadian-French proposal spells out an ambitious plan for teletext. It recommends that lines 10 through 18 of the vertical blanking interval be allocated for teletext, although lines 10 through 14 will only be used if it is determined that teletext data would not degrade regular video-program signals. The Telidon suggestion calls for a data rate of 5.727272 megabits-per-second and calls for "terminal independence," meaning that varying levels of resolution will be possible, depending on the sophistication of the home user's receiver.

SHIFTING LAUNCH SCHEDULES

Satellite launches are becoming so numerous that you'd think they would be going off regularly. But the sensitive equipment and timing of each launch often leads to delays—and that's what's happened this fall as several scheduled orbits have been pushed back. It started in early September when SBS II, the digital-data bird of Satellite Business Systems, ran into a problem on the launch pad that shoved its date back into October. That change forced a postponement in the launch date of RCA's Satcom III-R, the new satellite that will deliver all-cable programming; that bird was due for late-October launch, but was pushed back to mid-November. In turn Satcom IV, which was scheduled for mid-December launch, now has a January 1982 date.

AROUND THE SATELLITE CIRCUIT

- Western Union has received FCC permission to begin building its sixth satellite, a \$28-million bird due for launch in late 1983. The 24-transponder Westar VI will be built by Hughes Aircraft and is expected to last 10 years. It will operate in the C-band (6/5 GHz).
- How many people are taking advantage of at-home satellite reception? Current estimates put the audience at 10,000 private-home TVRO's, growing at a rate of 1,000 installations per month. That rate will probably pick up in coming years, according to Jonathan Miller, managing editor of Satellite Week, who foresees about 86,000 home-terminals receiving C-band signals by the end of 1983. That figure could triple during the following two years—but will then probably drop off if Direct Broadcast Satellites, using higher-powered Ku-band, go into operation. Those satellites will permit lower-priced reception equipment.
- Global TV Electronics has undercut its previous lowest-priced satellite reception system. They now offer a \$1695 setup, including their *SAT-TEC R2BR* 24-channel receiver, 120°K low-noise amplifier, and plans for a 12-foot spherical "screen" antenna, made from 2×4 lumber, for under \$80.

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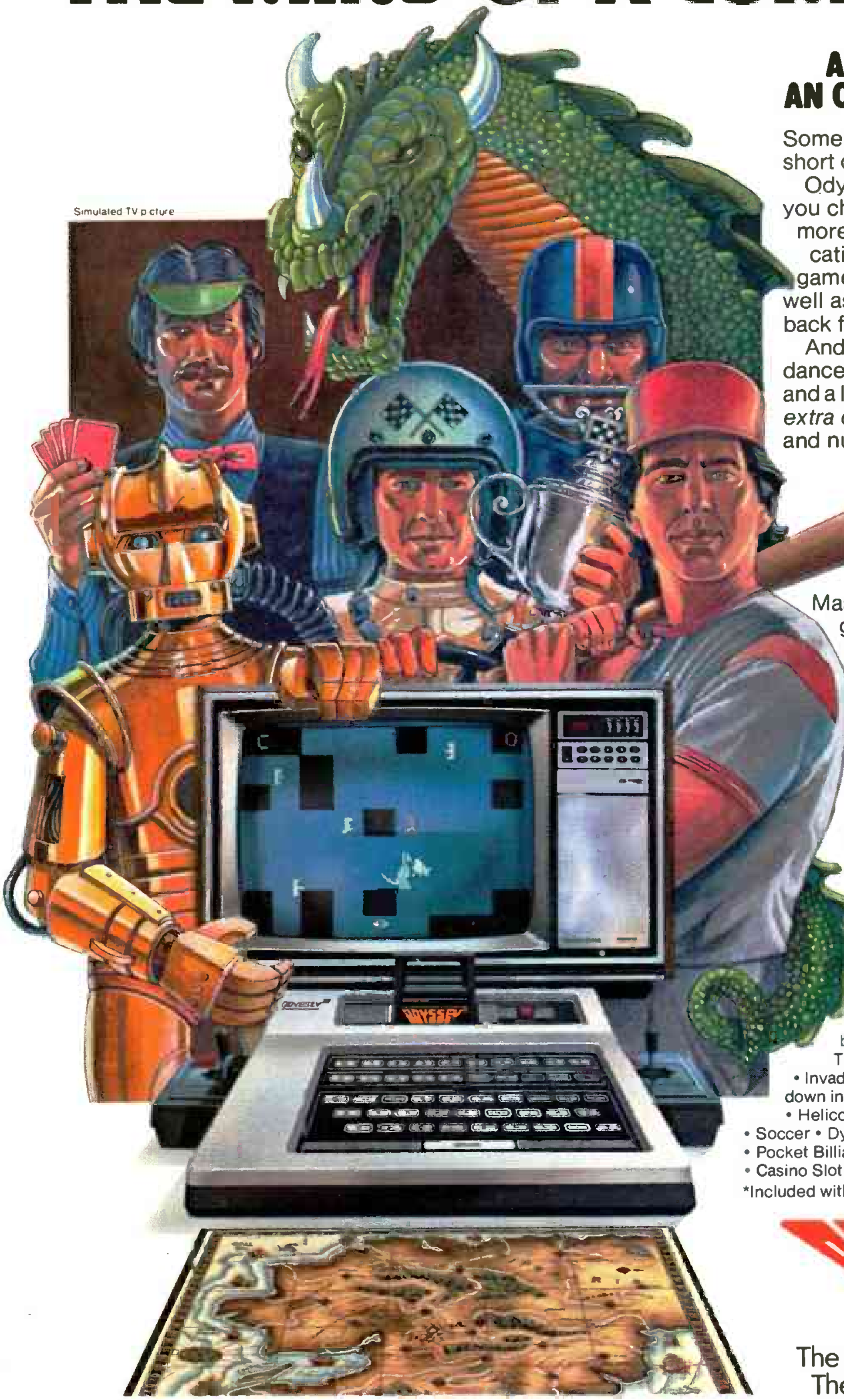

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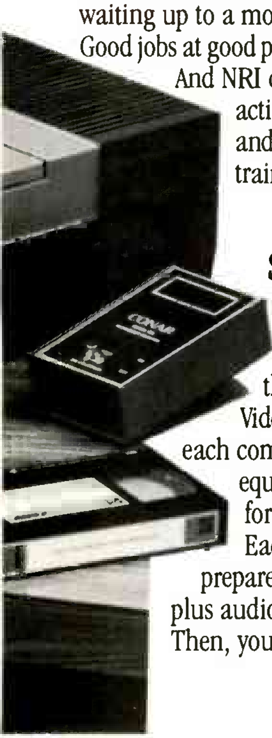

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The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only $39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

So in just a few minutes, with no special skills or tools required, you can upgrade your ZX80 to have all the powerful features of the ZX81. (You'll have everything except continuous display, but you can still use the PAUSE and SCROLL commands to get moving graphics.)

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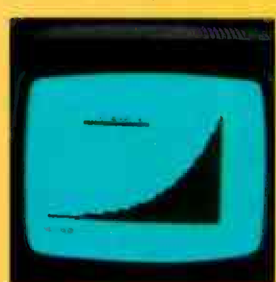

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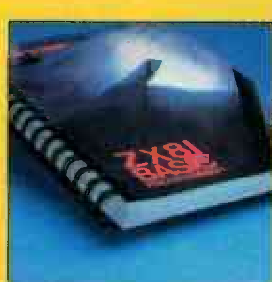

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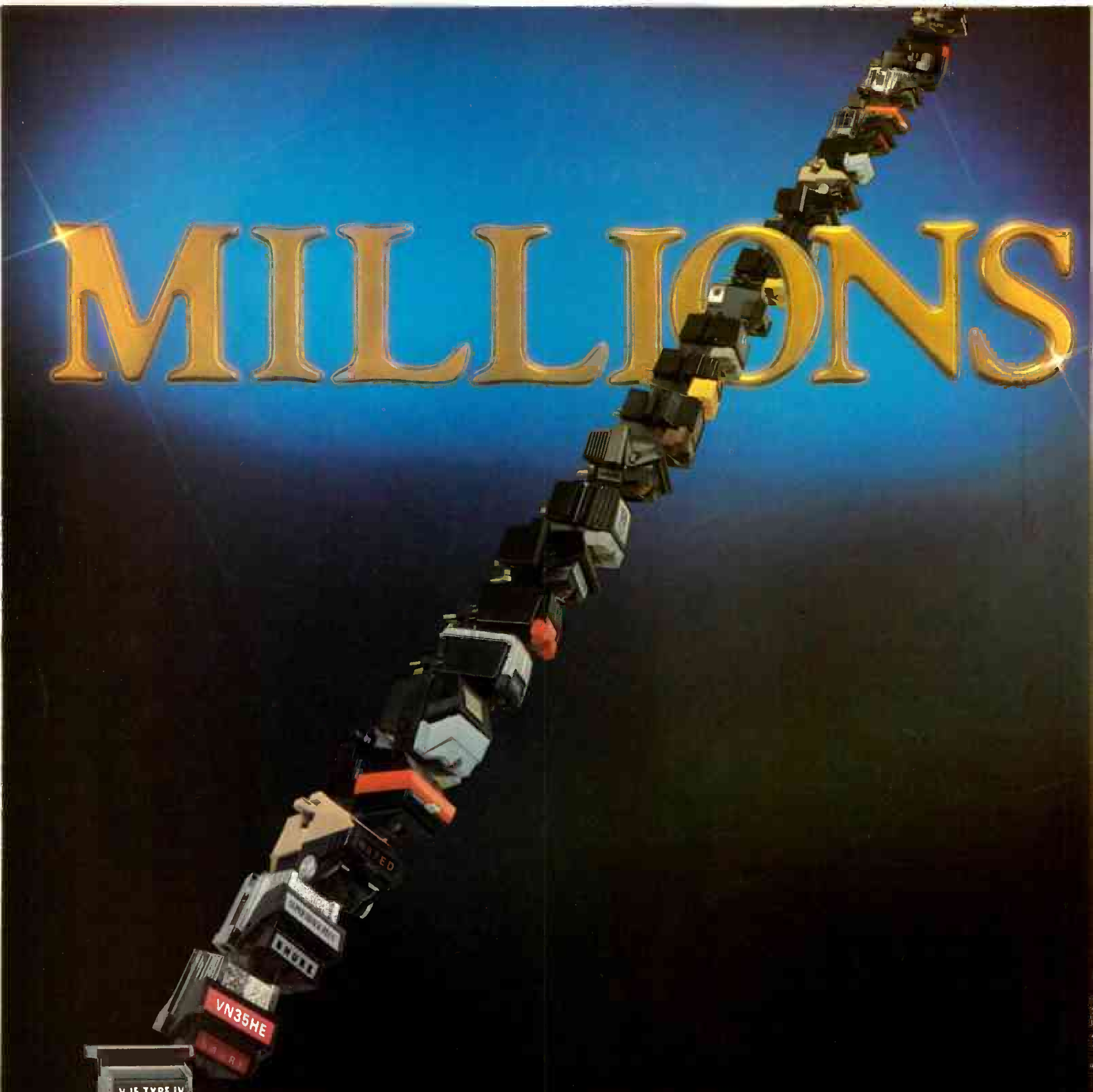

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EQUIPMENT REPORTS

Keithley Model 870 Digital Thermometer

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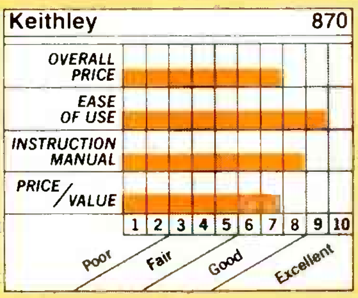

I RECENTLY GOT HOLD OF A RATHER INteresting instrument—one that is totally new to me. It's a *model 870* digital thermometer from Keithley Instruments, Inc. (28775 Aurora Rd., Cleveland, OH 44139), a well-known manufacturer of high-quality test instruments. This unit is styled much like their hand-held DMM's and features a large 3½-digit LCD readout.

The thermometer measures temperatures over four ranges: −40° to 200° Fahrenheit, −40° to 2000° Fahrenheit, −40° to 200° Celsius, and −40° to 1370° Celsius. Those ranges are selected by a four-position switch on the front panel. A two-position switch is used to choose one or the other of the two thermocouple inputs. All thermocouples used are Type K (NiCr/NiAl).

The unit comes with a single thermocouple on wire leads; it has a glass-insulated bead junction. The thermocouple just plugs into either the +TC1 or +TC2 jack, and the −COM jack on the front panel of the instrument. Two other jacks on the front-panel output an analog voltage corresponding to that developed by the thermocouple and are for use with a recorder, or an accurate DMM for high resolution readings (DMM readings can be converted into temperature by using a National Bureau of Standards chart).

Four special-purpose probes are available. They include a probe with a sharp tip for measurements within soft or semi-frozen solids; a surface probe with a special ball-socketed tip that keeps the surface of the sensor flush against what you wish to measure; an air-stream/gas-stream probe, whose exposed junction is protected by a shield (the shield protects the junction from the force of the stream so that the probe can accurately measure the temperature of the air or gas), and a hypodermic probe for biological and medical applications (the tiny junction in that probe has a one-second time constant). All of the probes themselves are stainless steel and have handles and long leads.

If you wish to use two probes (or thermocouples) at a time, a special plug-in adaptor (*model 8701*) is required. One note about the adaptor: If you plan to use it, your probes and thermocouple will require different terminations. The probes and the thermocouple are available with both the standard banana-plug terminations and the miniature plugs required for use with the adaptor.

This instrument should be very handy in any applicaion where fast, accurate temperature readings are required. One example of that would be to measure the case temperatures of high-power transistors. To check out the unit, I used it for a somewhat more mundane task. Thermostats on kitchen ovens are not too accurate in any case, but ours was considerably off. It was a simple matter to recalibrate the oven-temperature knob using the digital thermometer, bringing peace at mealtime!

A handy instruction manual that provides operating instructions, describes the use of the probes and adaptors, and has a complete set of disassembly and recalibration instructions comes with the unit. A standard 9-volt battery is required for operation; when the battery is low, a BAT signal appears on the readout. Accuracy is claimed to be 0.25% of reading +1° Celsius.

For any application that requires fast and accurate temperature measurement, this digital thermometer should be just the thing. It's small enough for field work, yet accurate enough for the lab. The suggested retail price for the *model 870* is $199.00. The specialized probes sell for $59.00 each, and the *model 8701* adaptor sells for $35.00. **R-E**

Radio Shack TRS-80 Model III Microcomputer

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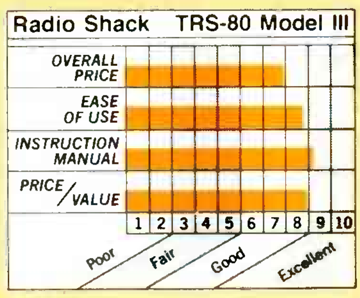

MICROCOMPUTERS FOR HOME, BUSINESS, and industry are now available with a bewildering number of features—and from almost as many manufacturers. One company that has done much to make the computer available to the home and small-business user is Radio Shack (1400 One Tandy Center, Fort Worth, TX 76102). The latest addition to its venerable *TRS-80* line is the *TRS-80 Model III*. While prices for this computer begin at $699.00 for the 4K *Level I* version, the unit reviewed here is the business computer featuring 48K of memory and two integral disk drives; it retails for $2495.00.

The business system comes with two 5¼-inch double-density disk drives. In

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addition, an I/O port will accommodate one or two external drives, as well as a cassette recorder. The double-density disks can each store about 175K bytes, for a total system capacity (with the two external drives) of 656K.

A parallel printer-interface and a buffered *Model III* bus-extension are also included. The printer interface lets you connect any of Radio Shack's printers directly.

The 2-MHz Z80-based computer features a full-size typewriter-style keyboard as well as an additional 12-key keypad for numeric-data entry. A REPEAT function is included. The Level II BASIC used in the business system supports both upper- and lower-case characters.

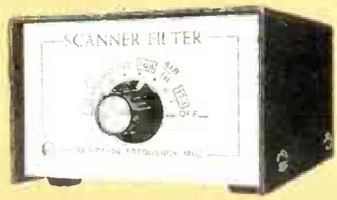
The video display uses a 12-inch CRT monitor and features scroll-protect, 96 alphanumeric characters, 64 graphics characters, and a further 160 special characters. The monitor can display sixteen 32- or 64-character lines.

An RS-232 serial interface is built into the *Model III* business system (it's optional on the less-expensive version). When used with a modem, it lets the computer communicate with others by telephone.

In operation, we found our *TRS-80 Model III* to be fast and flexible. The RF-interference problem that plagued earlier *TRS-80* computers, as well as many other units, has been greatly reduced to meet FCC regulations.

If you should run into any problems, I've found the Radio Shack computer service centers to be responsive and helpful. And, as if all of that were not enough, there is a rapidly expanding library of software covering home, business, and even modest industrial applications. To me, it looks as if Radio Shack has another winner on its hands. **R-E**

Grove Enterprises Model FTR-2 Scanner Filter



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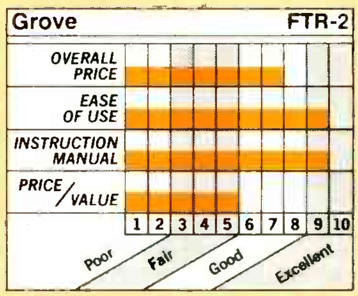

WITH SEVERAL PROMINENT DOMESTIC and off-shore manufacturers now producing crystal and synthesized scanning-receivers, the number of those units in use is growing at an ever-increasing rate. Thus, it's not surprising that listeners are discovering that those receivers are not immune from interference problems, especially in the larger cities.

The most common problem is image interference caused by signals that are displaced in frequency by twice the unit's IF. Next, and in some locations even more severe, is intermodulation from nearby transmitters. Among the sources of interference most frequently reported are: aircraft being heard on police- and fire-department frequencies; National Weather Service broadcasts, which seem to overpower many scanners, and mobile-telephone base stations, which show up almost anywhere. Since the VHF high-band is the most heavily used band for land mobile services, most of the interference occurs on those frequencies.

In response to those problems, Grove Enterprises has introduced their *model*

continued on page 26

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XL-75 Offset Ratchet Screwdrivers

600 Combination Screwdriver/Nutdriver Tool

Screwdrivers
Slotted Screws: R-144, R-146, R-181, R-184, R-3164, R-3166, R-3323, R-5325, S-388, S-3161, S-5161, S-5166
Phillips Screws: SX-101, XST-100, XST-101, XST-102
Hex Socket: P-18 & 19 (.028 & .035)
Nutdrivers HS-6, 8, 10, 11, 12, 14, 16, 18 Hollow Shaft
8M & 10M Magnetic

MODEL TC-100

Larger, more elaborate of the two cases. Contains 41 individual tools, 16 Series 99 interchangeable screwdriver/nutdriver blades and handles, and 5 specialized screwdriver/nutdriver kits, as listed. Case (19-1/2" x 13-1/2" x 6-3/4") covered with attractive, tough, chestnut-brown, leather-grain Marvelon. Removable three-panel, hinged pallet and tray outfitted with elastic loop and transparent plastic pocket tool holders. Solid brass locks, latches, and hardware. Padded handle. Partitioned bottom compartment for other tools.

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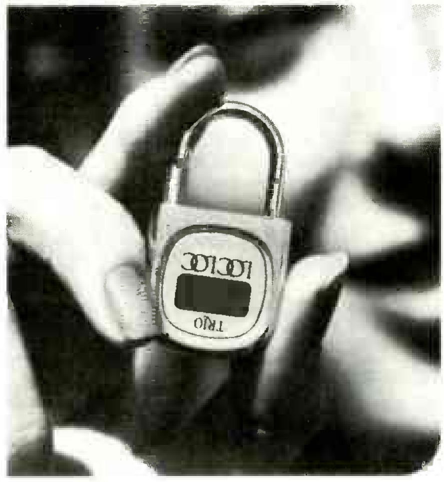

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The product is a digital watch in a lock called the LocLoc. The LocLoc hangs from your belt loop and the digital display is upside down to everybody but you.

Want the time, flip up the LocLoc and glance down. There's no watch to wear on your wrist, nothing to lug in your pocket and it makes a great way to keep track of the time while wearing a beautiful new piece of jewelry on your jeans. You can wear the LocLoc on everything from a pair of Calvin Kleins, to formal evening attire or even as a piece of jewelry around your neck.

The LocLoc is a full 5-function digital watch with night light–all housed in a solid brass case. The case is water resistant and comes in three textures: gold-tone, silver-tone, and anodized black.

Just twist the clasp on the lock and it opens. Then slip it over your belt loop. You'll enjoy the freedom of having nothing on your wrist and the convenience of always having the correct time at a glance.

Want more? The LocLoc comes in a see through vault-like container that fits into a denim drawstring tote bag. In fact, it's packaged as a perfect gift for both men and women–and for any age group.

Try one at no risk. Send your check for **$29.95** for the silver-tone version or **$39.95** for the anodized black or gold-tone version, plus $3.00 postage and handling. (Illinois residents add 6% sales tax.) Credit card buyers may use our toll-free number below.

We'll send you your LocLoc digital watch and clear vault-like container all packaged in its handy gift denim drawstring tote bag. After you receive it, attach it to your belt loop. Feel the freedom of not wearing a watch on your wrist. See how easy it is to glance down at the time and notice what a great accessory and piece of jewelry it makes. If you're not absolutely convinced that LocLoc is perfect for you, return it for a full refund, including your $3.00 postage and handling charge. But if you really like it, order more for gifts or for your friends.

Each LocLoc has a one-year limited warranty. Your LocLoc was designed to take plenty of abuse. In fact, the case is actually housed in a solid brass lock. But if service is ever required, our service-by-mail center is as close as your mailbox. JS&A is America's premiere electronics company and a company built upon service.

If you're looking for a really innovative gift–one that you yourself will enjoy–order a LocLoc today.

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EQUIPMENT REPORTS

continued from page 24

FTR-2 scanner filter. That device is a tunable wave trap designed to notch out interfering signals. Tunable (using a front-panel knob) over a range of approximately 76 to 220 MHz, the filter will attenuate undesired signals by as much as 30 dB while allowing other signals to pass uneffected.

The filter is very easy to use. To hook it up, simply plug your antenna cable into the rear of the unit and plug the interconnecting cable into your scanner's antenna jack. To use, simply turn the front-panel knob until the offending signal is rejected.

One thing to keep in mind is that the filter will surpress only a single frequency. If there are several interfering signals, all with different fundamental frequencies, the filter will be only partially successful.

How it works

The circuit here is very straightforward. The IN and OUT antenna connectors are interconnected by a 68-pF capacitor. That was done to prevent, or at least diminish, IF feedthrough from shortwave broadcasts. That is a problem that is often encountered by scanner users, but rarely recognized as such.

A series-tuned LC trap is connected from the antenna connectors to ground; that trap provides the tunable notch. The Q appears to be high, permitting a sharp notch at the frequency selected without attenuating the adjacent frequencies. Naturally, a single-stage tuned circuit such as this can not be tuned precisely to a single frequency, but the unit performs quite well considering its simplicity and low cost.

The front-panel scale is roughly calibrated to show the approximate settings for various sources of interference. While not precise, the scale lets the user turn to about the right spot quickly before fine tuning.

Our test

Connecting the device to a calibrated signal generator and feeding its output to a scanning receiver, we verified that the mid-band rejection is nearly 30 dB as claimed. In addition we found that the insertion loss was only 1 dB at VHF high-band frequencies; the insertion loss did rise slightly at UHF frequencies.

All in all, we found that the *model FTR-2* does perform as the manufacturer claims. While it will not remove all interference problems completely, it can provide considerable relief in crowded metropolitan areas. The *model FTR-2* sells for $39.95, plus $2.00 shipping, from Grove Enterprises, Inc., Brasstown, NC 28902. **R-E**

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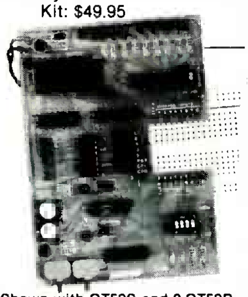

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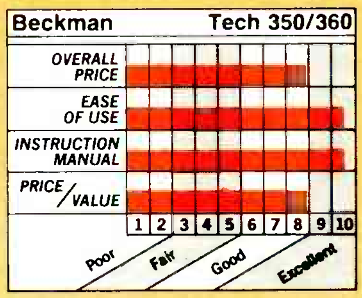

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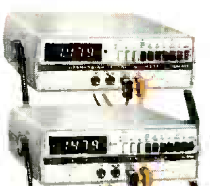

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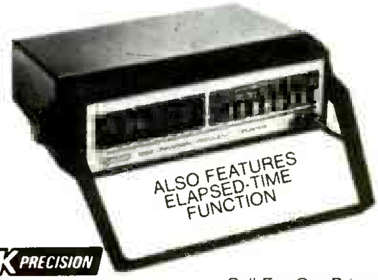

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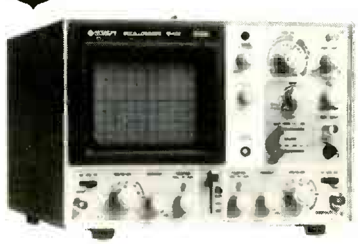

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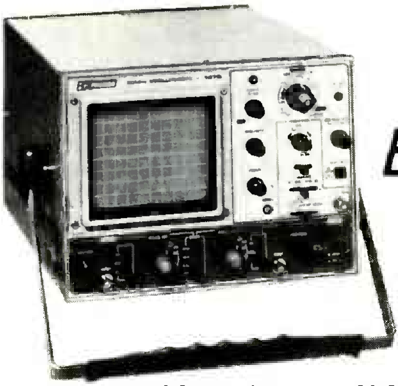

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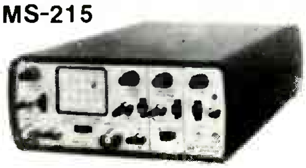

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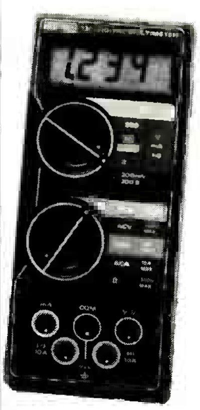

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DC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	2%
AC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	3%
RESISTANCE	200Ω, 2kΩ, 20kΩ, 200kΩ, 20MΩ	.5%

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EQUIPMENT REPORTS

continued from page 26

equipment, has introduced a pair of bench-model DMM's suitable for lab use, servicing, or any other application where a highly accurate multimeter is required. The *Tech 350* and *Tech 360* DMM's are nearly identical, the major difference being that the *Tech 360* can provide true RMS AC-voltage readings.

Although the instruments are compact (about the size of a cigar box), they can make an amazing variety of measurements. There are 30 ranges in all, and each function and range is selected by using the large rotary switch on the front panel. The ranges are as follows: AC volts, in 5 ranges, from 200 mV to 1000 volts full-scale; DC volts, in 5 ranges, from 200 mV to 1500 volts full-scale; AC and DC current, in 5 ranges, from 200 μA to 10 amps full-scale, and resistance, in 7 ranges, from 20 ohms to 20 megohms full-scale.

The remaining range is marked with a diode symbol and is used for testing any semiconductor junction. Unlike the resistance ranges which are "low power" and do not cause a junction to conduct, this range outputs a maximum of 4 mA from a constant-current source. When the diode test-range is selected, the voltage drop in millivolts across the junction being checked is shown on the 3½-digit LCD display. Among the uses for that range are determining the semiconductor type (silicon or germanium) and testing a transistor for bad junctions or leakage. Any test can be made in-circuit provided that there are at least 300 ohms of resistance in parallel with the junction under test.

The four input jacks on the front panel are COMMON, VOLTS-OHMS, AMPS and 10 AMPS. The AMPS jack has its own 2-amp fuse. The meter itself is protected by a 3-amp fuse. All of the jacks are UL-approved, and there is no exposed metal. The test leads are rather novel: They have insulated plugs at both ends. Simply plug one end of the lead into the test probe you want to use, and the other into the meter. The standard probes have sharp tips and a protective collar.

Small switches in the top right corner of the front panel are used to turn on the unit, turn on the audible continuity-test, and select between RMS AC and RMS AC + DC (*Tech 360* only). The continuity test is used to avoid having to deal with the slow settling-time typical of most LCD displays. To activate it, set the CONTINUITY switch to ON and turn the selector switch to the desired resistance range. When the continuity test is in use, the unit will emit a beep and an "Ω" symbol will appear on the display any time the resistance is less than twice the maximum of the range selected. The display will show the exact resistance within ½-second. Overrange readings are also indicated by the display.

The *Tech 360* has a special socket for a K-type thermocouple. With that probe in place, the meter can measure temperatures from −20° C to +1265° C, and then display them directly on the readout.

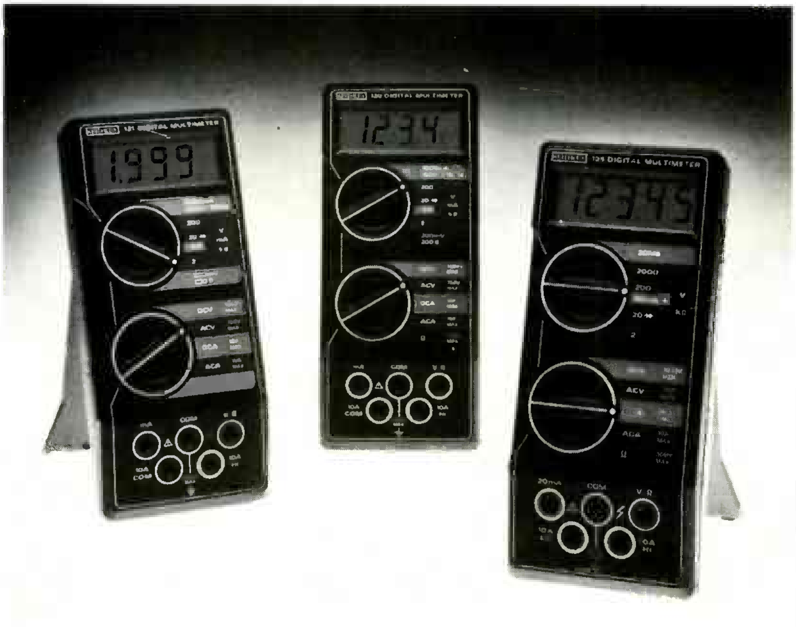
Most of the circuitry is contained in three IC's. The majority of the meter's functions are handled by the LSI "multiprocessor" IC. A smaller IC is used to generate the audio tone used in the continuity test. The third IC is a high-precision divider network used on all the ranges, and helps assure accuracy for many years.

Both meters are battery powered (just the thing for hot-chassis TV sets) and require 6 D-size cells. Battery life is claimed to be 12,000 hours continuous, or up to four years in normal use; only alkaline cells should be used as replacements when required.

In addition to the thermocouple for the *Tech 360*, there are several other accessories available for the two meters. A high-voltage probe extends their range to 50 kilovolts, with an accuracy of ±2%. A peak-detecting RF probe ex-

continued on page 41

ADVANCE IS PROUD TO INTRODUCE the KEITHLEY Line of High Quality Digital Multimeters Featuring The New 130 Hand-Held DMM



Rugged DMMs from Keithley — all feature large, bright LCD display, easy-to-use rotary switches, externally accessible battery and fuse, 10A current range, diode test capability, low battery indicator, cushioned components.

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131	0.25%	0.75%	1%	2%	0.2%	100μV	1μA	100μV	1μA	100mΩ
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RF-6300 8-band AM/FM/SW

There are other ways the RF-3100 commands the airways: It can travel the full length of the shortwave band (that's 1.6 to 30 MHz). It eliminates interference when stations overlap by narrowing the broadcast band. It improves reception in strong signal areas with RF Gain Control. And the RF-3100 catches Morse communications accurately with BFO Pitch Control.

Want to bring in your favorite programs without lifting a finger? Then consider the Panasonic RF-6300 8-band AM/FM/SW receiver (1.6 to 30 MHz) has microcomputerized preset pushbutton tuning, for programming 12 different broadcasts, or the same broadcast 12 days in a row. Automatically. It even has a quartz alarm clock that turns the radio on and off to play your favorite broadcasts.

The Command Series RF-3100 and RF-6300. Two more ways to roam the globe at the speed of sound. Only from Panasonic.

*Shortwave reception will vary with antenna, weather conditions, operator's geographic location and other factors. An outside antenna may be required for maximum shortwave reception.

†Based on a comparison of suggested retail prices.

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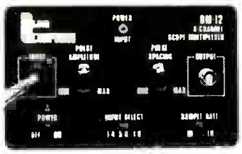
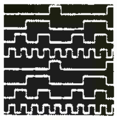
8 CHANNEL SCOPE MULTIPLEXER, DM-12

Convert your single channel scope into a 4 or 8 channel instrument, just connect the DM-12, 8 channel scope multiplexer to your scope, clip the 8 input probes to the signals you want to view. Simple, easy, fast — can handle logic level TTL signals from DC to 3MHz. Features separate spacing and trace amplitude controls and selectable sampling rate — all to insure easy clear scope display.



Completely Assembled and tested! Ready to use!



- 8 TTL compatible input channels (1 TTL load per channel) can drive 50 Ohm scope cable.
- Maximum full screen amplitude 1.6 Volts adjustable.
- Trace amplitude and spacing controls.
- 4 or 8 channel selector switch.
- 8 color coded input cable, 24" long with insulated alligator clips.
- External 9 VDC power supply included (Model MMAC-2).
- Size 6.25" x 3.75" x 2".
- BNC Output Cable Accessory (Model PSA-2 add $14.95).

VIEW 8 CHANNELS AT ONCE!

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Connect this high quality low cost Capacitance Meter Module, DM-8 to your digital Volt Meter and turn it into a Digital Capacitance Meter — the Low Cost Way!

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A fully assembled and tested power supply that provides a solid, fully wired triple power supply including fixed 5V @ 1 Amp, 5V to 15V @ 0.5 Amp, and −5V to −15V @ 0.5 Amp — all supplies regulated, short proof. Each supply has short indicator LED. Complete and ready for use in a durable (8" x 6" x 3 1/2") metal case.

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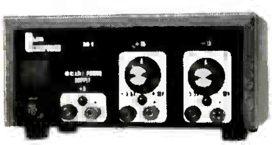

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• CRT	130BUB31 (5-inch, round shape)
Display area	8x10div (1 div = 9.5mm)
Acceleration potential	Approx. 2kV
Intensity modulation	Over 5Vp-p
• Vertical deflection Sensitivity and bandwidth	5mV/div ~ 5V/div ± 5%, DC ~ 15MHz, −3dB; 1mV/div ~ 1V/div ± 6%, DC ~ 5MHz Typ., −3dB (Using x5 amplifier)
Rise time	24ns
Dynamic range	More than 4div at 15MHz
Input R and C	Direct 1M Ohm, approx. 30pF
Maximum input voltage	600Vp-p or 300V (DC + AC peak)
Display mode	CH1, CH2, DUAL, ADD, DIFF
X-Y operation	DC ~ 500 kHz, 5mV div ~ 5V div; Phase difference DC ~ 10kHz 3°
• Horizontal deflection Sweep mode	Auto, NORM, TV (+), TV (−)
TV synchronization	TV sync-separator circuit
Internal	Over 1 div (V sync-signal)
External	Over 1Vp-p (V sync-signal)

Trigger sensitivity	Frequency	Internal	External
	20Hz ~ 2MHz	0.5div	200mV
	2 ~ 15MHz	1.5div	800mV

Trigger slope Sweep time	0.2μs/div ~ 0.2s/div ± 5%, 19 calibrated steps
Sweep-time magnifier	10 times (± 7%)
Max. sweep rate	100ns/div
• Amplitude calibrator	1kHz ± 10% Typ. Square wave
Waveform / Voltage	0.5V ± 3%
• Power requirements	100V (120/220/240V) ± 10%, 50/60Hz, 40W
• Dimensions	Approx. 275(W) x 190(H) x 400(D)mm
• Weight	Approx. 8.5kg
• Ambient operation temperature	0 ~ +40°C

MODEL V-152B WITH 2 YEAR MFG. WARRANTY

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WITH FREE DM-12 8 CHANNEL MULTIPLEXER A COMBINED VALUE AT LIST OF $804.95 YOU SAVE $160.00

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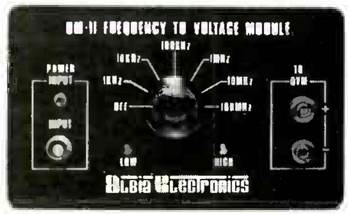
FREQUENCY METER MODULE "5Hz to 100MHz", DM-11



Measure frequencies from 5Hz to 100MHz on your digital voltmeter with a resolution of 3 1/2 digits — easy to use — perfect for field service — lab testing — home hobbyist! Connect the DM-11 to your DVM, set the DVM to the 2VDC range, connect a signal to the DM-11 via a BNC cable (not included) and measure the frequency of any source. Hi Lo Range LED's insure fast accurate readings.

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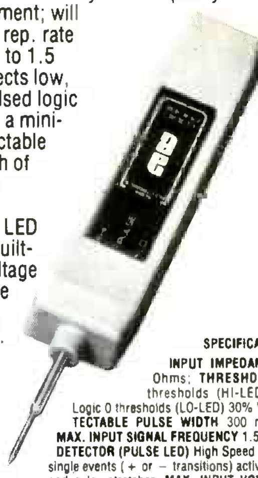

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SPECIFICATIONS

INPUT IMPEDANCE 300,000 Ohms; **THRESHOLD** Logic 1 thresholds (HI-LED) 70% Vcc Logic 0 thresholds (LO-LED) 30% Vcc; **MIN DETECTABLE PULSE WIDTH** 300 nanoseconds; **MAX. INPUT SIGNAL FREQUENCY** 1.5 MHz; **PULSE DETECTOR (PULSE LED)** High Speed pulse train or single events (+ or − transitions) activate 1/10 second pulse stretcher. **MAX. INPUT VOLTAGE** ± 50V continuous 120VAC for less than 15 seconds. **POWER REQUIREMENTS** 5 Volt Vcc 30 Ma 15 Volt Vcc 40 Ma 25 Volts max. with power lead reversal protection. **OPERATING TEMPERATURE** 0 to 50°C **PHYSICAL SIZE L x W x D** 5.8x1.0x0.7" (147 x 25.4 x 17.8 mm) **WEIGHT** 3 oz. (85g) **POWER LEADS** 36" (61 cm) with color coded Insulated clips.

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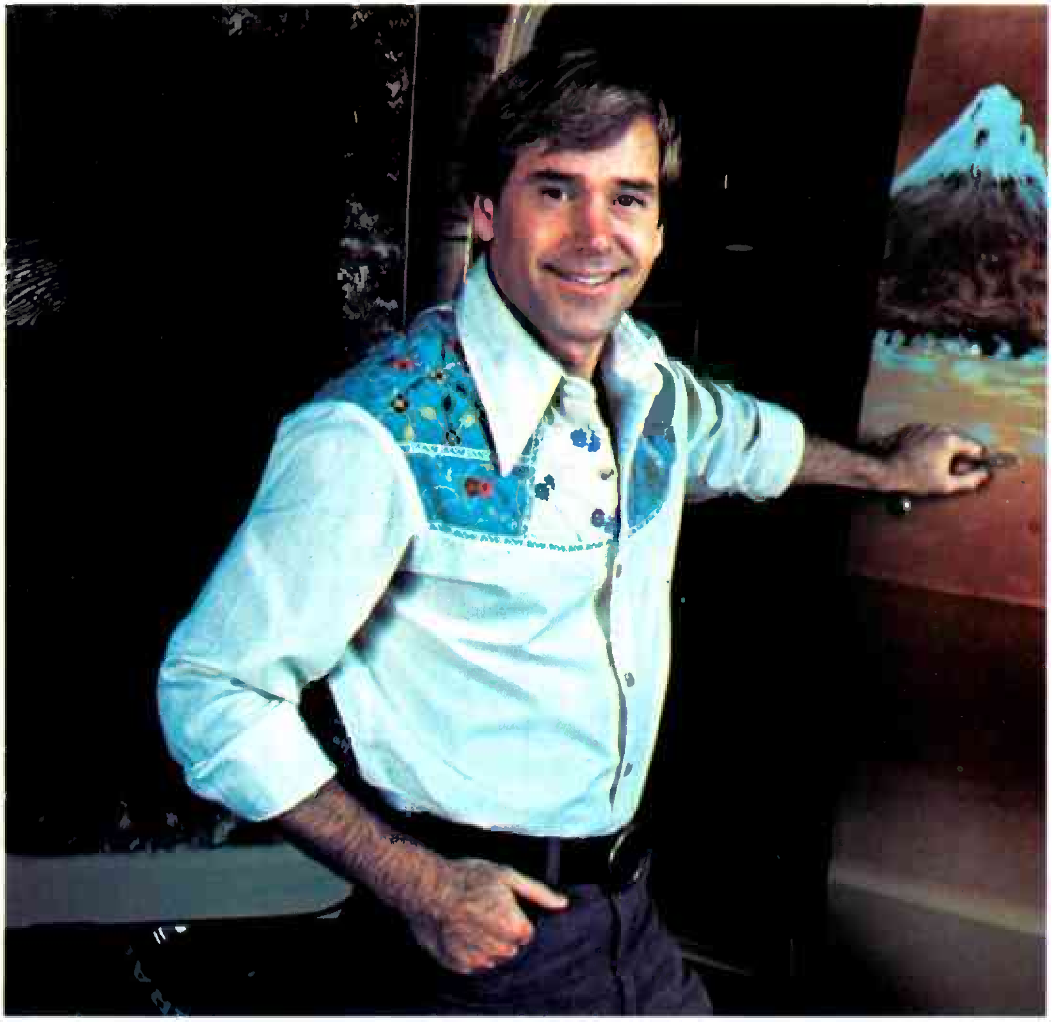

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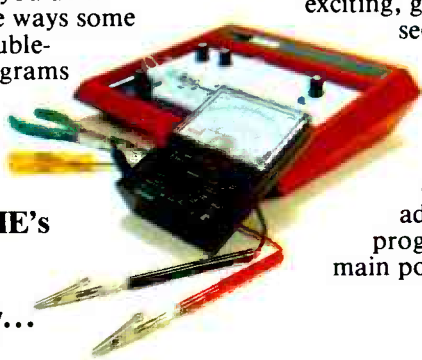

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The heart of the system is the Heath/Zenith 89 Computer, a complete, stand-alone unit with professional keyboard, smart video terminal and 5¼-inch disk drive. It's easy to use for people having little or no experience – yet it can also run extended languages like BASIC, COBOL, FORTRAN and Pascal.

The 89 comes with 48K bytes RAM, expandable to 64K. It has two Z80 microprocessors, one for computer functions, one for terminal functions. And three serial I/O ports for interface with printers and modem.

The video display features a 12-inch diagonal, high-resolution CRT that's easy on the eyes. It displays up to 2,000 characters at a time, 24 lines (plus 25th status line) by 80 characters, with full cursor control. Also 33 block graphic characters for charts and graphs.

The heavy-duty keyboard follows standard typewriter format for easy operator training. All terminal functions are programmable from keyboard or I/O ports.

The 5¼-inch floppy diskette stores 100K bytes of information and interfaces on line with the Heath/Zenith 67 Hard Disk System.

Winchester Disk System

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The floppy is double-sided, double-density and can also operate in single-sided or single-density modes, compatible with standard IBM 3740 format.

The 67 features write-protect switches for both drives to prevent accidental erasure of information. The average access time of the hard disk drive is 70 milliseconds.

High-speed printer

The Heath/Zenith 25 Printer is a heavy-duty, high-speed, dot matrix printer that gives you sharp, clear printouts. It prints over 150 characters per second with whisper-quiet smoothness.

The entire 95-character ASCII set prints in upper case and lower case with descenders, in a 9 x 9 matrix. Also, 33 block graphic characters let you create graphs and charts. All functions and timing are microprocessor-controlled.

It uses standard edge-punched papers and features a convenient cartridge ribbon for easy, no-mess replacement.

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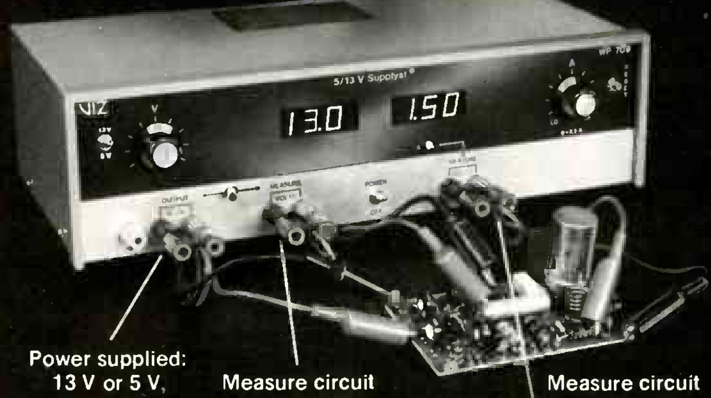

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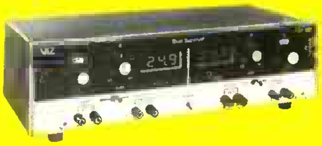

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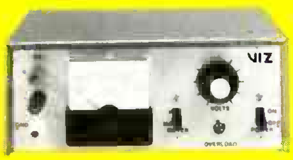

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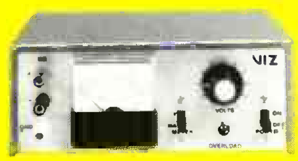

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EQUIPMENT REPORTS

continued from page 30

tends the meters' frequency range to 200 MHz (normally 10 kHz). Two AC-current clamps are also available. One lets you read AC current up to 150 amps without opening up the circuit; the other extends the range up to 1000 amps! A "hold" probe will hold a reading on the display as long as a switch on the probe is held down. A deluxe test-lead kit contains an assortment of probe ends: alligator clips, spade lugs, banana tips, and a spring-loaded hook tip. A storage compartment for extra probes and leads is located under a hinged lid on the top of the case. An optional vinyl carrying-case with a belt loop holds either meter, test leads, and the manual.

We tried one of the meters out on the bench and were very pleased with what we saw. Settling time for the display is very good, and the readings are steady. The claimed accuracy of 1% should make either meter suitable for almost any application. The *Tech 350* has a suggested retail price of $229.00; suggested price for the *Tech 360* is $289.00. **R-E**

Heathkit Model IM-2410 Frequency Counter

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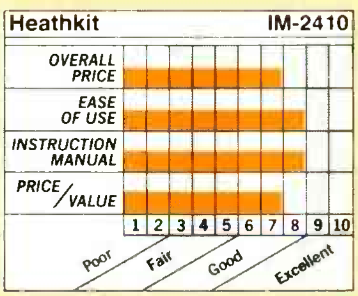

A FREQUENCY COUNTER IS ONE OF THOSE instruments that is useful in a wide variety of professional and hobby applications. A new offering from the Heath Company (Benton Harbor, MI 49022) is their *model IM-2410* with a frequency range of 10 Hz to 225 MHz.

Packaged in an attractive cabinet, the unit measures 3⅜ × 7¼ × 9½ inches and weighs 5 pounds. The required assembly is straightforward and, depending on the builder's experience, should take just a couple of nights to complete. An assembled version, the *model SM-2410*, is also available. As usual with Heathkit products, no special tools or test equipment is required either for construction or calibration.

Speaking of calibration, we calibrated our counter using WWV as outlined in the instructions. We then checked the calibration against an accurate standard and found that they agreed to within 1 Hz. The accuracy that you will obtain depends on the care you take during calibration, but it should be well within the requirements of most applications.

The device counts frequency over two ranges, with a choice of 1- or .1-second gate time on each. The first range is 10 Hz-50 MHz, with a sensitivity of 10 millivolts (typical) to 30 MHz, and a maximum sensitivity of 50 millivolts from 30 to 50 MHz. Resolution depends on gate time; it is 1 Hz at 1 second and 10 Hz at .1 second. The second range covers frequencies from 20 to 225 MHz, with a sensitivity of 10 millivolts (typical) throughout the range. Resolution is 10 Hz at a gate time of 1 second, and 100 Hz at .1 second.

All readings are shown on an eight-

continued on page 105

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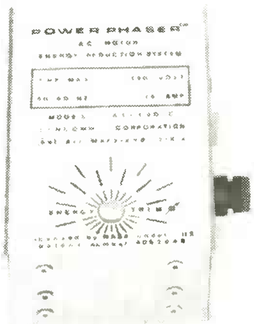

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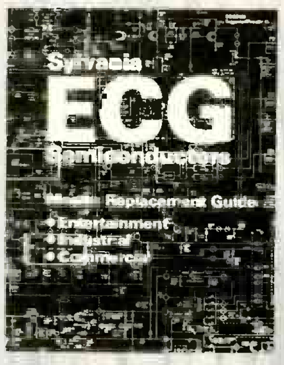

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HI-FI CX Decoder For Records

JOEL COHEN

Last month we presented the theory behind CBS's new compatible CX companding system for records. This month we'll show you how to build your own expander so that you can enjoy the full benefits of the new CX-encoded discs.

ONE OF THE HOT PIECES OF NEWS IN THE recording industry is the new *CX** companding system developed by CBS. In audio, the word "companding" refers to a signal-processing technique in which the dynamic range of program material is compressed during the recording process, and expanded during playback. One companding system that you may be familiar with is *Dolby B;* that system, used to reduce noise in tape recordings, only works on low-level, high-frequency signals. *Dolby A* covers a wider frequency range, but is used only in professional recording applications. Other companies, such as dbx Inc., also produce professional and consumer companding systems.

Common to all of those systems is the fact that they were designed to get the best performance out of a specific recording medium and it was assumed that a compressed recording would always be played back using the appropriate expander. The frequency response and dynamic characteristics of the recorded material are therefore substantially modified during the recording process in all of those systems. Playing back a *Dolby B* recording without an expander, for example, would boost low-level, high-frequency signals by as much as 10 dB, giving the music an artificially "brighter" quality than was intended.

Companding was originally developed to compensate for the difference between the dynamic range of live music and that of the two most popular recording mediums, magnetic tape and phonograph records. The dynamic range of live music, from ambient noise to an orchestral peak, is about 85 dB. Contrast that to the 50-dB dynamic range of a typical audio cassette-tape (as opposed to open-reel) and the 65-dB dynamic range of the very best phonograph record. The difference between the dynamic range of the actual music and that of the best record is about 20 dB.

A few years ago, dbx modified its consumer recording-tape noise-reduction system to work with phonograph records. While the resulting system increased a record's dynamic range to more than 85 dB, it still had the drawback of requiring that the record be played back using an expander. Since most record buyers are not interested enough in the extra dynamic range, and the corresponding increase in noise reduction, to invest in the required expander, *dbx*-encoded recordings are in comparatively limited distribution and sell at a premium price.

CBS Laboratories took a different approach and set out to design a *compatible* companding-system for phonograph records—a system in which recordings would sound natural and have unaltered frequency response if played back without an expander and that would provide superior-quality sound if an expander were used. The *CX* system was the result. While CBS expects to have at least 50 *CX* recordings in distribution by the end of this year, they are also granting free licenses to other record companies. Warner Communications, RCA, Telefunken, and Teldec are among those who have already signed agreements with CBS, and records from them and from other firms should be appearing soon. In addition, the system has been adopted for use with videodiscs, and is being considered for stereo TV.

Although someone without an expander would be unable to tell that a *CX*-encoded recording was different from any other, to get the full benefits of the system, including 20 dB of noise reduction, he would need an expander. This article describes a *CX* expander that you can build yourself. With it, a *CX* record will sound as good as the master tape itself, and considerably better than most other signal sources. In addition, the expander described here has a peak dynamic-range expander for use with conventional records to overcome the effects of limiting.

How it works

In the *CX* system, signal levels greater than −40 dB below a reference (5-cm/second lateral stylus-velocity at 1000 Hz) are compressed by a 2:1 ratio. Signals below −40 dB remain linear, since compression of those signals could bring the level of the background noise above the level of the record's surface noise. The 2:1 compression is broadband, so there is no change in the signal's frequency response in the process. Also, while previous com-

*CX is a trademark of CBS, Inc.

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panding systems used a single time-constant, the *CX* system uses four. Because of that, the action of the compressor is totally masked by the music. It is almost impossible to identify a *CX* disc when listening to it without a expander. In fact, substituting the system's 2:1 compression ratio for the sharp limiting of musical peaks that would be required otherwise often makes the dynamics of a *CX*-encoded record superior to those of a conventionally-recorded one.

During playback, signals above −20 dB (with respect to the 0-dB reference mentioned previously) are expanded by a ratio of 1:2. That is the purpose of the expander described here; its block diagram is shown in Fig. 1.

The compressed music-source passes through a full-wave rectifier circuit that is prebiased with a DC reference-voltage. That reference keeps the output of the rectifier at a constant ½-volt for low-level signals. Signals above −20 dB increase the output of the rectifier; a 0-dB signal results in an output of 5 volts.

The output from the rectifier goes through the main filter-circuit, and on to four additional filters that set the attack and delay time-constants for the expansion. Those time constants are the same as those used during compression. The outputs from the filters are summed, and the result is applied to the variable-gain amplifiers in the right and left channels. The resulting expansion curve is shown in Fig. 2, along with its corresponding compression curve. When the action of those two curves is combined, the result is linear, as shown by the dashed line.

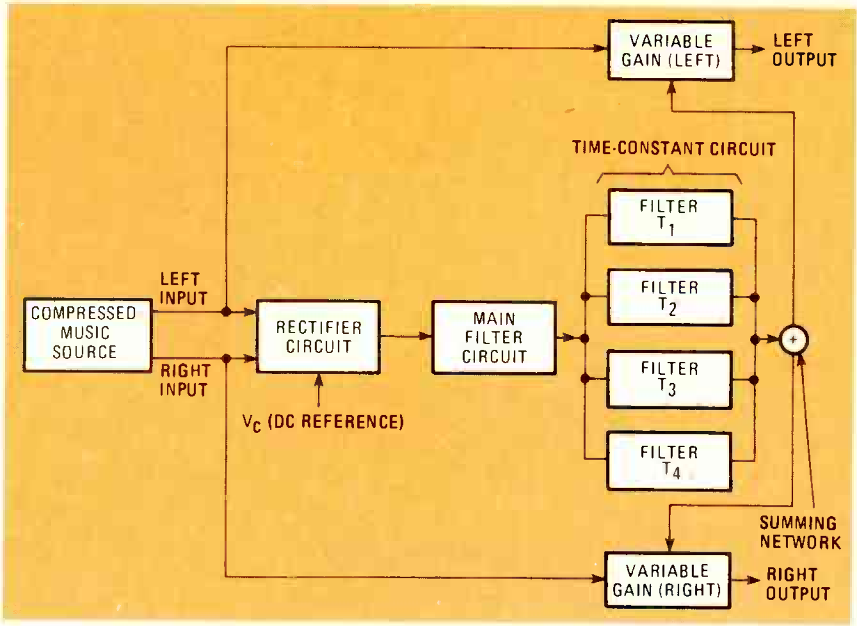

FIG. 1—BLOCK DIAGRAM OF THE *CX* EXPANDER shows how left and right-channel signals are combined to derive a gain-control voltage using the rectifier and filter circuits.

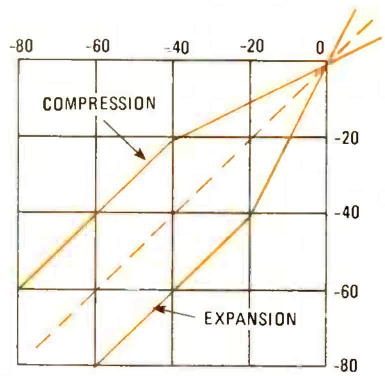

FIG. 2—THE COMPRESSION and expansion curves for the *CX* system. When the two curves are combined, the result is linear, as shown by the dashed line.

Signal path

Figure 3 is a schematic diagram of the expander. The left and right channels are identical and share a common gain-control signal. The description that follows refers to the left channel.

The expander is designed so it can be connnected in an external-processor loop, a tape loop, or between the preamp and power amp of your stereo system. Depending on how the system is configured, pushbutton switch S1 is used to select the signal source (receiver or preamp) in the SOURCE position, and the tape deck in the TAPE position). The signal is then passed through a 7-Hz high-pass filter formed by C6 and R37. Resistor R37 is the input calibration gain-control and feeds the signal to one of the sections (IC1-d) of IC1, a high-impedance, FET-input, quad op-amp. That IC has an unusually high slew-rate to meet the requirements of the subsequent stages. Op-amp IC1-d is configured for a 6-dB gain using a feedback loop consisting of R35 and R36. Its output, set for 250 millivolts at the 0-dB reference, feeds two points.

The first is a voltage divider consisting of R20 and R21; that divider presents a low-impedance, attenuated signal to the variable-gain stage. That stage uses IC3-a, one half of an LM13700N variable-transconductance amplifier. The attenuated signal is fed to the non-inverting input of IC3-a, and that IC's inverting input is terminated by R28. That resistor, along with R57 and trimmer potentiometer R59, are used, in effect, to null out the input offset-voltage of the IC. A signal-current proportional to the signal voltage at pin 3 appears at pin 7, and is converted to a voltage by the combination of R22-a (the front-panel VOLUME control) and R30. The ratio of the output-signal current at pin 5 to the input-signal voltage at pin 3 is controlled by the gain-setting section of the expander. To improve linearity and minimize distortion, the bias current to the input-linearizing diodes in IC3 is supplied through resistor R47. The dual emitter-follower in IC3-a acts as a buffer for the signal voltage at pins 5 and 7, and as an output driver to pin 8. The ground reference and the AC coupling for the output signal are provided by C8 and R40. Switch S2 is used to bypass the expander when so desired.

Control path

The output of IC1-d also feeds a high-pass filter consisting of C1, C10, and R1. When switch S3 is in the CX mode, that filter has a corner frequency of 100 Hz; in the PEAK mode the corner frequency is 500 Hz. Those corner frequencies minimize any gain pumping resulting from very-low-frequency signals, such as those caused by record warp.

The output from the high-pass filter is fed to IC1-c, which is configured as a non-inverting amplifier with a gain of about 19. Musical peaks in the source signal may cause the output of that amplifier to swing almost 30 volts peak-to-peak, which is why a high-slew-rate amplifier such as the LF347N was required for IC1. Resistors R4 and R5, and IC2-d, one section of a second LF347N quad op-amp, are configured as an inverter with unity gain. The positive peaks from IC1-c are rectified by D6; the negative peaks are inverted by R4, R5, and IC2-d before they are rectified by D7. As a result, the highest positive or negative peak from either channel is detected by the base of Q2. Diodes D6 and D7 are reverse-biased by a constant DC bias provided through D5 by Q1. The level of that pre-bias is determined by a voltage divider consisting of R2, R3, and R60. When the expander is in the CX mode, R60 is bypassed and the pre-bias is approximately ½ volt. Thus, for signal levels up to

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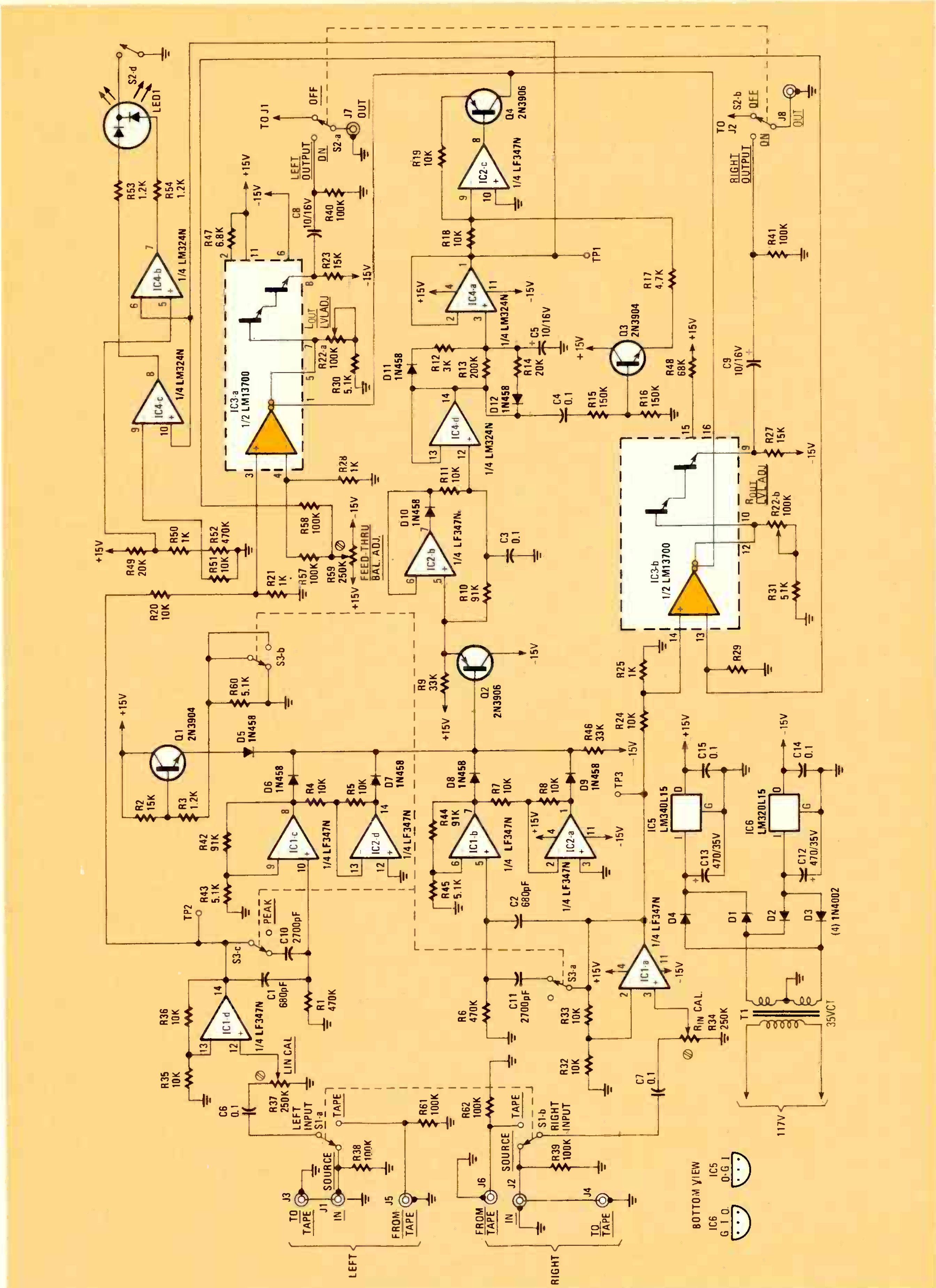

FIG. 3—SCHEMATIC DIAGRAM for the *CX* expander. This unit also has a peak dynamic-range expander circuit for use with non-*CX*-encoded discs.

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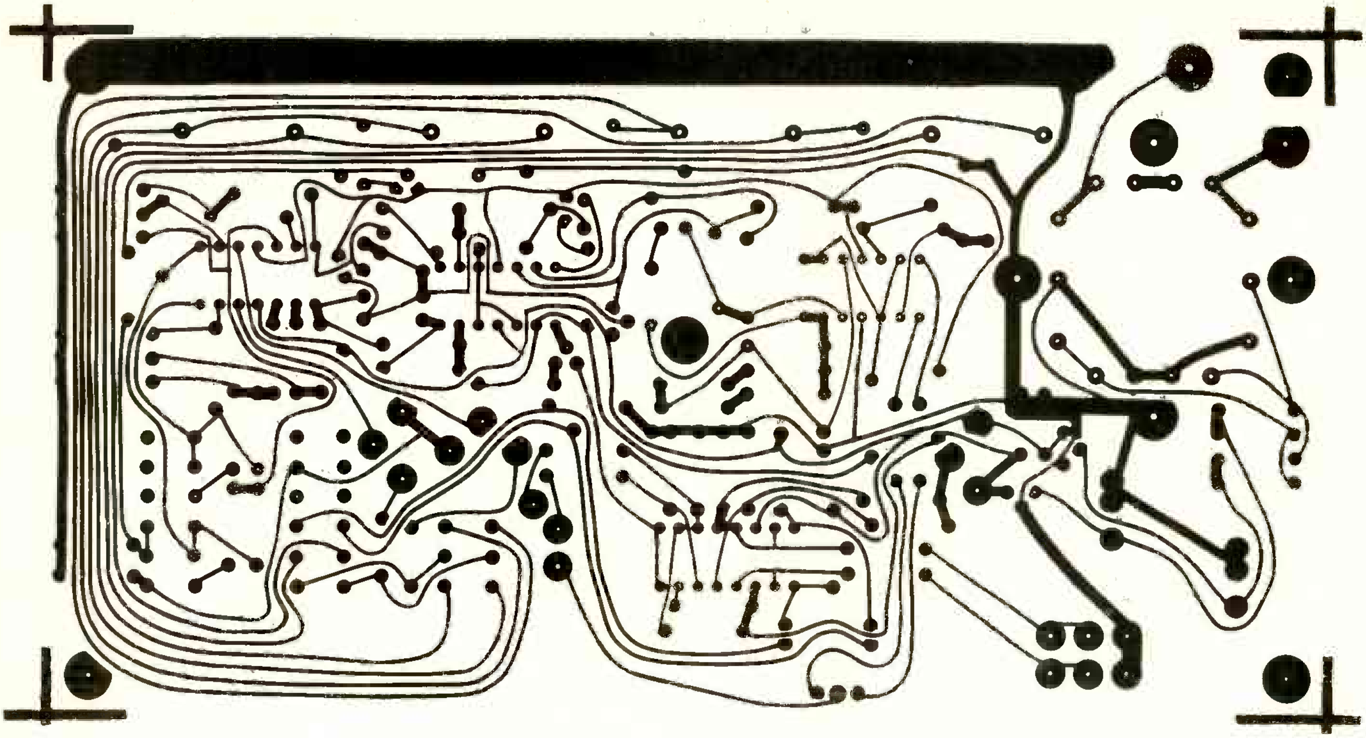

FIG. 4—THE *CX* EXPANDER is built on a single-sided PC board. Several jumpers are used to achieve this simplicity. Etched boards are available (see the Parts List).

PARTS LIST

Resistors, ¼ watt, 5%, unless otherwise noted
R1, R6, R52—470,000 ohms
R2, R23, R27—15,000 ohms
R3, R53, R54—1200 ohms
R4, R5, R7, R8, R11, R18-R20, R24, R32, R33, R35, R36, R51—10,000 ohms
R9, R46—33,000 ohms
R10, R42, R44—91,000 ohms
R12—3000 ohms
R13—200,000 ohms
R14, R49—20,000 ohms
R15, R16—150,000 ohms
R17—4700 ohms
R21, R25, R28, R29, R50—1000 ohms
R22—100,000-ohm dual potentiometer, audio-taper, PC mount
R26—not used
R30, R31, R43, R45, R60—5100 ohms
R34, R37, R59—250,000 ohms, trimmer potentiometer, PC mount
R38-R41, R57, R58, R61, R62—100,000 ohms
R47, R48—68,000 ohms
R55, R56—not used
Capacitors
C1, C2—680 pF, axial ceramic, 5%
C10, C11—2700 pF, axial ceramic, 5%
C3, C4, C6, C7, C14, C15—0.1 µF, ceramic disc
C5, C8, C9—10 µF, aluminum electrolytic, 16 volts
C12, C13—470 µF, aluminum electrolytic, 35 volts
Semiconductors
D1-D4—1N4002
D5-D12—1N458
LED1—dual element LED, Dialight 521-9178 or equivalent (DO NOT USE A BIPOLAR TWO-COLOR LED)
IC1, IC2—LF347N quad FET-input op-amp
IC3—LM13700N dual transconductance amplifier
IC4—LM324N quad op-amp
IC5—LM340L-15 or 78L15 regulator, +15 volts, 100 mA.
IC6—LM320L-15 or 79L15 regulator, −15 volts, 100 mA.
Q1, Q3—2N3904 NPN transistor
Q2, Q4—2N3906 PNP transistor
J1-J8—dual RCA-type phono jack, right-angle PC mount
S1-S3—three-switch assembly (1 DPDT, 2 4PDT), PC mount, Centralab PB20 series or Schadow F series
T1—35 VCT, PC mount, Dale PL-12-09 or equivalent
Miscellaneous: PC board, case, wire, hardware, line cord, solder, etc.

NOTE: The following are available from Sound Concepts, Inc., P.O. Box 135, Brookline, MA 02146: SX-1—PC board (etched, drilled, solder masked, with power terminals), $16.00; SX-2—switch assembly with knobs, volume control with knob, four dual-phono-jacks, three trimmer potentiometers, and the dual LED with lens, $13.50; SX-3—IC1-IC6, $11.00; SX-4—all resistors, capacitors, diodes, and transistors, $8.00; SX-5—power transformer, $7.50; SX-6—silk-screened chassis, cover, line cord, strain relief, and hardware, $18.00; SX-7—calibration record, $2.00; SX-80—assembled unit with one-year warranty, $119.00. Add $2.00 for shipping and handling for all orders within the continental United States. Massachusetts residents add 5% sales tax.

½ volt, the gain will remain constant and the output from the expander be linear. In the PEAK mode, the pre-bias is 3.3 volts, causing the gain to remain constant for signals to that level, so that expansion takes place only at the very top of the dynamic range. That higher bias also results in a higher gain in the CX mode than in the PEAK mode when expansion is not taking place.

Transistor Q2 acts as a buffer and level shifter to make up for the voltage loss caused by the drop across the rectifiers. The transistor's output is peak-detected and smoothed by the main-filter circuit consisting of IC2-b, D10, R11, C3, and R10. The time constants for that stage are 1 millisecond for attack and 10 milliseconds for decay.

The output of the main-filter stage is buffered by IC4-d, a section of an LM324 quad op-amp; that op-amp is also used to drive the time-constant network. The primary attack time-constant of 30 milliseconds is set by D11, R12, and C5. The decay time-constant of 200 milliseconds is set by D12 and R14. For very small signals—less than the conduction voltages of D11 and D12—R13 provides a two-second time-constant; that prevents any rapid changes in signal level in the event of low-level changes in the source material. Op-amp IC4-a buffers the output from the time-constant network; the output from the op-amp is the basic gain-control signal and is available at TP1.

A buffered high-pass filter with a 1-

continued on page 75

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VIDEOTEX FOR TV: HOW IT WORKS

While it looks simple on the screen, videotex has a very complex organization. In this part we'll look at several ways of transmitting and decoding videotex, and start examining its data structure.

RICHARD LARRATT, M.A., P. Eng.*

Part 2 IN THE FIRST PART OF this series we discussed videotex in general terms. In this part we'll go into considerably more detail and explain some of the technical requirements of videotex and some ways being considered for its implementation.

We'll use the term *videotex* to mean the general practice of transmitting information to a TV receiver using the vertical blanking-interval. That has also been referred to sometimes as *teletext* or *teletex*. For our purposes—and, it is expected, eventually in general usage—we'll define those terms as follows: *Teletext* can also be called "broadcast videotex," and is essentially what we are describing here—information being transmitted over the air. *Teletex* (no "t" at the end) is a computer-terminal-based information service; the best known of those services is offered by Radio Shack. *Interactive videotex* is two-way videotex, where the user can respond to the information provided on his or her TV receiver through the use of a telephone link to the videotex computer. Finally, the term *viewdata* is sometimes used as a synonym for interactive videotex.

The above terms are somewhat arbitrary—videotex is still young and definitions have not been fixed. We will use the term "videotex" to refer to a system using only the vertical blanking-interval on an over-the-air or cable channel. "Teletext" will refer to one that uses a standard video format to transmit information and may or may not use that interval.

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Some more terms defined

Videotex uses both alphanumerics (letters and numbers) and graphics. The alphanumerics can be produced by a simple character-generator IC or, as we'll see later, be specially defined. Similarly, low-resolution graphics elements can be stored in a character-generator ROM. Higher-resolution graphics require a more sophisticated system.

There are three videotex systems for generating graphics and special-purpose alphanumerics.

The first, *alpha-mosaic*, uses a 2 × 3 *pixel* (or *pel*) array to form various low-resolution graphics symbols. A pixel—or pel—is a "picture element," the smallest shape that can be displayed on a video screen. Actually, the pixels used to display ordinary alphanumeric symbols are dots, while the pixels used in alpha-mosaic graphics are small squares made up of several dots each. Personal computers such as Radio Shack's *TRS-80*'s and Commodore International's *VIC* and *CBM (PET)* use this system. Figure 6 shows the elements within a cell that are used to generate alpha-mosaic graphics characters for videotex.

Alpha-geometric graphics use elements made up of dots rather than small blocks. This means that much-higher-resolution graphics are available—it is possible to construct sections of curves and, in general, produce higher-quality, less "chunky-looking," images. Exidy's *Sorcerer* computer contains a number of alpha-geometric graphics symbols that allow rather sophisticated images to be constructed. Alpha-geometrics uses a bit-mapped system, where each pixel-dot is assigned a memory location in the decoder's memory, and then transferred to the screen.

The third system is called *alpha-photographic*. It uses a bit-plane memory—several layers of bit-mapped memory—and, while it is somewhat more costly (but not terribly) to implement, and requires more time to transmit, it allows still video-frames—in black-and-white or color—to be sent.

There are two methods for transmitting alphanumeric/graphic informa-

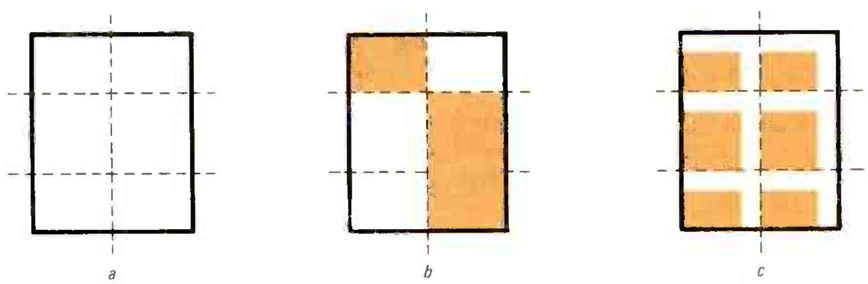

FIG. 6—MOSAIC CHARACTERS use a 2 × 3 pixel matrix (*a*). Either contiguous characters (*b*) or separated characters (c) can be formed.

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tion. The first is referred to as *serial-attribute*. It is more or less a real-time system. As the data is received, it appears from left to right, and top-to-bottom on the screen. Its big drawback is that the information specifying what color is to be transmitted occupies a space that would ordinarily be occupied by an alphanumeric or graphic character. That means that if a transition from, say, red to blue, is made in displaying a picture, there can be a blank space on the screen where the information specifying the color change appears, since the information is meant for control, and not display, purposes. While serial-attribute transmission is reasonably simple to accomplish and is used in many systems (particularly the British), there is a better way to generate graphics.

That way is known as *parallel-attribute* transmission. There, each character transmitted carries along with it information describing its particular characteristics—generally, color, although, as we'll see, other attributes can also be described. The equipment used for parallel-attribute transmission and reception is more complex than that needed for serial-attribute data, but the results are much superior. The map shown in Fig. 7 shows how, using the parallel-attribute method, colors can be changed "on the fly." It is also interesting to note the use of alpha-mosaic graphics characters made up using the elements shown in Fig. 6.

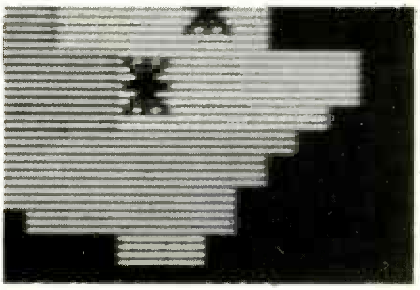

FIG. 7—ENLARGED SECTION of map drawn using Antiope shows benefits of parallel-attribute transmission. Also, note odd-shaped graphics characters used to form border.

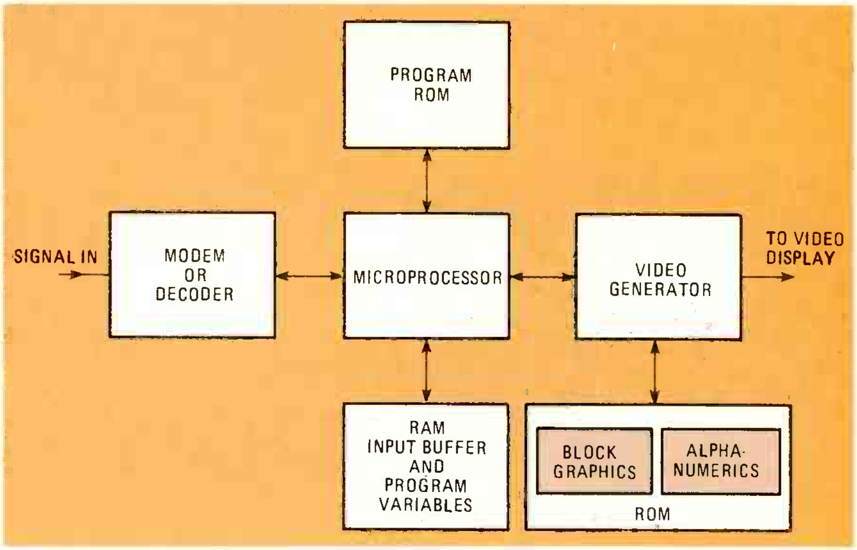

FIG. 8—BLOCK DIAGRAM OF PRESTEL SYSTEM. Note that display is limited to block graphics and alphanumeric characters stored in ROM.

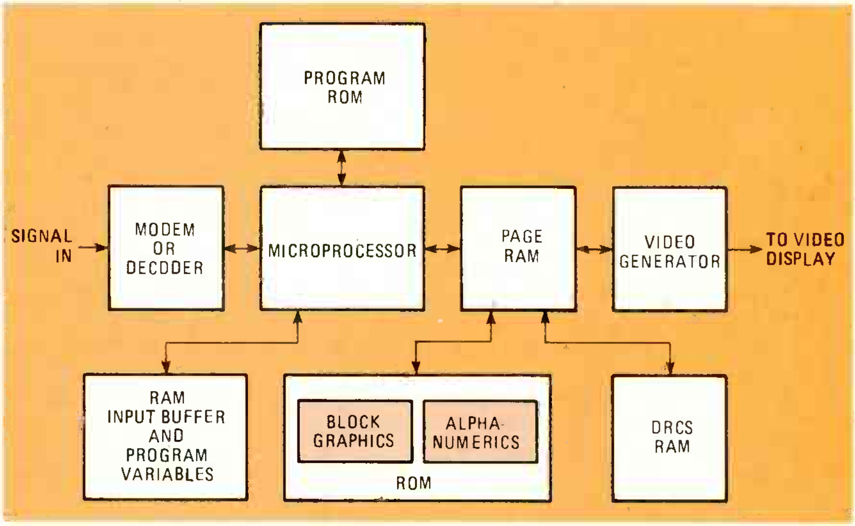

FIG. 9—ANTIOPE ADDS DRCS RAM for customer character-generation. The addition of page RAM allows the system to store video data, and instructions for displaying it, separately.

There are two terms that remain to be defined—at least for the moment. They are "DRCS" and "PDI."

DRCS stands for *D*ynamically *R*edefinable *C*haracter *S*et. As opposed to fixed block-graphic symbols, the DRCS allows any shape to be defined, using the maximum dot-resolution permitted by the system. It is a user-definable alpha-geometric system. Once a DRCS character, such as a particular section of a curve, has been transmitted and stored in the videotex decoder's memory, it is available for use whenever needed.

This bring us to *PDI's* (*P*icture *D*escription *I*nstruction). They permit an intelligent decoder to reproduce images in extreme detail. Typical PDI's include ARC, LINE, POLYGON, and, of course, TEXT. Using PDI's, a complete set of DRCS's need not be sent. Instructions can be given to draw a straight line, or curve, from one point to another. The decoder can be provided with a DRCS and the PDI's used to manipulate them. PDI's and DRCS' are extremely powerful videotex tools.

System characteristics

There are three formats competing for acceptance in the rapidly growing U.S. videotex field. They were discussed briefly in the first part of this article, but now that we have a little more information as to what's involved in videotex, we can talk about them in more detail.

The British Prestel system is the simplest, and probably, at this time, the most widespread. Its simplicity lies in the fact that it is alpha-mosaic in nature and uses the serial-attribute system. The equipment required for it, shown in block form in Fig. 8, is less sophisticated, and less expensive, than for the other systems. Unfortunately, when graphics are called for—and, after all, that's what TV sets are good for—Prestel falls short. Still, there are many who argue that Prestel is the best way to get videotex into the greatest number of homes at the least expense.

Antiope, the French-developed system, is more sophisticated in that, while still alpha-mosaic, it uses parallel-attribute transmission. That means that, while the equipment required for it is more complex (Fig. 9), and requires several thousand bytes of RAM (*R*andom-*A*ccess *M*emory), its graphics capabilities are greater. Through the use of DRCS', higher-quality images can be presented. As we'll see, Antiope is a serious contender in the videotex race.

Finally, there's Telidon, the Canadian system, shown in Fig. 10. Telidon is

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alpha-*geometric* and uses parallel-attribute transmission; what's more, it also makes use of DRCS' and PDI's. Telidon's bit-plane memory allows for complex and detailed graphics, and permits the use of the alpha-photographic mode. It's the most advanced videotex system to date.

Until recently, Prestel was probably the logical choice for videotex because of the complexity and relative expense of the other two systems. However, the circuitry required for such niceties as parallel-attribute transmission (and reception) and higher-resolution, more complex, graphics, can now be handled by microprocessors and a few LSI or VLSI (*V*ery *L*arge-*S*cale *I*ntegration) IC's and, in mass production, the increase in cost over what would be required for Prestel is negligible.

A factor that figures heavily in making the decision as to which videotex standard should be adopted is that Antiope and Telidon can be made compatible, because of their parallel-attribute nature, while Prestel, a serial-attribute system, is unique.

That probably played an important part in defining what has come to be known as the North American Broadcast Teletext Specification.

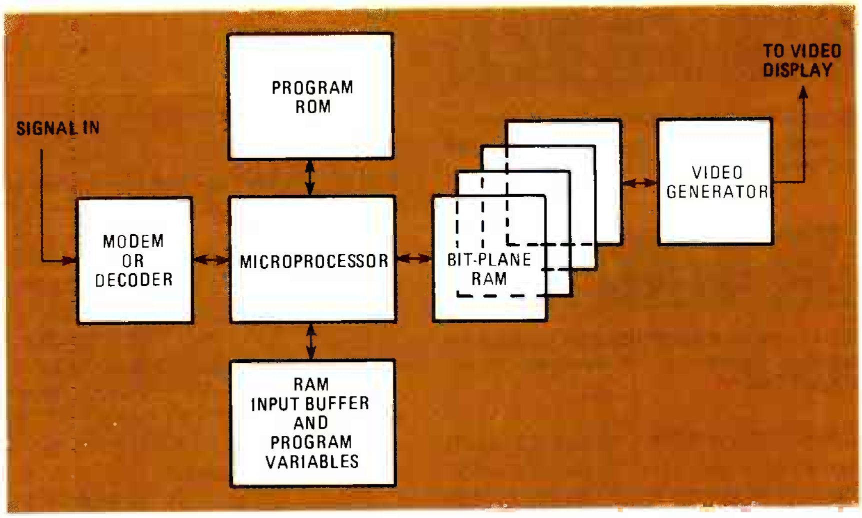

FIG. 10—TELIDON USES MORE RAM than other systems. Four layers of bit-plane RAM permit complex graphics and use of the alpha-photographic mode.

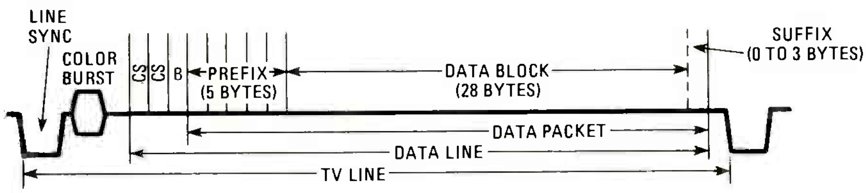

FIG. 11—SINGLE VIDEO LINE carrying information required for the presentation of videotex. Data representing material actually displayed does not appear on this line.

North American Broadcast Teletext Specification

Despite the simplicity of the British Prestel system, the fact that a higher level of videotex technology exists has caused us to consider adopting either the Antiope or Telidon systems, or a combination of the two.

While the controversy continues, the EIA (*E*lectronic *I*ndustries *A*ssociation) has put forth a proposal to the FCC to adopt as a standard an Antiope/Telidon-based system. That is known as the North American Broadcast Teletext Specification. (We'll try to avoid using the term too frequently.)

In essence, the NABTS calls for an Antiope system, with Telidon enhancements. Its Presentation Level Protocol (the description of how the data is to be transmitted) was proposed by AT&T and subsequently endorsed by CBS, which had submitted a similar proposal, but with minor differences.

Videotex protocol levels

There are seven layers (levels) of protocol involved in videotex. They are:

1. Physical—Provides the mechanical and electrical provisions for the physical interconnection.
2. Link—Provides ways of establishing and maintaining data links between parts of a network.
3. Network—Provides the means to exchange network service data units over a network.
4. Transport—Provides a universal transport mechanism for lower-level protocols.
5. Session—Provides for the combination and/or separation of two presentation entities.
6. Presentation—Provides the method of coding and presenting information.
7. Application—Invokes the protocol requested by the user.

In this part we'll concern ourselves with the levels up to, but not including, the presentation protocol.

Videotex information is intended to be transmitted on lines 15 and 16 of the vertical blanking-interval. Lines 17 and 18 may also be used to increase the amount of data that can be sent, but lines with lower numbers are out of the question, since they can be visible on some TV receivers.

Another form of videotex, known as *full-field* uses all the video lines, transmitting video information on the visible lines and control and other information in the vertical blanking-interval.

Videotex data is sent at the rate of 5,727,272 bits per second. If lines 15 and 16 are used, this works out to an effective baud rate of approximately 22,000. Because of this relatively high rate of data transfer, it is important that the received signal be as clean as possible. Of particular concern are "ghosts" and ignition noise, which can garble the true data being transmitted. Complex error-protection techniques (Hamming encoding) are used for videotex transmissions, but even so, a clean signal is required for reliable results. While this is not as much a concern to cable videotex systems as it is to broadcast videotex, it is still a factor to be contended with.

Another concern is that the data-transmission frequency is very close to the maximum bandwidth of 6 MHz allocated for broadcast stations, and that spillover may occur. This is particularly disturbing to operators of cable systems, where channels may be packed one next to the other. Continued testing is sure to show a way to minimize or eliminate these potential problems.

Figure 11 shows a TV line in the vertical blanking-interval carrying videotex information. The line can contain up to 288 bits (36 8-bit bytes).

The first two bytes ("CS," "CS") are the *bit-synchronization sequence*. They provide a videotex decoder with a reference burst that synchronizes the decoder's clock and initializes the data slicer that extracts the videotex information.

The next 8-bit byte, "B," is the *framing code*, and defines the structure of the rest of the line. This byte has the binary structure "11100111," with the least-significant bit (at the right) being sent first. Two other framing codes have been reserved for future use.

The prefix

After the bit-synchronization sequence and framing code, a domain of data known as the *data packet* begins. It starts off with a 5-byte *prefix*, shown in detail in Fig. 12.

The first three bytes of the prefix, "P1"-"P3," define the data-packet

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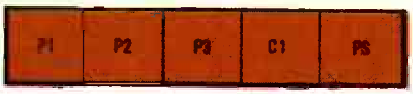

FIG. 12—FIVE-BYTE PREFIX carries information for multiplexing and error detection, and describes the date group that follows.

FIG. 13—DATA GROUP HEADER provides information concerning the treatment of the videotex data.

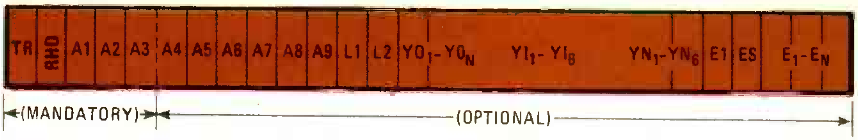

FIG. 14—RECORD HEADER prepares the way for the videotex material to be displayed. Much of its content concerns where the material is to be found, and how it is to appear.

address. Up to 4096 (2^{12}) data channels can be carried on a single television channel. A simple BCD (*B*inary *C*oded *D*ecimal) keypad can be used to select any of the first 1000 pages; the rest are reserved for future use.

Byte "CI" is known as the *continuity index* and is used to detect the loss of a data packet due to transmission errors.

The final byte of the prefix, "PS," specifies the nature of the data packet ("standard," "synchronizing," "full of information," etc.). The second bit of byte "PS" indicates that a *data group* follows.

The data group header

The next group sent is an 8-byte sequence, the *data group header* (Fig. 13). It tells the decoder what is coming up.

The first byte, "TG," tells the decoder what type of processing is to be applied. Broadcast videotex always sets the value of this byte to zero. The second byte, "C," verifies the sequence of data groups of the kind defined by "TG" in a particular data channel (defined by "P1"-"P3" in the prefix).

Byte "R" indicates the number of retransmissions of a particular data group. Its value can range from 1 to 15.

Bytes "S1" and "S2" specify the number of data blocks in a data group. This number can be anywhere between 0 and 255. Bytes "F1" and "F2" indicate the number of bytes in the last block of a data group.

Finally, byte "N" is used by the broadcaster to identify the routing of the data group through his network. Values from 0 to 15 can be assigned to this byte, which is not used by the videotex decoder.

Record header

The last batch of data sent before the actual videotex display is the *record header* (Fig. 14). Its purpose is to specify the qualities of the videotex material further. It is divided into a 5-byte mandatory section, and a following optional group that may or may not be transmitted.

The first byte of the mandatory section, "TR," indicates whether the transmission is broadcast videotex, closed captioning, or some other form of data transmission. Byte "RHD" can be used to indicate the presence of one or more subgroups consisting of: address extension, record linking, complementary record classification, or header extension field.

Bytes "A1"-"A3" contain the record or page number. Bytes "A4"-"A7" are optional. When they are used, bytes "A1"-"A7" represent the page number, and byte "A8" and "A9" represent the page number within a document.

Bytes "L1" and "L2" are linking bytes—they tell the decoder where to look for records that are to appear sequentially.

The whole class of "Y" bytes carries information pertinent to the retrieval and display of the videotex data. Among other things, it can indicate whether a message is to be superimposed over the image being displayed, whether a message is to be withheld until requested by the user, whether a message has priority and should override the image being displayed, etc.

Bytes "EI" and "ES" indicate the presence and length of any header extension fields ("E_I - "E_N").

Where's the picture

By now you can realize how complicated videotex is, and, perhaps, why there is such contention over how it should be implemented. Why, we haven't even begun to answer the question of how the videotex image gets on the screen! That will come next month, when we discuss DRCS', PDI's, and, finally, how videotex becomes visible. **R-E**

VIDEO ENTERTAINMENT '82 a special supplement

In our next issue, January 1982, **Radio-Electronics** *will present a special supplement—virtually a magazine within the magazine—dealing with the phenomenal video "revolution" that is sweeping across our society. It will be chock full of pertinent technical data and information that you will want to keep for reference and decision-making.*

We will take a close look at tomorrow's home-entertainment system, with a TV set as the core receiving/reviewing unit to which all electronic components are attached: personal computer, VCR, video disc, video games, cable, and other software.

We'll present accessories that can enhance the performance of your video system and, among the other features, you'll find comprehensive discussions on the latest in such areas as projection TV, VCR's and cameras.

The January 1982 issue goes on sale December 17, 1981; don't miss it!

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4 TOYS for the HOLIDAY SEASON

DAN AND DIANE TALBOT

Just in time for the holiday season, here are four electronics toys that are sure to delight any young person.

WITH THE HOLIDAYS RAPIDLY APPROACHING, MOST PARENTS (as well as grandparents, aunts and uncles, etc.) are in the midst of their annual search for a present that their child will enjoy. Your local toy store, however, is not the only place to look for such a present. Often, a simple electronic toy that you build for your child, or help your child to build for himself or herself, will be far more appreciated and enjoyed than most. The toys described in this article were designed for their ease of assembly, the availability of parts, and, I hope, to appeal to a child's curiosity. In addition, they are fun to build. The theory of operation of each is fully explained, making them educational for the builder, as well as entertaining for the child. Those toys also make good "science fair" projects for children up to junior high-school age.

You can build any of the toys with just a handful of new or junk-box parts. The siren requires only two easy-to-obtain transistors, a few resistors and capacitors, a pushbutton switch, and a battery. The bird-chirper requires only four standard transistors in addition to the resistors, capacitors, and the like. The AM wireless microphone requires two transistors, a common op-amp IC, and a couple of tuning coils; incidentally, projects similar to that have long been favorites with young people. The electronic "chug-chug" simulates the sound of a steam locomotive with variable speed, and uses a design that doesn't need a special noise diode, selected transistors, or Zeners. While the chug-chug is the most complicated of the projects, it still should not take more than a weekend to finish, depending on the builder's experience.

Before we get into each project in detail, let's go over a few points about selecting parts. While you should have no trouble finding most of the parts, you may run into a situation where a particular listed part is not available locally. In that case you have two alternatives: order it by mail (the advertisers in the back of this issue are a good source), or find a suitable substitute. There are a couple of choices listed for many of the critical components, and while those are the ones that will work the best in a particular circuit, in most cases (the exceptions are noted in the text) there are others that will work. For instance, IC1 in the "chug-chug" toy is listed as a CA3240. Actually, that IC is a dual CA3140 (that is one possible substitute). Acceptable substitutes include a TL062, a TL072, or a TL082 IC, although those IC's have a lower noise-output. In fact, almost any dual MOSFET-input op-amp can be used if you know its pin-out.

One note about the capacitors: While ceramic discs can be used with good results in most situations (except where electrolytic or tantalum types are specifically called for), if you are buying new parts, you may want to consider Mylar or mica capacitors instead. While those are more expensive, they are precision units and, depending on the application, they may provide better results.

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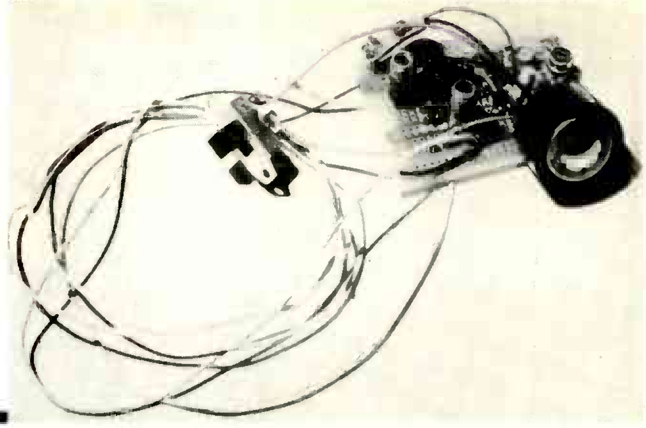

1. WIRELESS AM MICROPHONE

The schematic for the wireless AM microphone is shown in Fig. 1. Transistor Q1 and its associated components comprise a tuneable RF oscillator. This oscillator generates an RF signal in the AM broadcast band. The output frequency of the oscillator is tuned by coil L1 to an unused frequency between 800 and 1200 kHz. The RF signal is fed to transistor Q2, which serves as the modulator. Operational amplifier IC1 increases the level of the audio signal from the microphone, and applies it through resistor R4 to the base of Q2. The amplified audio signal varies the bias current of Q2. The non-linear characteric of Q2 results in an amplitude-modulated RF signal that is taken from the emitter of Q2, and connected to the antenna via a matching network consisting of C6, L2, and R6. The antenna itself is a 7- to 10-foot length of insulated, stranded hookup-wire.

The audio sensitivity is determined by the output level of the microphone used, and by the value of R10. The value shown for that resistor will give you adequate sensitivity when using a 600-ohm or higher impedance dynamic-type microphone, similar to the inexpensive ones (generally less than five dollars) sold for use with audio cassette recorders.

Construction details

You can build the wireless microphone using any one of a number of construction techniques. However, the easiest method to use for this project would be wire-wrap. First mount the components on perfboard using wire-wrap posts. Use a wire-wrap IC socket for IC1. Then, following the schematic, connect the posts using a wire-wrap tool. As with any other RF circuit, keep the wiring short and neat, and avoid locating the antenna, L2, C6, R6, L1, C5, or C3 near pins 2 or 3 of op-amp IC1. Also, keep L1 away from L2 so that no interaction occurs. When connecting the microphone, be sure to use shielded cable to prevent hum pickup.

After construction is completed, turn on an AM radio and tune it to an unused frequency betwen 800 to 1600 kHz. Then turn on the wireless microphone and place it next to the radio. Tune L1 until you hear a change in the audio level coming from the radio. Whistling into the microphone while you tune L1 will help you recognize when L1 is tuned correctly.

Use an RF probe and a VTVM to monitor the output voltage from the antenna, and peak it by adjusting L2. (Alternatively, the "S" meter of a general-coverage receiver tuned to the correct frequency can be used.) If L1 is disturbed, it may be necessary to readjust L2 for peak performance. Depending on the impedance of the microphone you chose, the audio sensitivity (gain) can be increased by decreasing the value of R10, and vice-versa.

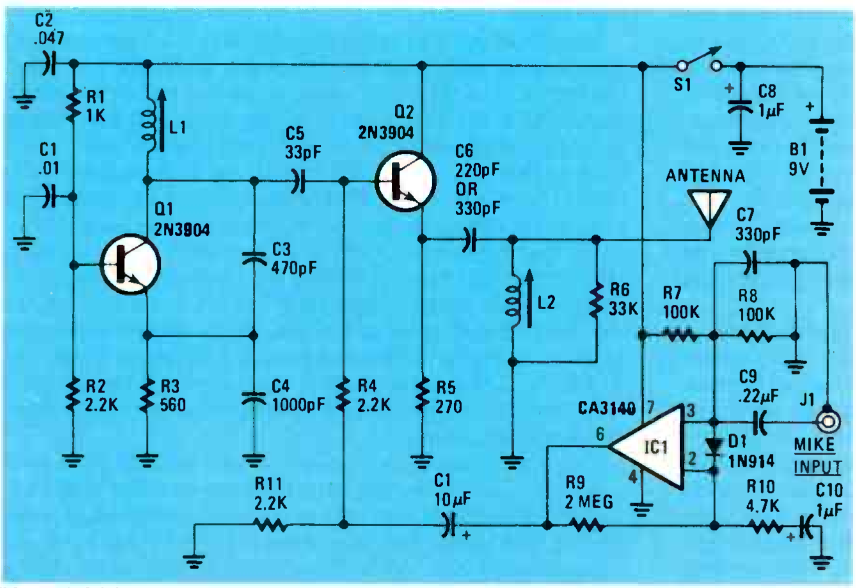

FIG. 1—A GOOD INTRODUCTION to the principles of radio, AM wireless microphones have long been a favorite with young people.

PARTS LIST—AM WIRELESS MICRPHONE

Resistors ¼ watt, 5%, unless otherwise noted
R1—1000 ohms
R2, R4, R11—2200 ohms
R3—560 ohms
R5—270 ohms
R6—33,000 ohms
R7, R8—100,000 ohms
R9—2 megohms
R10—4700 ohms (nominal, see text)

Capacitors
C1—.01 µF, ceramic disc
C2—.047 µF, Mylar or ceramic disc
C3—470 pF, mica or ceramic disc
C4—1000 pF, Mylar or ceramic disc
C5—33 pF, mica or ceramic disc
C6—220 pF, mica or ceramic disc
C7—330 pF, mica or ceramic disc
C8, C10—1 µF, 10 volts or higher, electrolytic
C9—0.22 µF, mica or ceramic disc
C11—10 µF, 6 volts or higher, electrolytic

Semiconductors
D1—1N914
IC1—CA3140 op-amp
Q1, Q2—2N3904, 2N2222, or equivalent general purpose NPN transistor
L1, L2—68-180 µH "loopstick" AM-radio oscillator coil (Miller 9055, Miller 9018, or equivalent)
B1—9-volt battery, transistor-radio type
J1—phono jack
S1—SPST switch

Miscellaneous: wire, solder, stranded hook-up wire (for antenna, see text), etc.

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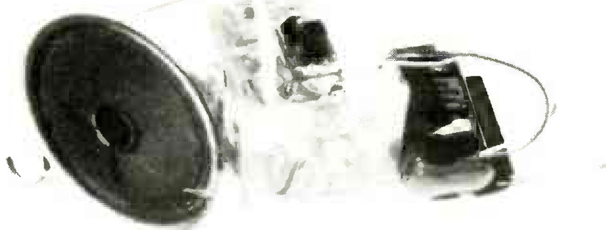


2. ELECTRONIC SIREN

The schematic diagram of the siren is shown in Fig. 2. The "wailing" sound of the siren is generated by a variable-frequency oscillator consisting of Q1 and Q2. Capacitor C2 provides the feedback for the oscillator. The frequency of the oscillator is varied by the voltage applied to the base of Q1 through R3. When switch S1 is closed, capacitor C1 charges, thus increasing the oscillator frequency. When S1 is released (opened), capacitor C1 discharges and the oscillator frequency decreases. Capacitor C3 limits the maximum oscillator frequency. The average battery current drain is about 15 milliamps.

Construction

You can build the siren using any construction method you choose; there is nothing critical about the layout. Be sure to use only the transistors listed for Q2. You have a little more flexibility in choosing Q1, as long as it is equivalent to the ones listed. Use a miniature push-button-switch for S1. When S1 is closed, the siren will begin its upward wail; a slow, downward wail will begin as soon as S1 is released.

The loudspeaker should be a miniature 8-ohm transistor-radio type. You can change the overall pitch of the siren by changing the value of R3. If you decrease the value of R3, the overall pitch of the siren will increase. Too small a value of resistor R3, however, could make the oscillations stop prematurely, provided that switch S1 is held down long enough.

PARTS LIST—SIREN

Resistors, ¼ watt, 5%, unless otherwise noted
R1, R4—7500 ohms
R2—33,000 ohms
R3—270 ohms
R5—4.7-10 ohms
Capacitors
C1—100 μF, 10 volts or higher, electrolytic
C2—.0068 μF, Mylar or ceramic disc
C3—1 μF, 10 volts or higher, tantalum or electrolytic
Semiconductors
Q1—2N3904, 2N2222, or equivalent NPN transistor
Q2—MJE370 or 2N4919 PNP transistor
B1—9-volt battery, transistor-radio type
S1—SPST momentary pushbutton-switch, normally open
Miscellaneous: wire, solder, 8-ohm speaker, etc.

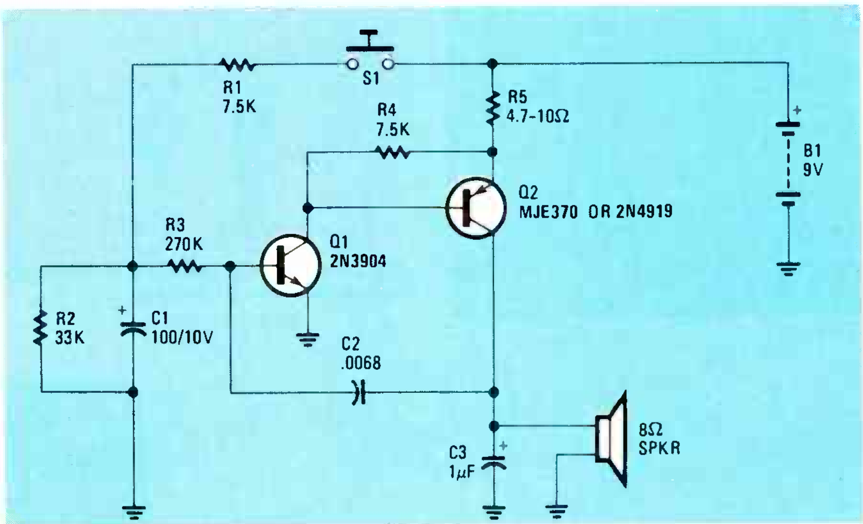
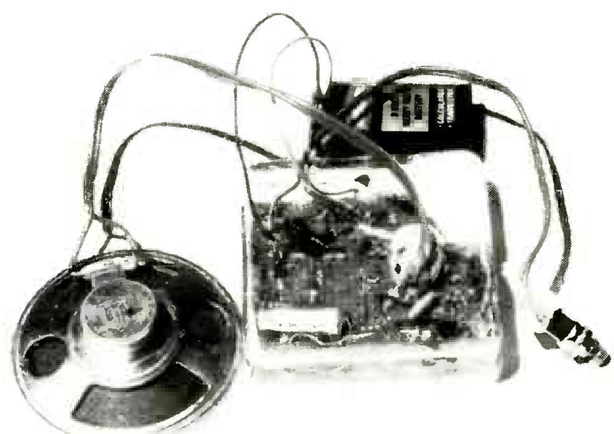


FIG. 2—EASE OF CONSTRUCTION makes this electronic siren a great first-time project for your child. Be sure to use only the transistors listed for Q2.



3. ELECTRONIC BIRD CHIRPER

The schematic of the electronic bird chirper is shown in Fig. 3. Transistors Q1 and Q2 form the two halves of a free-running multivibrator whose frequency is determined by the voltage across C8. That capacitor is charged and discharged by closing and opening switch S1.

Transistors Q3 and Q4 make up a variable-frequency oscillator similar to the one used in the siren. The output of the free-running multivibrator frequency

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modulates the Q3-Q4 oscillator, causing the "chirping bird" sound. The number of chirps per second is determined by the frequency of the Q1-Q2 multivibrator, which also varies. The pitch of the chirps is determined by C5 and C6.

Construction

Once again, there is nothing critical in the layout of this project; it can be built using any of the popular construction techniques. The chirping is controlled by opening and closing switch S1, a normally open, momentary SPST pushbutton switch. When you finish the circuit, if the pitch of the chirps is too low and not bird-like, you can omit C5; but monitor the battery current if you do so. (If you can, substitute a current-limited power supply for the battery while you are testing the circuitry; doing that will prevent the battery from draining. If the current drain exceeds 50 milliamperes when S1 is closed for a second or so, you should raise the value of C6. Be sure to use the listed transistor for Q4.

PARTS LIST—BIRD CHIRPER

Resistors, ¼ watt, 5%, unless otherwise noted
R1, R8—20,000 ohms
R2, R4—4700 ohms
R3—12,000-18,000 ohms
R5—180 ohms
R6—5600 ohms
R7—120,000 ohms

Capacitors
C1, C3—10 µF, 6 volts or higher, electrolytic
C2—3300 µF, 10 volts or higher, electrolytic
C4—.0047 µF, Mylar or ceramic disc
C5—0.1 µF, Mylar or ceramic disc
C6—.02 µF, Mylar or ceramic disc
C7—200 µF, 10 volts or higher, electrolytic
C8—100 µF, 10 volts or higher, electrolytic

Semiconductors
D1—1N914
Q1-Q3—2N3904, 2N2222, or equivalent NPN transistor
Q4—MJE370 or 2N4919 PNP transistor
B1—9-volt battery, transistor-radio type
S1—SPST momentary pushbutton switch, normally open

Miscellaneous: wire, solder, miniature 8-ohm speaker, etc.

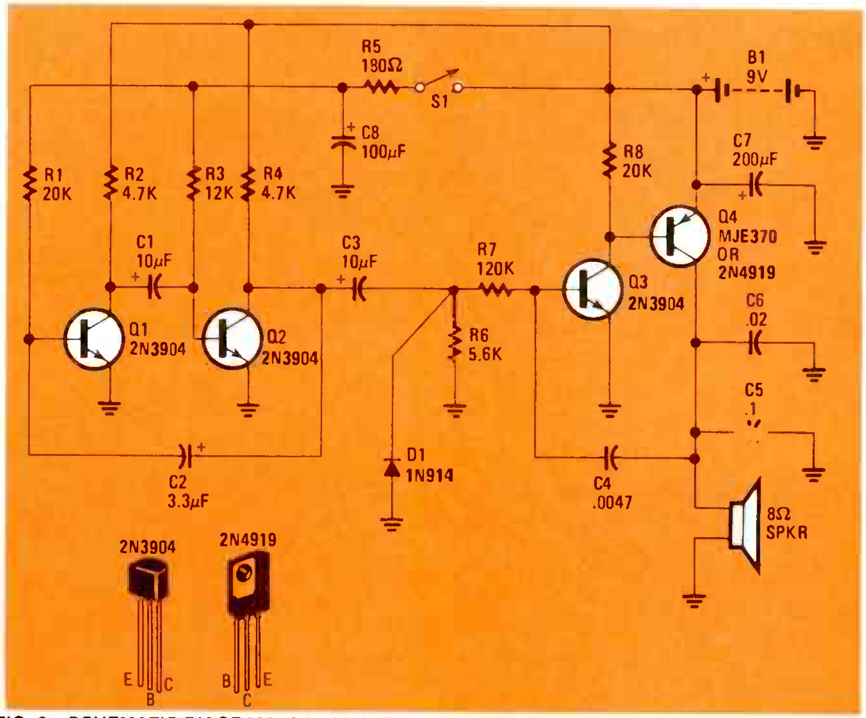
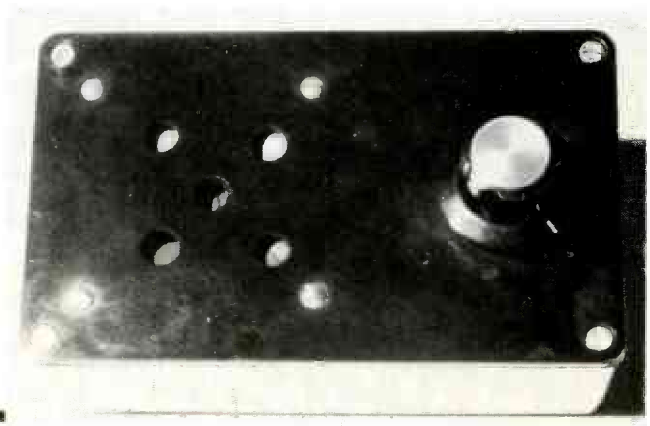


FIG. 3—SCHEMATIC DIAGRAM of the bird-chirper toy. The pitch of the bird sounds is determined by capacitors C5 and C6 (see text).



4. CHUG-CHUG

The schematic diagram for this project is shown in Fig. 4. Op-amp IC1, a CA3240 dual MOSFET-input device (equivalent to two CA3140's), is used as a white-noise source. The white noise appears on pin 7 of IC1 as a current rather than a voltage signal. The noise is not converted to a voltage because of the low AC impedance around IC1. That low impedance makes the layout less critical than for other types of noise sources, and eliminates the need for shielding to prevent hum pickup.

Op-amp IC2 is used as a driver stage for the push-pull output stage formed by Q5 and Q6. Negative feedback is taken from that output stage and brought back to pin 2 of IC2. Resistors R6 and R8 determine the minimum amount of negative feedback, and hence the maximum gain.

Transistors Q2, Q3, and Q4 form a variable-frequency multivibrator; resistor R11 is the SPEED control, and is used to control the multivibrator's frequency. The output from the multivibrator is differentiated by C8, and is then applied to modulator transistor Q1 through D1 and R7. Transistor Q1 modulates the gain of the output-amplifier stage by changing the impedance to ground seen by R6 and C4. That creates chopped white-noise; there is also residual low-level noise from IC2 when Q1 is not conducting. When the multivibrator's frequency is reduced using R11, C8 discharges slowly, creating a sound similar to escaping steam from a stopped locomotive. As the multivibrator's frequency is increased, the toy generates a sound like an accelerating locomotive.

Construction details

The only thing to keep in mind when

continued on page 93

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Why Radio Moscow is WINNING the dB WAR

If you are an SWL'er, you may have noticed that Radio Moscow's signal appears much stronger than its competition's. We can't be certain why, but this may be the reason.

*STANLEY LEINWALL

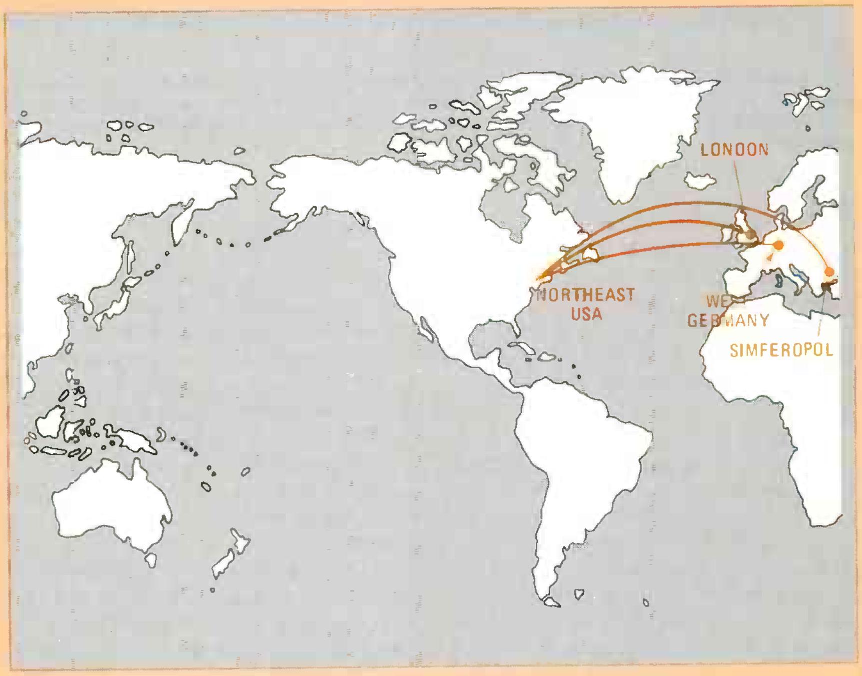

FIG. 1—SIGNALS FROM THE RUSSIAN TRANSMITTERS at Simferopol travel more than 1,000 miles farther than those from the BBC or Deutsche Welle. They also follow a more northerly path, putting them closer to the auroral zone.

RADIO MOSCOW'S ADDITION OF A WORLD Service in English several years ago provided yet another example of the strong emphasis the Russians have placed on shortwave broadcasting as a highly effective and economical medium for the mass dissemination of information. (A "World Service" is a 24-hour-a-day operation that serves all parts of the world: that differs from Moscow's earlier English-language service where broadcasts occurred only at certain times of day and were aimed only at English-speaking regions.) The Russians are by far the world's largest broadcaster. Using approximately 200 shortwave transmitters operating around the clock, they transmit in 65 different languages and dialects to virtually every corner of the globe.

The Soviet effort in broadcasting has not been concentrated solely on quantity. Listeners here in North America have observed that many Soviet shortwave signals are stronger than most competing broadcasts. In some cases, signals coming direct from the USSR are stronger than the relays coming from Cuba, leading you to believe that radiated power levels from the Russian-based transmitters are enormous.

Technically, however, one would not expect that to be the case, and there is, in fact, growing evidence to indicate that the Russians are instead considerably ahead of the West in the application of antenna and propagation theory for long-distance shortwave communication.

As an example, consider one of the principal transmitting sites used by the Soviets for their broadcasts to North America. Located in Simferopol, in the Crimea, it is approximately 5000 miles from the northeastern United States. Yet, signals from that transmitter site are considerably stronger in North America than signals from the BBC and Deutsche Welle, in spite of the fact that the transmitters for the latter two are at least 1000 miles closer to their target areas.

The world map shown in Fig. 1 illustrates the normal paths that those signals travel. Note that not only does the Russian signal need to travel more than 1,000 miles farther than the signals from the BBC and Deutsche Welle, but that the path of the Soviet signals is farther north and closer to the auroral zone. Both factors are quite significant.

In general, the farther radio signals must travel from a transmitting station, the weaker they are. Based on the location of the BBC, Deutsche Welle, and

*Stanley Leinwoll is Director of Engineering, U.S. for Radio Free Europe—Radio Liberty.

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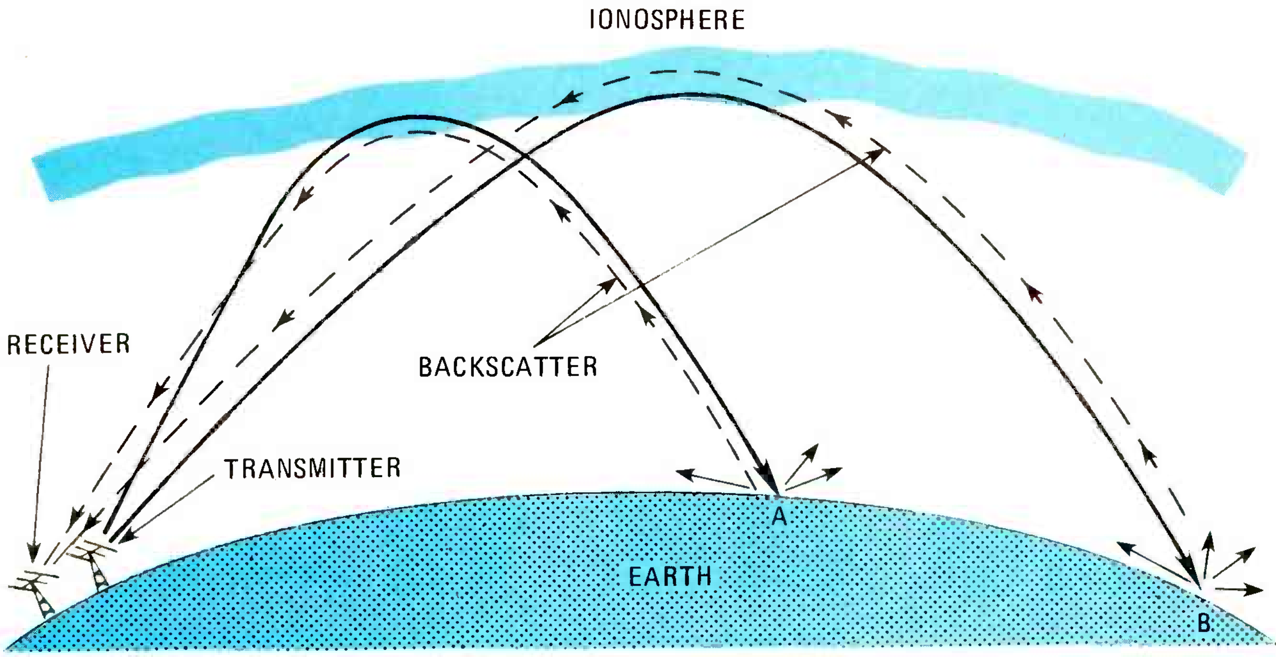

FIG. 2—WHEN SIGNALS STRIKE THE EARTH they are reflected; some of the energy is reflected back towards the transmitter where a receiver can pick it up. In an operational backscatter system, that reflected signal can be used to determine which frequency and angle of radiation are the most effective at the time.

Radio Moscow transmitters, we would expect the signals from the Soviet station to be 10 to 12 dB weaker than signals from the BBC and Deutsche Welle—all other things being equal. Yet, Radio Moscow's signal strength is generally about 10 decibels higher than the BBC's.

The more northern path of the Russian signal is important because the ionosphere in the auroral zone is frequently unstable. Northern lights, or auroras, are very common in that zone and adversely affect radio transmissions passing through the zone or close to it. During periods when the ionosphere is disturbed, the auroral zone moves south and signals that are normally stable are weakened. That is why transmissions from the BBC to North America, for example, "break up" before signals from Rome and Madrid. The paths of the latter signals lie farther to the south and those signals are therefore less prone to auroral effects even during ionospheric disturbances. But despite their more northerly path, Radio Moscow's signals remain strong even under adverse ionospheric conditions.

If SWL's (*S*hort*W*ave *L*isteners) receive Radio Moscow signals about 10 dB more strongly than signals from the BBC, and if we consider that the BBC uses 250-kilowatt transmitters and high-gain curtain antennas that are located more than 1000 miles closer to America than those of Radio Moscow, then a few simple calculations would seem to lead us to the conclusion that the power output of the Radio Moscow transmitters is on the order of 32,000 kilowatts (32 *megawatts*) or more! But that is not the case, for—as far as is known—the most powerful transmitters the Russians use for international broadcasting have power outputs on the order of 500 kilowatts. What, then, are the Russians doing that is, in effect, giving them a power gain of over one hundred?

The mystery deepens if you listen carefully to Radio Moscow when it first comes on the air. Frequently the Russian signal will rise and fall in strength over a period of several minutes; that rise and fall is not related to normal fading of DX signals. After that, the signal level increases to a peak value and then remains very high for the remainder of the broadcast.

Backscatter

Scientists are becoming convinced that they have unraveled the mystery. Since the Soviets are apparently not using super-power transmitters, they must be doing something to their signals. The signal variation may be related to a technique called "backscattering". In addition, the Russians appear to be using antenna systems that are more sophisticated than anything currently available in the West.

The principle of backscatter has been known for a long time. Essentially, on returning to earth after being reflected by the ionosphere, a radio signal is scattered in all directions because of the irregularities in the earth's surface (see Fig. 2). A small fraction of the energy is returned to the transmitter site—having been "scattered" back in the direction from which it came. The strength of the "backscatter" echo depends on the strength of the signal that struck the ground after reflection by the ionosphere.

It follows that if a wide range of frequencies is transmitted, some frequencies will penetrate the ionosphere and go into space, some will be absorbed, and some will be reflected. Backscattered signals will be received only for the frequencies that are reflected. Furthermore, the round-trip time delay of a very short pulse of radio energy is related to how far away from the transmitter the scattering took place; the longer the time delay, the farther away the signal was returned to earth.

A number of very useful facts can be obtained from an operational backscatter-system: We can determine the range of frequencies that the ionosphere is reflecting at any given time. From the strength of the backscatter signal we can learn which frequencies are strongest on reaching the earth from the ionosphere, and that tells us which frequencies the ionosphere is propagating best. From the time delay of the returned pulse and the characteristics of the transmitting-antenna pattern, we can also learn the height of the ionosphere from which the signals are being reflected. Using that information, it is possible to schedule frequencies that will deliver the best signals to a given target area. But, better still, that information makes it possible to determine the optimum radiation angles.

Suppose, for example, that in using conventional radio-forecasting techniques, the Russians have determined that at a particular hour the 7-MHz band should be optimum for transmission to the United States. The best radiation angle for that transmission will depend

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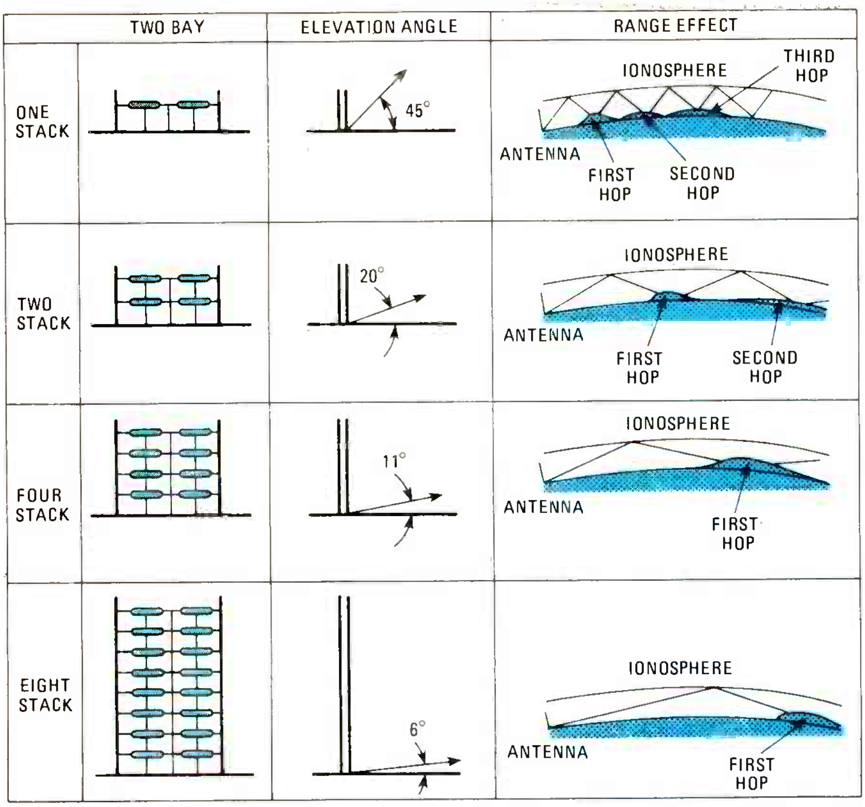


FIG. 3—THE MORE STACKS a curtain antenna has, the lower its angle of radiation will be.

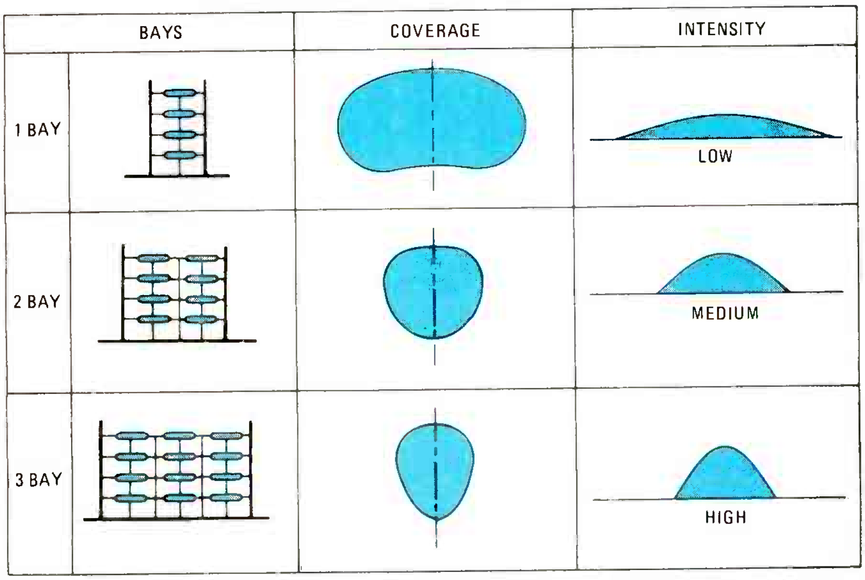


FIG. 4—THE WIDTH OF THE BEAM narrows, and the strength of the signal delivered to the target area increases, as the number of bays of a curtain antenna increases.

upon the height and state of the ionosphere at that time. A backscatter system that transmits very short pulses at various vertical angles could tell the broadcaster which radiation angle was returning the strongest signal, and consequently which angle would *deliver* the strongest signal. Appropriate adjustments in the vertical radiation angle of the antenna could then be made.

Antennas

The most sophisticated shortwave-broadcasting antenna systems are known as *curtains*, consisting of arrays of dipole antennas erected in a plane and fed from a common source. The dipole antennas are arrayed both horizontally and vertically (one above the other). The number of dipoles erected vertically are called *stacks*, and the number horizontally are called *bays*.

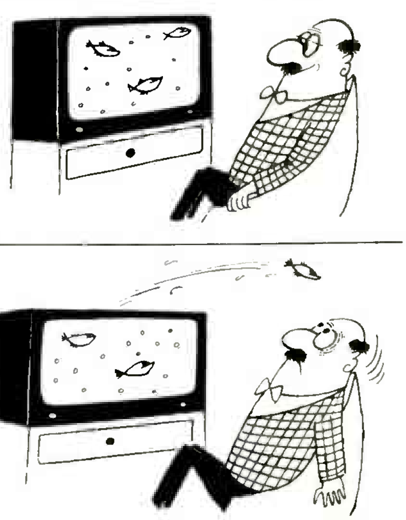
As the number of stacks is increased, the vertical firing-angle narrows and becomes lower, concentrating more and more energy into a narrower beam as shown in Fig. 3. As the number of bays is increased, the horizontal radiation pattern narrows, again concentrating the energy into a narrower beam as shown in Fig. 4.

In the West, most curtain-antenna systems consist of four bays and four stacks. Such systems provide an antenna gain on the order of about 20 decibels. There is now considerable evidence to indicate that some Russian transmitting antennas, especially those used for long-distance broadcasting, consist of eight bays and eight stacks, giving an antenna gain of close to 30 decibles. Furthermore, curtain antennas can be slewed—that is, the vertical and horizontal angles at which the antenna radiates can be varied—by adjusting the phasing of the signals being fed to each bay and stack of the antenna.

Experiments have shown that a gain of from 6 to 10 dB is possible if the ionosphere's height is properly used. Slewing is one way that the gain can be achieved. It would appear, therefore, that slewing, combined with a backscatter system, is the method used by the Russians to deliver such strong signals to the United States.

The use of optimum vertical radiation angles would also account for the Russian signals' remaining so strong during ionsopheric disturbances. We have learned that during certain types of disturbances the ionosphere "tilts" and is no longer parallel to the earth's surface. Such tilts could affect optimum radiation angles, and backscattering for optimum angles would be invaluable.

The Russians tell us very little about their technical facilities, and we can only make some guesses from what we observe. But based on the strength of the signals from the BBC and Deutsche Welle using known antenna gains and transmitter powers, we must conclude that the Russians are using facilities and techniques that the United States will not be able to duplicate for at least three to five years. **R-E**



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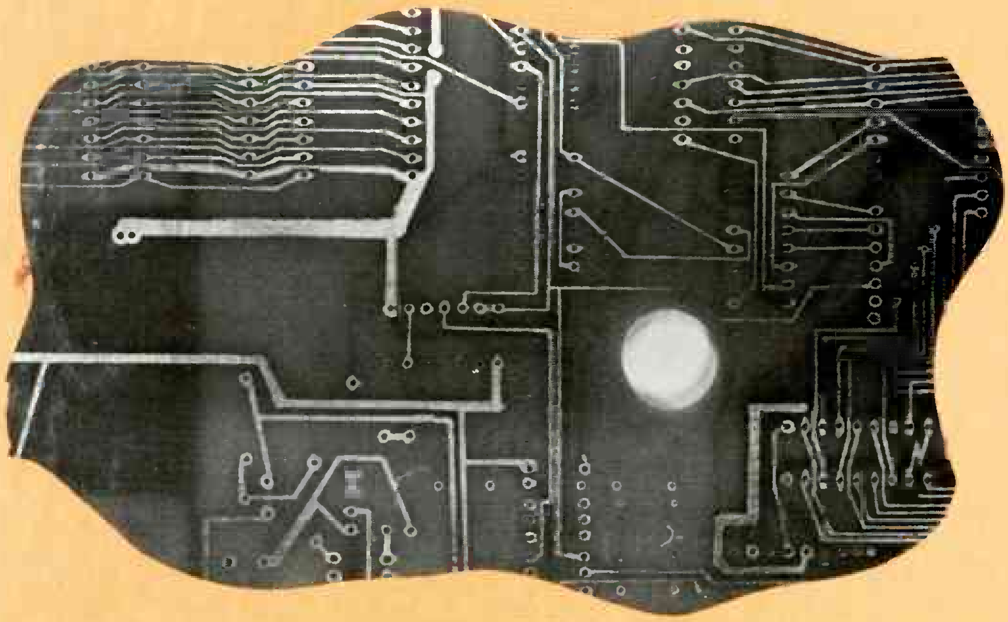
HOW TO



ETCH YOUR OWN PC BOARDS

Even the most complicated printed-circuit boards are easy to make with this simple technique. No exotic materials are required.

NEIL R. DAVIS

ONE OF THE MORE DIFFICULT PROBLEMS YOU MAY RUN INTO when you build a complicated project is laying out and etching the circuit boards. There are several techniques that can be used, but all of them seem to have one drawback or another. For small boards, the usual methods include dry transfers, drafting tape, or etch-resist pens.

The dry transfers produce clean, sharp lines, but are difficult to use where there is a lot of fine work or where there are bends in the pattern. In addition, they don't always adhere properly throughout the etching process; you're likely to find the transfer floating in the bath while the foil disappears in the etching solution. The same problem occurs with narrow drafting tape, although the wider strips work reasonably well. Etch-resist pens are a good idea, but often don't protect the copper adequately.

Large boards, or microprocessor boards with complex buses, are difficult to make without using photographic techniques. Unfortunately, the photographic equipment and drafting aids needed make this technique somewhat impractical for the low-budget hobbyist.

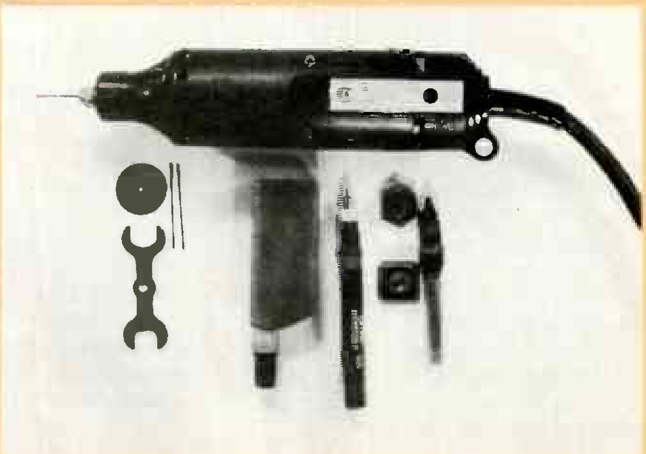


FIG. 1—TINTED SHELLAC, a *Rapidograph* or similar drafting pen, a high-speed rotary drill, and drill bits are the only tools you need to make high-quality PC boards.

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The easy way

The method described here uses a different etch-resist—ordinary shellac—that is laid down using a drafting pen such as the Koh-I-Noor *Rapidograph*, or similar pens made by Keuffel & Esser and Staedler-Mars. The tools that you'll need (including a PC-board drill) are shown in Fig. 1. The shellac should be tinted with a paint pigment (blue makes for good contrast) so that it is visible on the copper. Mix the shellac and the pigment thoroughly, and use the mixture undiluted.

To lay down a trace, simply draw a line on the copper, and go over it again if necessary, judging the thickness of the trace by the density of the pigment. For very fine work, it may help to dab the pen on the copper like a pogo stick to build up an even layer. Be careful that you don't leave an "empty" area in the center of a line.

What if you make a mistake? For smaller errors, scrape off the dried shellac with a small knife-blade, then clean the area with an ink eraser before redrawing. Larger mistakes can be removed easily with a cotton swab dipped in shellac thinner (methanol). Use the same solvent to clean the shellac off the board after etching, and to clean out the pen—it won't hurt

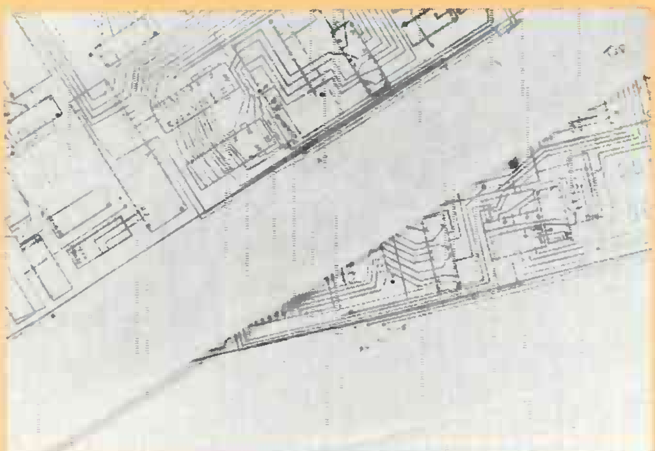

FIG. 2—DRAW YOUR PATTERN on a sheet of tracing paper that has been attached to a sheet of graph paper. The graph paper should have 0.1-inch spacing. For double-sided boards use a second sheet of tracing paper.

the plastic parts. As a matter of fact, the shellac can be left in the pen for several days or more without drying up or even getting gummy.

The technique is just as useful for small boards as it is for large ones. For small boards, simply copy the artwork from an article or draw your own on the copper. For larger boards, you will generally want to lay out your artwork on paper before working in shellac (see Fig. 2). The artwork can be done much more quickly if you use tracing paper or onionskin typing paper stapled or taped to a sheet of graph paper that has 0.1-inch spacing (the same spacing as IC pins).

For double-sided boards, add a second sheet of tracing paper for the traces on the other side of the board. As a general rule, put the most complicated traces (data bus, address bus, etc.) on the bottom side of the board, and use the top side of the board to "cross over" the traces on the bottom. Remember that the holes will not be plated through so allow for feedthrough jumpers where necessary. Use No. 28 or 30 wire-wrap wire for the jumpers and solder them on both sides of the board.

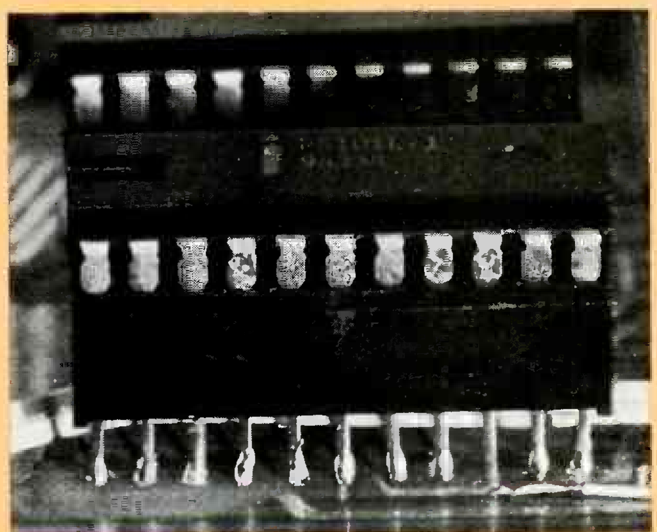

FIG. 3—SINCE THE HOLES ARE NOT PLATED THROUGH, wire-wrap sockets should be raised about 3/16 inch off the board so that the pins can be soldered on both sides.

For complicated boards, it might be a good idea to use a hybrid wire-wrap/PC construction technique: Use the bottom side of the board for most of the circuitry; use the top side of the board for the power and ground, and wire-wrap sockets and wire-wrapping for the runs that won't fit on the board. The wire-wrap sockets should be raised approximately $^{3}/_{16}$ inch above the board to allow them to be soldered to both the top and bottom traces, as shown in Fig. 3.

Another approach for very complicated boards is to use both sides of the board for the circuit traces, and to hard-wire the ground and power lines later using jumpers. That is what was done in the board shown in Fig. 4: a microprocessor board with keyboard and display interface, a serial data interface, a total of 52 ports, and a battery-powered back-up memory.

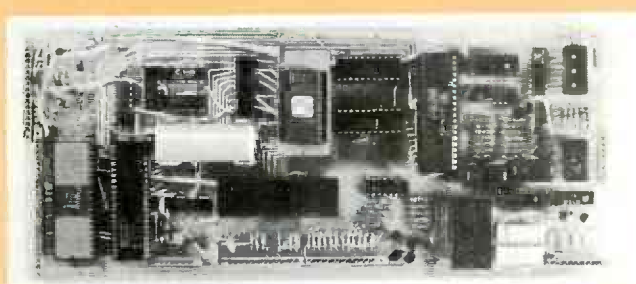

FIG. 4—THIS MICROPROCESSOR BOARD was built using the hybrid wire-wrap/PC construction discussed in the text. The board has a keyboard and display interface, a serial data interface, a total of 52 ports, and a battery-power memory back-up.

Step-by-step

The first step in making a board is drilling the holes. That is best done with a Dremel or similar high-speed rotary drill. Make a photocopy of your completed layout for use as a drilling guide, tape it to the board, and mark all of the holes with a center punch or scratch awl. For small boards, a piece of perforated construction board using 0.1-inch spacing makes an excellent drilling guide (see Fig. 5).

Use a No. 62 or No. 60 drill bit for resistor and capacitor

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solder pads, and for IC solder pads where traces do not run between the pads; a No. 65 bit where the traces *do* run between the IC solder pads, and a No. 74 bit for feedthrough holes.

After you've finished drilling, clean off all the burrs with a fine file, sand the board thoroughly with No. 400 sandpaper, and then clean the board thoroughly by scrubbing the board with cleanser and water.

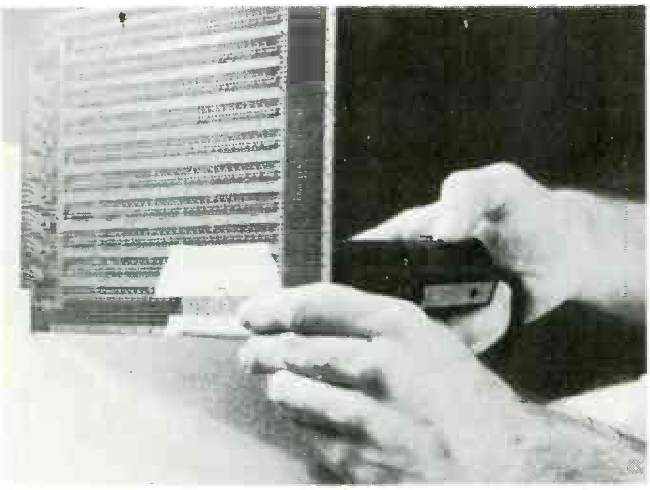


FIG. 5—WHEN DRILLING A SMALL BOARD, a piece of perforated construction board with 0.1-inch spacing makes an excellent drilling guide.

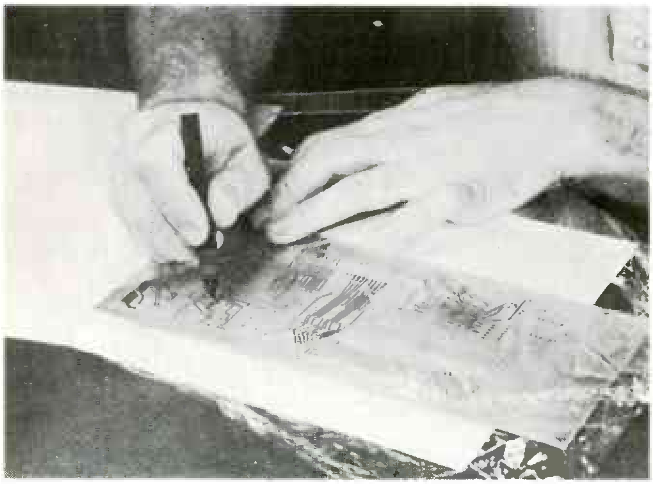
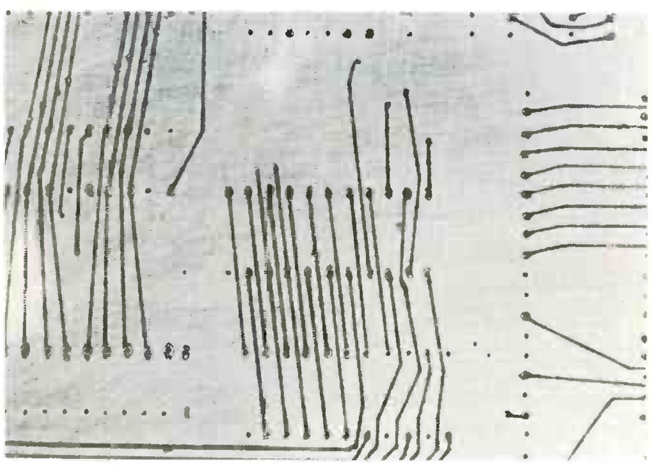


FIG. 6—PLASTIC KITCHEN WRAP is used to protect sections of the board that you are not working on from skin oils and smudging.



CLOSE-UP VIEW OF A PC BOARD under construction showing the shellac resist in place.

When that has been done, you can start drawing the pattern on the board. Complete one side of the board before starting the other, and begin by drawing the IC pads with the tinted shellac. Then, draw the larger traces using a drafting pen with a No. 2½ tip; use a No. 1 tip for traces that go between the IC solder pads and for labeling the board. Use a straightedge to guide the pen, and plan your work so that you will not have to lay the straightedge on wet shellac. Cover the portions of the board that you are not working on with plastic kitchen wrap, as shown in Fig. 6, to prevent contaminating the copper with skin oils and salts, and to keep from smudging the board.

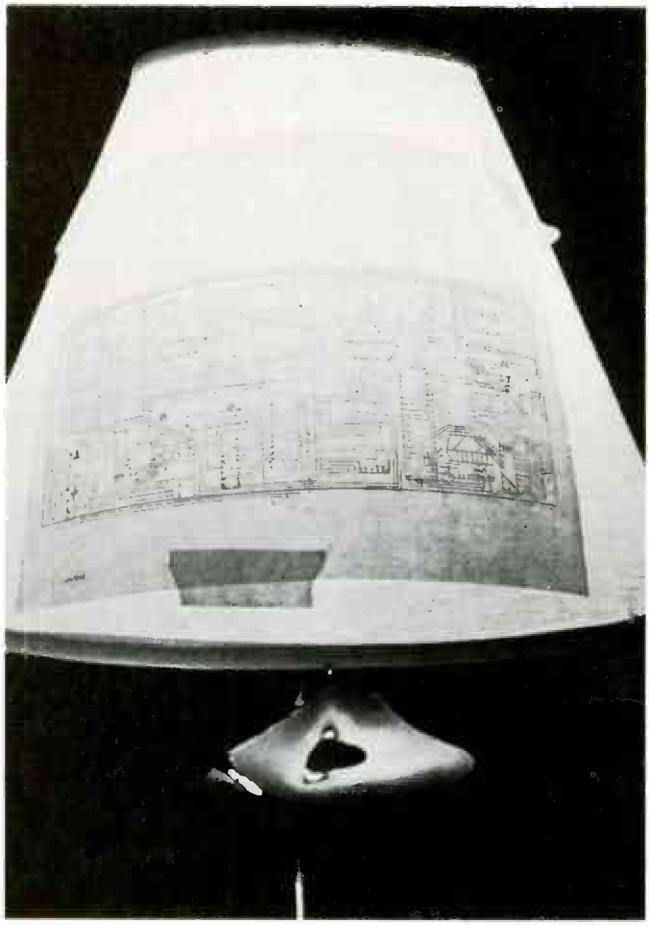


FIG. 7—TO OBTAIN A MIRROR image copy of a foil pattern, tape the art to a lampshade and trace it.

To draw the traces on the top side of the board, simply copy your artwork. For the bottom side of the board, you will have to turn your artwork over and hold it up to a light (taping the drawing to a lamp shade as shown in Fig. 7 is one approach that will make the job easier) before copying the artwork onto the copper.

After etching, clean the board thoroughly with methanol to remove the shellac. If you have followed the instructions, and have been careful, the result will be a clean and sharply-detailed foil pattern.

Be sure to solder all feedthrough jumpers on the top and bottom sides of the board before installing the sockets or IC's. Try to use sockets for the larger or more expensive IC's, or where you anticipate circuit changes. Soldering the IC leads is usually safe, but it is a good idea to use a temperature-controlled iron with a fine tip to avoid any damage resulting from excessive heat.

When the board is completed, clean off all solder residue with lacquer thinner or carburetor-cleaner spray. As a final step, coat the copper traces with a varnish or lacquer to prevent corrosion. R-E

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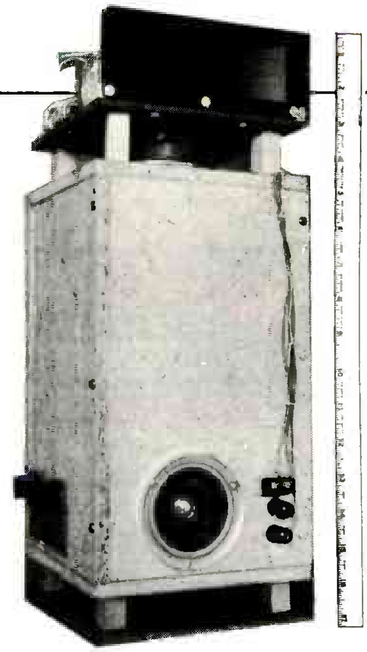
BUILD THIS



HI-FI MINI SPEAKER

The SAFE principle allows extended bass response from small speakers. Here's a 3-way mini-SAFE speaker you can build that's just 17 inches high; it will astound you with its performance and low cost.

GEORGE PAPPANIKOLAOU

ONE OF THE MANY PROBLEMS WITH MINI-SPEAKER SYSTEMS IS that it is difficult—if not downright impossible—to get full-size performance from them. (For example, it would be ludicrous to try to design a mini-Klipschorn!) By using acoustic-suspension techniques and special speakers, some manufacturers have managed to produce high-quality mini-speakers, although at a decrease in efficiency and an increase in price. Some people feel that there is no advantage to a mini-size speaker system that has to be used with a hefty amplifier.

There *is* an approach other than acoustic-suspension, however, that can be used for smaller speaker-systems. That is the SAFE (*S*ymmetrical *A*ir *F*riction *E*nclosure) configuration, covered by U.S. patent No. 4,168,761. Figure 1 illustrates the SAFE principles.

A SAFE speaker-system does not use a sealed enclosure, but, rather, makes use of both the front and back waves emanating from the woofer to provide clean, extended, bass response. The mid- and high-range radiators are conventional; the difference lies in how the bass is treated. The woofer is mounted near the top of the enclosure, facing downwards. The back wave propagates freely in all directions through the opening at the top of the enclosure. (Low-frequency sound is essentially non-directional to the ear—the idea is to generate as much of it as possible.)

The front wave from the woofer (represented by the dashed line) propagates along a path determined by a series of chambers formed by three centrally-located horizontal partitions and three other horizontal partitions with center holes (see Fig. 2). The wave is repeatedly split and recombined as it follows this path. That slows its speed, making it apear as if it had traveled a longer distance than the length of the path actually permitted. Upon reaching the center hole of the lowest partition, the back wave travels down the vertical port (tube) until it reaches the bottom plate of the enclosure and exits to the outside, again dispersed in all directions. The relatively long path (real and apparent) followed contributes to the low-frequency efficiency of the SAFE design.

Having already designed woofers and subwoofers using SAFE principles, I decided to try to use the same principles to build a three-way mini-size speaker that could be used by itself with a small amplifier, or with a subwoofer, to form a complete subwoofer-plus-satellite stereo-speaker system. While neither would be suitable for outdoor concerts, they would be more than adequate to fill the average-size listening room with sound.

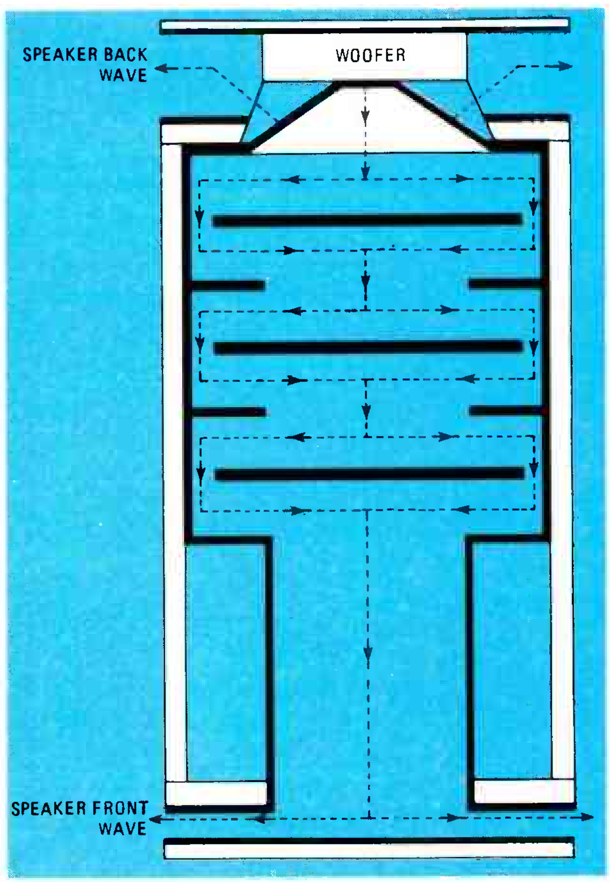


FIG. 1—SAFE EFFECT uses both the front and back waves from the woofer to extend bass response. The front wave travels through an acoustically long labyrinth to increase apparent size of enclosure.

Speaker selection

The 8-ohm speakers needed for the mini-SAFE system should be available from a number of sources: mail-order houses, audio outlets, and even car-stereo dealers.

The 5¼-inch woofer must be of the free-cone type—that

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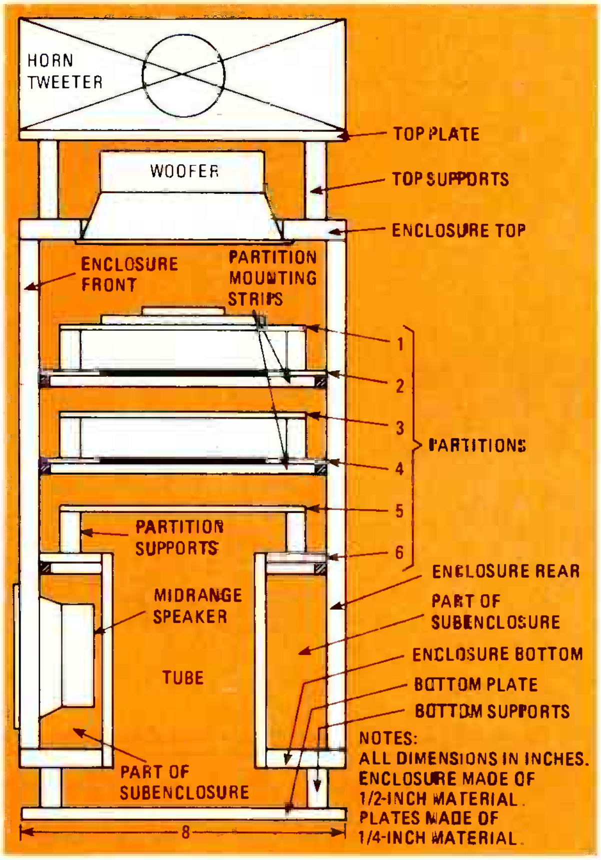

FIG. 2—LARGE HORN-TYPE TWEETER can be mounted above woofer. Sealed mid-range speaker is fitted into its own airtight sub-enclosure.

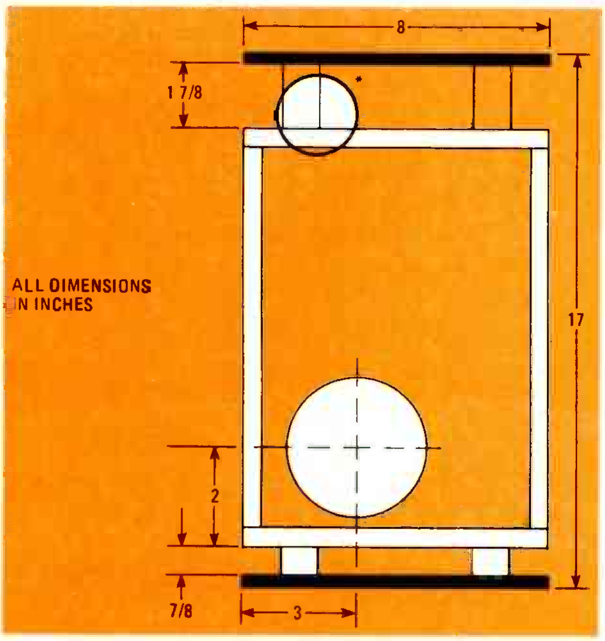

FIG. 3—POSITION OF CONE or dome-type tweeter is marked by asterisk. Note that both tweeter and mid-range speaker are mounted off-center—the latter to eliminate standing waves.

PARTS LIST—CROSSOVER NETWORK

L1—620 turns No. 18 enameled wire one-inch core, three inches long.
C1—2.2 μF, non-polarized (1.0 μF may be required if large horn-type tweeter is used)
C2—47 μF, non-polarized
L-pads—standard, 8 ohms (Radio Shack 40-980 or similar)

PARTS LIST—ENCLOSURE

Quantity	Size (inches)	Description
2	8 × 8 × ¼	Top and bottom plates
2	3½ × 5⅝ × ¼	Part of tube
2	4 × 5⅝ × ¼	Part of tube
1	2 × 2 × ¼	Part of partition-1 assembly
1	7 × 7 × ¼	Partition 6 (with 4 × 4-inch hole for tube)
4	1⅞ × 1 × 1	Top supports
4	⅞ × 1 × 1	Bottom supports
12	1 × 1 × 1	Partition supports
6	7 × ¼ × ¼	Mounts for partitions 2, 4, and 6
6	6½ × ¼ × ¼	Mounts for partitions 2, 4, and 6
2	7 × 7 × ⅛	Partitions 2 and 4 (with 4 × 4 center holes)
3	6 × 6 × ⅛	Partitions 1, 3, and 5
2	8 × 12¾ × ½	Enclosure sides
2	7 × 12¾ × ½	Enclosure front and rear panels
1	4 × 4 × ½	Part of partition-1 assembly
2	8 × 8 × ½	Enclosure top with woofer mounting-hole and enclosure bottom with 4 × 4 center hole

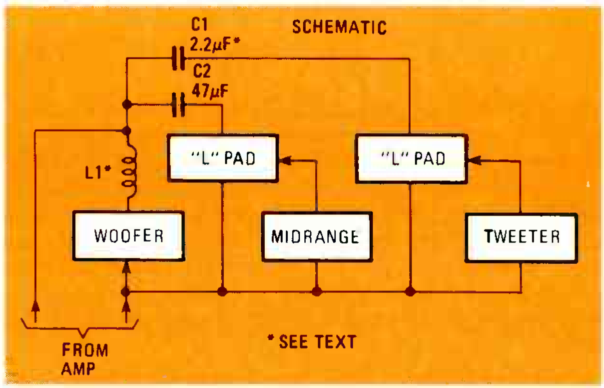

FIG. 4—SIX dB/OCTAVE crossover network is simple to build. L-pads balance sound from the three sections of the system.

is, the cone has to be able to radiate from both its front and back. A sealed acoustic-suspension type woofer is not suitable for use in a SAFE system. Woofers of the free-cone type are frequently found in car-stereo upgrade systems and can usually be purchased separately. A good heavy magnet is also essential—about 16-20 ounces.

A car-stereo outlet may also be able to provide the mid-range unit. It should be an acoustic-suspension type, about 3¾-inches in diameter with a 6-10 ounce magnet.

Both the woofer and mid-range units should be as shallow as possible, to fit into the small enclosure. If the woofer is too deep, it is possible to add some height to the cabinet, but the mid-range speaker is fairly critical in that respect.

The choice of a tweeter is not critical—it can be a high-efficiency cone or dome type, or even a relatively large horn mounted on top of the cabinet as shown in Fig. 2. A cone or dome-type tweeter should be mounted in the area indicated by an asterisk in Fig. 3. The tweeter is mounted to one side so that, if the mini-SAFE system is used in a horizontal position, the tweeter will be located higher than the mid-range speaker. (With a large horn, the positioning doesn't seem to make a difference.)

If desired, two systems can be made mirror-images of each other—that can improve the stereo effect, although, since the systems are so small, it may not be an important factor.

Crossover and L-pads

The mini-SAFE's crossover networks and L-pads are shown in Fig. 4. The L-pads are used to balance the system and also to optimize its bass response, which can vary depending on where in the listening room it's placed. (The bass

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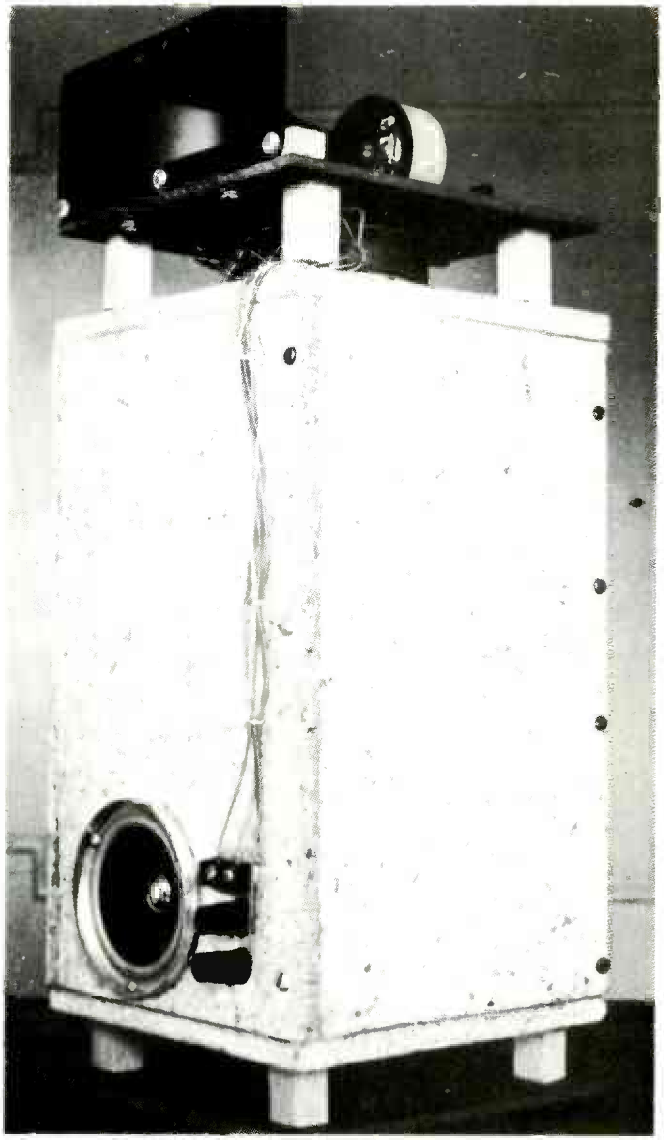

FIG. 5—CONNECTIONS FROM crossover network and L-pads are brought out through mid-range sub-enclosure. L-pads are on left side of enclosure.

PARTS LIST—SPEAKERS

Woofer: 5- or 5¼-inch woofer, 16-20 oz. magnet, open front and rear (not acoustic suspension) (Herald S-22 or equivalent)
Mid-range: 3¾- or 4-inch, 6½-10-oz. magnet, sealed (air-suspension) (Pioneer TS-107 or equivalent)
Tweeter: Cone, dome, or horn-type, high efficiency. Size not critical

will generally increase if the system is located near a room boundary and decrease as it is moved away from the walls and/or floor.)

The L-pads are standard 8-ohm units, available from a number of sources. It's important to make sure that they have adequate power-handling capacity. (The entire system is rated at 15-20 watts, maximum.)

The crossover networks are designed with a 6 dB/octave rolloff. The mid-range crossover network is designed to take effect at about 450 Hz; the high-frequency one has a crossover point of about 10 kHz. If a horn-type tweeter is used, the value of C1 should be changed from 2.2 μF to 1.0 μF. Coil L1 is made from 620 turns of No. 18 enameled wire wound on a one-inch core three inches long. Do not try to wind a shorter, thicker, coil—it may not fit into the space intended for it.

Figure 2 shows a sub-enclosure for the mid-range speaker.

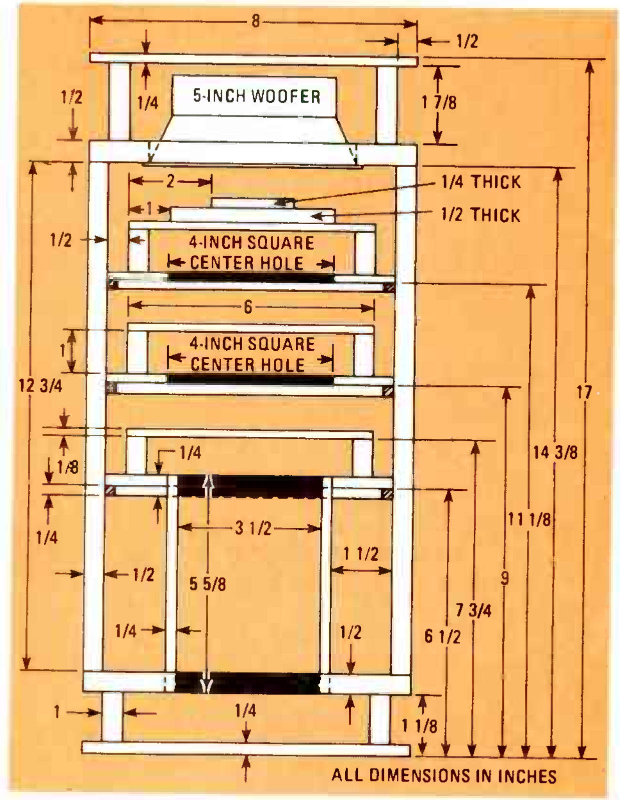

FIG. 6—CRITICAL DIMENSIONS for mini-SAFE enclosure. If woofer is deeper than one shown, top supports may be lengthened.

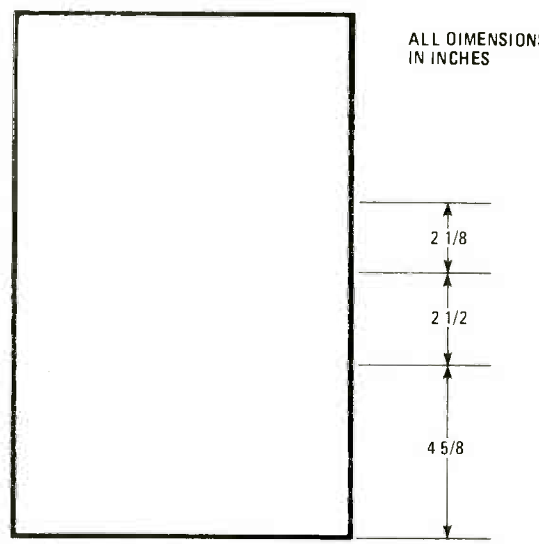

FIG. 7—INSIDE OF FRONT, BACK, AND SIDES should be marked as shown. Pieces should also be marked to indicate function ("FRONT," "L. SIDE," etc.).

That is where the L-pads and crossover networks are mounted. Wiring from them is brought out to terminals mounted on the front of the enclosure (see Fig. 5) to preserve its air-tightness. Wiring to the woofer and tweeter is run along the outside of the cabinet. The L-pads should be located on the side of the cabinet that will remain facing up if the speaker is to be used on its side instead of upright.

Construction

Refer to Figs. 2, 6, and 7, and to the Parts List, as we go through the assembly of the mini-SAFE system step-by-step. Before we start, here are a few helpful hints.

The flat parts (sides, top, bottom, and partitions) can be

continued on page 106

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HOW TO CHOOSE TAPE FOR YOUR

Finding a tape that is compatible with your deck is easy, but finding one that is ideal is not. The tests described here can be performed without expensive test equipment and will lead you toward the best tape for your particular machine.

CHOOSING AN AUDIO CASSETTE-TAPE for your deck used to be a fairly simple affair—you went out and bought your favorite brand of ferric-oxide tape, because that was all that was available. Some years ago, things became a little more complicated with the introduction of chromium-dioxide tape. That formulation offered improved high-frequency response and a better signal-to-noise ratio, but required a much higher bias level than ferric-oxide tape. Soon, cassette decks with two-position bias switches to accommodate the two formulations began to appear.

Now, with the addition of cobalt-treated ferric and metal tapes, the simple two-position switch of a few years ago has given way to separate three- and four-position bias and equalization switches (yielding from nine to sixteen different combinations of bias and equalization), as well as continuously variable bias controls. And of course, if you can afford them, there are several new and expensive cassette decks that, with the aid of a microprocessor, will adjust their own operating parameters to suit any tape you pop into the tape compartment.

While those decks let you get the best results from almost any tape, what do you do if you have one of the less costly decks with two-position fixed bias and equalization switches? The answer is simple: If you can't adjust your deck to match the tape, you should pick your tape to match your deck.

Consulting your owner's manual provides very little help. Usually, the booklet will list a dozen or more tapes that are said to be compatible with your machine. Compatible, maybe—but hardly ever ideal, unless you happen to know which brand of tape was used by the manufacturer in calibrating your machine when it left the production line. To make matters worse, manufacturers of cassette tape have a habit of changing or improving their tape formulations without necessarily changing the model number or trade name of the tape. As a result, the type of tape that worked ideally with your cassette deck when it was new may no longer be the best tape to use with that machine.

Frequency response

The specification that is of greatest concern to most amateur recordists is the record/playback frequency response. Even among the so-called premium tapes of the same formulation, different brands of tape will yield widely different overall frequency-response curves. That is clearly shown in Figs. 1, 2, and 3; the graphs in those figures show the frequency-response curves of three high-quality ferric-oxide tapes. Figure 1 shows the record/playback response, at a recording level of −20 dB (with respect to a reference 0 dB of 200 nanowebers/meter) for TDK *OD* tape, while Fig. 2 shows overall record/playback response for Maxell *XL-IS* tape tested on the same machine at the same record level.

Finally, in Fig. 3 we see the record/playback response for Fuji *FX-I* tape. All of those tapes were tested under identical conditions on a Nakamichi *model 680ZX* cassette deck—hardly a bottom-of-the-line model. Yet, rather significant differences in high-end response are obvious from the curves. If the user wants flat, extended high-end response, the tape to choose (from among those tested) is obviously the Maxell *XL-IS* tape, with its +1.8-dB output at 20 kHz. TDK *OD* ran a close second on our test machine, with an output that is up 1.1 dB at 20 kHz, while the Fuji *FX-I*, though by no means an inferior tape, delivered a −0.3 dB output at 20 kHz *when used with that machine*.

In Figs. 1, 2, and 3, we deliberately expanded the vertical scale so that each division is equal to only 2.0 dB. That

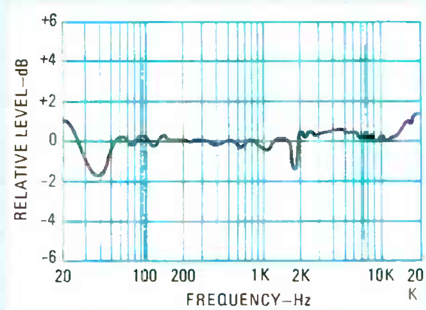

FIG. 1—OVERALL FREQUENCY RESPONSE CURVE for TDK type *OD* tape. That response curve was obtained at a recording level of −20 dB.

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THE BEST CASSETTE DECK

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

was done so that it would be easy to distinguish small differences in output at specific frequencies. But what about the average hobbyist who does not own or have access to expensive frequency-response plotting equipment found in hi-fi labs?

The answer is: Even without test equipment of that sort, it is quite simple to judge differences in overall tonal balance or frequency response. One easy method involves the use of an FM tuner. When an FM tuner is tuned between stations (with the muting circuitry deliberately turned off), what you hear has been described as random white noise. It isn't white noise; it's white noise *modified* by the de-emphasis network built into your tuner. That network attenuates frequencies above 1 kHz or so to compensate for the same amount of high-frequency boost introduced at the broadcasting end of the chain. In any event, that random noise signal can serve as an excellent test signal with which to evaluate the frequency response characteristics of a tape recorder.

In checking the response of two-head recorders, it is first necessary to record a reasonably long amount of FM-tuner noise onto the tape in question. Make that recording at about a −20 dB record level (as indicated on your recorder's VU meters or other level indicators). Since it is not possible to monitor the results instantly from the tape, rewind the tape to the beginning and start playing it back, alternating between the original random-noise source (with the monitor switch on your receiver or amplifier set to source) and the recorder version of the same noise (with the monitor switch set to "tape").

In making that test, it is extremely important that the two loudness levels be identical. It is not enough to verify that "by ear." Rather, you should attach a wideband AC voltmeter to the output terminals of your amplifier (or the speaker-output terminals of your receiver) and adjust levels so that the meter reads an identical value when switching from "source" to "tape" on your tape monitor switch. If you do not have access to a wideband voltmeter (such a meter has a frequency range of 20 Hz to 20 kHz), you can rectify the output from your amplifier (using a full-wave bridge), and feed the resulting signal to a standard voltmeter. While that will not yield an exact voltage reading, you will be able to compare and match the relative levels using the meter's *DC* scale. Since the amplifier or receiver is likely to have only one volume control, use it to control the original random-noise level from the tuner section. Use the output control on your tape deck to obtain the identical level of output when listening to the tape playback of the noise.

Using that method, even *small* tonal differences are easily detectable. Some practice may be required before you can pinpoint just what the sonic differences (where the peaks and valleys) are, but it takes little or no practice to determine accurately which of several tape samples comes closest in overall tonal balance to the original sound. To verify that, we took a spectrum-analysis photo of our reference noise signal (Fig. 4) and compared it with the recorded results obtained from two different tapes (Figs. 5 and 6). Superficially all three noise spectrum photos seem to

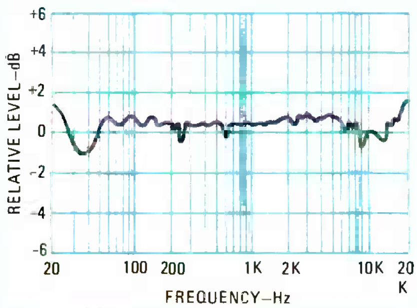

FIG. 2—FREQUENCY RESPONSE of Maxell *XL1S* tape.

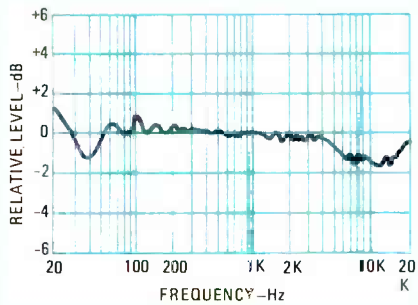

FIG. 3—FREQUENCY RESPONSE OF Fuji *FX-1* tape.

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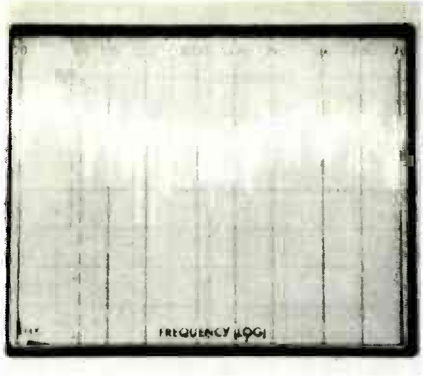

FIG. 4—SPECTRUM ANALYSIS of a reference noise signal.

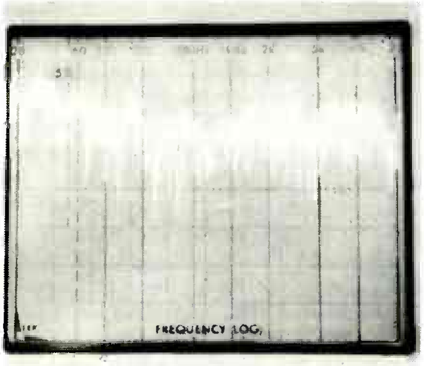

FIG. 5—THE REFERENCE NOISE was recorded on the Maxell tape, and a spectrum analysis was made of the result. That analysis is shown here.

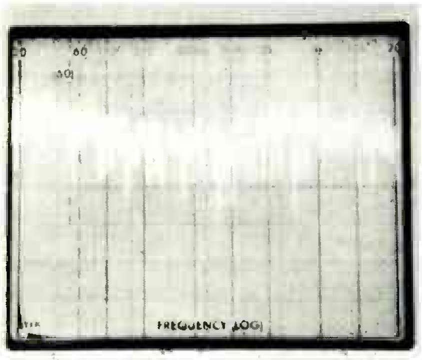

FIG. 6—ALTHOUGH THE SPECTRUM ANALYSIS of the Fuji tape superfically appears similar to those shown in Figs. 4 and 5, the recorded signal *sounded* less like the original than did the Maxell tape.

be about the same; yet, when we listened to the tapes, the Maxell *XL-1S* tape (whose noise spectrum is shown in the photo of Fig. 5) sounded more like the original noise that did the competing tape of Fig. 6.

The procedure used for three-head tape decks is considerably simpler and faster. Here, it is only necessary to flip the source/tape switch on the deck itself from one setting to the other, listening alternately to the source noise-signal, and then to the recorded version of it.

In making those tests on a three-head machine that uses separate heads (as opposed to the machine where the record and playback heads are in a single housing), it is important to check the azimuth alignment between the record head and the playback head. Most three-head machines provide a simple means for making that check and for adjusting the azimuth if it is not perfect. Incorrect azimuth alignment, of course, will result in severe attenuation of high frequencies, which might be incorrectly attributed to the tape or tapes under test.

Distortion

If a tape is slightly underbiased or overbiased, the most profound effect observed is a change in overall frequency response. However, non-optimized bias levels have an effect upon distortion, as well. Almost any tape can be made to have "flat" response if you lower bias levels without regard to distortion at mid-frequencies. Referring back to Figs. 1, 2, and 3, third-harmonic distortion for each of the three tapes tested is as follows: Maxell *XL-1S*, 0.5%; TDK *OD* and Fuji *FX-1*, 0.29%. Note that while the third-harmonic distortion for the Maxell tape is nearly twice as high as the others, it provided the highest output of 20 kHz of all the tapes tested. All three tapes have reasonably low distortion at the 0-dB record level (the level at which those third-order distortion levels are measured), since even 0.5% distortion is inaudible to most listeners. What *does* make an important difference in choosing the right tape for your machine is the so-called headroom, or the maximum record level, that can be applied to the tape before reaching 3% third-order distortion.

Figures 7, 8, and 9 plot third-order distortion (vertical axis) against recording level (horizontal axis). Surprisingly, the Maxell *XL-1S* tape had the greatest headroom (+9 dB for 3.1% third-order distortion) of all three tapes tested. The results are shown in Fig. 7, while those for the Fuji *FX-1* tape (+8 dB for 3.1% third-order distortion) are shown in Fig. 8; and the TDK *OD* tape (+7 dB for 2.6% third-order distortion) is in Fig. 9. One note about the test equipment used to obtain those results: While it is very accurate, it does have one limitation—readings can only be obtained at 1-dB increments. The recording levels listed above are the closest levels to the 3%-distortion point.

Once again, you can duplicate those tests, although with somewhat less accuracy, without expensive test equipment. If you have a single-tone oscillator that can produce a mid-frequency tone of about 400 Hz (1 kHz will also work, as will anything from around 300 Hz to 1 kHz) and an AC meter with a dB scale, then all you need to do is to record progressively greater signal levels onto the tape that you are testing.

If you do not have a single-tone oscillator, the simple circuit shown in Fig. 10 will serve. The circuit will generate some distortion itself; but since we are interested in which tape is best, and not the headroom for precisely 3% third-order distortion, that distortion will not affect the result. Also, the output of that circuit is adjustable down to 1 volt, using the potentiometer. Verify, with a meter, that the output is indeed 1 volt before you connect it to your tape-deck's input.

If your meter does not have a dB scale, you can use Table 1 to convert the voltage reading on your meter to dB. To establish the voltage ratios, use the "0-dB" point on your tape deck's meters as a reference. Note the reading on your externally connected AC meter, and then increase the signal level in 1-dB steps until you are at a record level of 10 dB, or even a bit higher. You need the external meter, because most tape-deck VU meters read only to about +3 dB, or at most +5 dB, whereas the recording head-

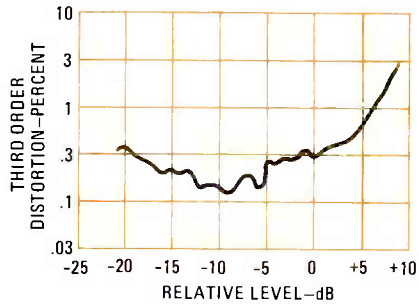

FIG. 7—THIRD-ORDER DISTORTION for TDK type *OD* tape is plotted against recording level here.

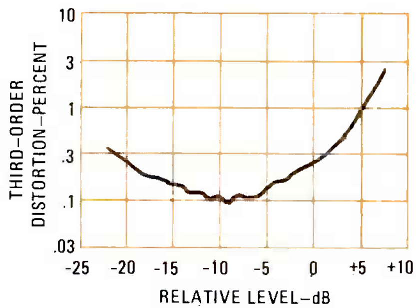

FIG. 8—THIRD-ORDER DISTORTION for Maxell type *XL1S* tape.

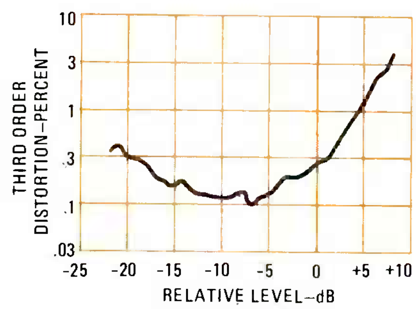

FIG. 9—THIRD-ORDER DISTORTION for Fuji type *FX-1* tape.

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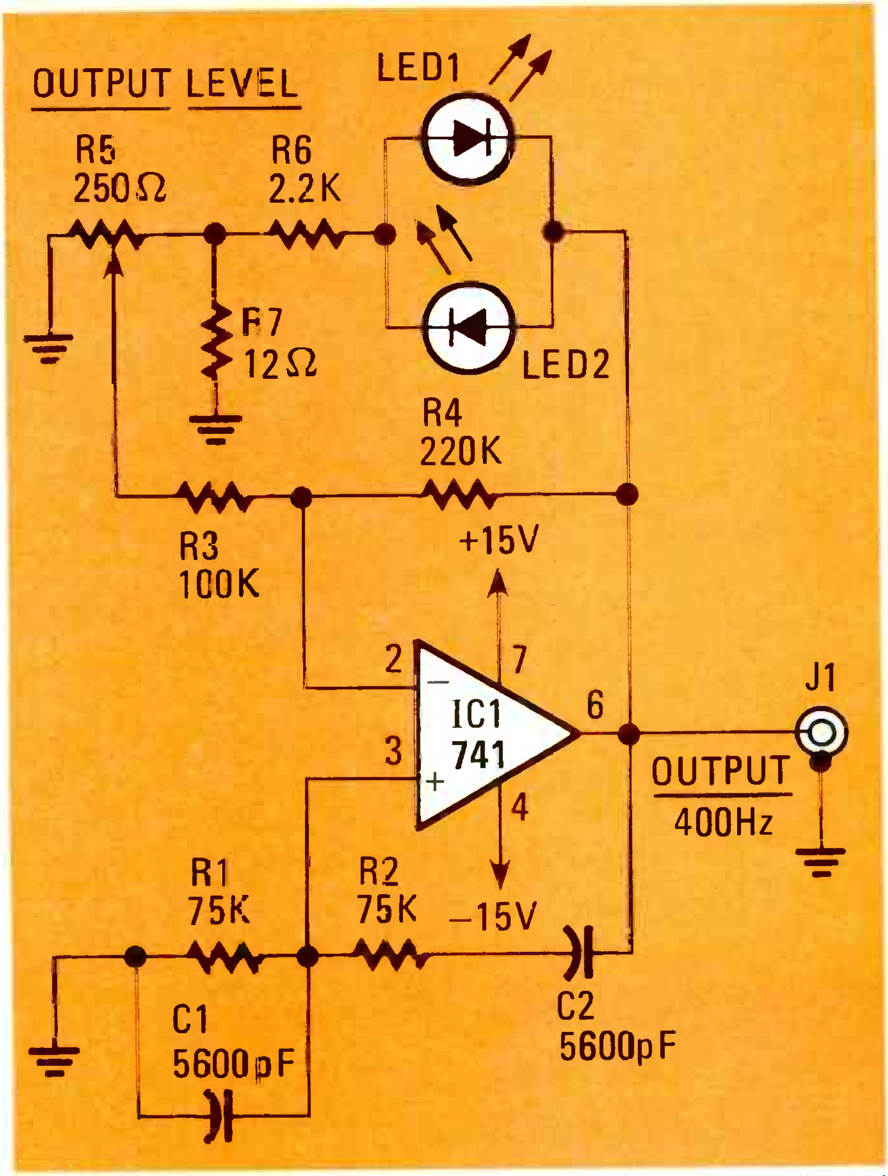

FIG. 10—USE THIS CIRCUIT if you do not have a single-tone oscillator. Make sure to adjust the output to 1 volt before connecting it to your tape deck's inputs.

room for the tapes you are testing may well be above that. Don't be concerned if you peg the needles on your tape deck's meters—the meters won't be destroyed.

Once again: In the case of two-head machines, you will have to rewind the tape and play back the recording. Count the successive steps above 0 dB as you hear them. At some point, you will hear a clear indication or rising distortion (the presence of 3% or more of third-order distortion will be obvious). Record the number of dB above 0-dB reference where this occurs, and go on to the next tape.

In the case of three-head machines, as before, you can increase recording level in 1-dB increments and listen to the recorded results as you go, comparing the purity of tone of the source signal with the tonal mix of the recorded signal. You will probably detect a change well before you reach 3% third-order distortion, but again, since you are interested in finding out which tape is "best," and not the relative head-

TABLE 1

Voltage ratio	+dB
1.000	0
1.122	1
1.259	2
1.413	3
1.585	4
1.778	5
1.995	6
2.239	7
2.512	8
2.818	9
3.162	10
3.548	11

room for precisely 3% distortion, it doesn't matter where you stop the test, so long as you stop at the same level of perceived distortion for each tape.

Dynamic range

Having established the maximum recording levels of each tape for your tape deck, you will want to find out their dynamic range. The dynamic-range capability of any tape is the difference,

PARTS LIST—400 Hz TONE GENERATOR

Resistors, ¼ watt, 5%, unless otherwise noted
R1, R2—75,000 ohms
R3—100,000 ohms
R4—220,000 ohms
R5—250 ohms, potentiometer
R6—2200 ohms
R7—12 ohms
Capacitors
C1, C2—5600 pF
Semiconductors
IC1—741 op amp
LED1, LED2—jumbo red LED
J1—phono jack
Miscellaneous: wire, solder, etc.

in dB, between the maximum recording-level and the signal-to-noise ratio (in negative dB) for that tape. For example, if a given tape has +8 dB headroom at mid-frequencies and a signal-to-noise ratio of −45 dB (below the 0-dB reference), then the useful dynamic range for that tape, at least at mid-frequencies, is 53 dB.

In the case of our three tapes, the signal-to-noise ratios are shown in the bar graphs of Figs. 11-a (Fuji *FX-I*), 11-b (Maxell *XL-IS*), and 11-c (TDK *OD*). Adding the 8 dB of headroom previously observed for the Fuji tape to its 48.4 dB S/N ratio, we get a dynamic-range capability of 56.4 dB. For the Maxell tape it is 45.8 dB plus 9 dB of headroom, or 54.8 dB, while for the TDK tape it is 46.5 dB plus 7.5 dB, or 54.00 dB. (As mentioned above, the maximum recording-level for the TDK tape was set at the 2.6% third-order distortion level, while the maximum recording-level for the other two tapes in this test was set by the 3.1% level. Because of that difference, an extra ½-dB was added to the headroom of the TDK tape to make our comparison fairer.) Thus, the Fuji tape wins out in this parameter for *this tape deck*.

Again, you can measure S/N ratios easily, using nothing more than the mid-frequency tone generator (or the circuit shown in Fig. 10) and the AC voltmeter as before. Here however, it is important that the AC meter be sensitive enough to read the low voltage levels of the residual noise that is present during tape playback. If the nominal output level from your deck is 1.0 volt (a typical figure) when playing back a signal recorded at the 0-dB reference level, then your AC meter should be able to read down to levels of 1.0 millivolt, or lower (1 mV is 60 dB lower than 1 volt), especially if you hope to read the S/N ratio with the noise-reduction circuits turned on. Note that the signal-to-noise ratios we obtained in Fig. 11 were obtained without the benefit of any noise reduction.

To make the tests, first establish the

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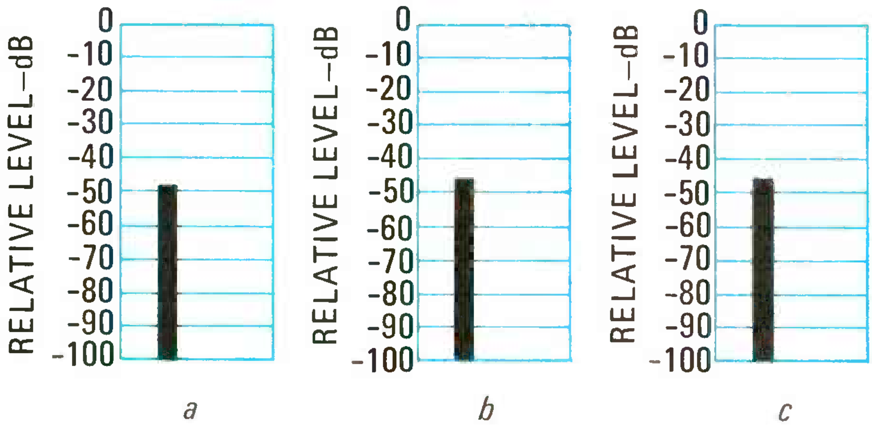

FIG. 11—THESE BAR GRAPHS SHOW the signal-to-noise ratios for the three tapes tested. Each tape's dynamic range is found by adding its signal-to-noise ratio to its maximum recording level (see Fig. 5).

TABLE 2

Voltage ratio	−dB
.01	40
.00891	41
.00794	42
.00708	43
.00631	44
.00562	45
.00501	46
.00447	47
.00398	48
.00355	49
.00316	50
.00282	51
.00251	52
.00224	53
.002	54
.00179	55
.00158	56
.00141	57
.00126	58
.00112	59
.001	60

0-dB reference level, recording a tone onto the tape at that level. Then, turn down the input level control all the way and short the input terminals of the deck to get a section of tape without any signal. Don't try to read the results on a three-head deck while the no-signal recording is in progress. In that instance, treat the deck as if it were a two-head machine, rewinding the tape to the beginning of the "no signal" portion of the tape. (If that is not done, you might read the recording bias-voltage as "noise," which it clearly is *not*.)

If your meter does not have dB scales, use Table 2 to determine the S/N ratio in dB and then add the headroom (obtained in the previous test) in dB to get the useful dynamic range for the tapes being tested. That method does not take into account any "weighting curves" (CCIR/ARM weighting was used to obtain the results shown in Fig. 11) but that is not a serious shortcoming because we are only interested in relative signal-to-noise ratios, so that we can establish which tape is best for a particular machine.

Some mid- to high-priced cassette decks offer continuously variable bias adjustments in addition to the bias settings provided by a three- or four-position switch. If you own such a machine, you can use the same measurement techniques to establish the precise bias levels for the tape of your choice, instead of making the measurement on several tapes to establish which brand and type is best for your requirements. Remember, however, that a change of bias affects *all* of the parameters that we have discussed; so if you change bias to obtain a more uniform frequency response, be sure to recheck distortion, headroom, and the signal-to-noise ratio. Then you can arrive at the best compromise bias setting for your tape and machine. **R-E**

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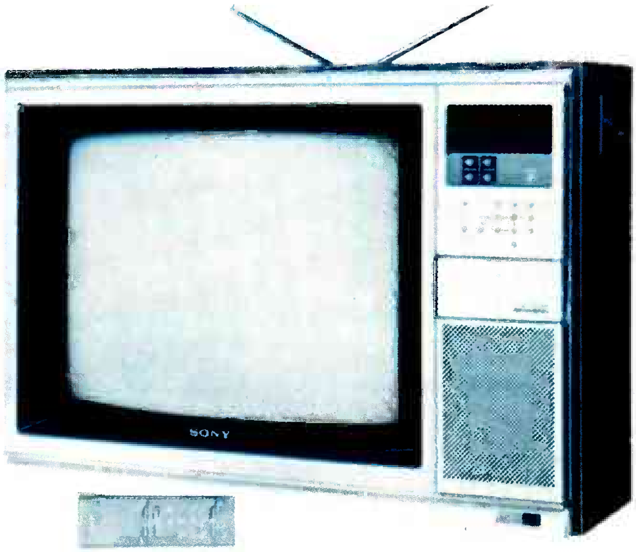

To obtain the best possible performance from your color TV set, the color video stages must be properly aligned. Here are step-by-step procedures on how to do that alignment using a scope and a sweep/marker generator.

Do it yourself COLOR ALIGNMENT

JACK DARR
SERVICE EDITOR

IN COLOR TV SETS, THERE IS A VERY important stage that must be aligned—the color bandpass and color takeoff. In that stage, there are only two coils: a single-tuned coil in the input (the color takeoff) and a double-tuned transformer (the color bandpass), which is really only a 3.5-MHz IF transformer!

This is the circuit that amplifies the color signals after they have been picked off in the video detector. In that stage, the signals beat against the 45.75-MHz picture carrier and emerge at their original frequencies of between 3.08 and 4.08 MHz.

Actually, this is a group of sideband signals of the 3.58-MHz color carrier, all of which must be passed or the color will be wrong. That requires the proper bandpass transformer. All sets have at least one—you may find some that have two bandpass transformers. It makes no difference, any more than in an AM radio with two or three IF stages—the alignment is similar.

A hill from two slopes

You want only the color signals. So to obtain them from the confusion of assorted frequencies at the output of the video detector, just hook up a simple tuned transformer that passes only the desired signals. (It's the same as the process used to pick off the IF in a radio mixer!)

But there's one problem: The color band-limit signals in the IF are *not* at equal amplitudes. That is because they're on the color slope of the IF curve. A frequency of 4.08 MHz is much higher than one of 3.08 MHz. How do you get a nice symmetrical, flat-topped hump-shaped curve out of that?

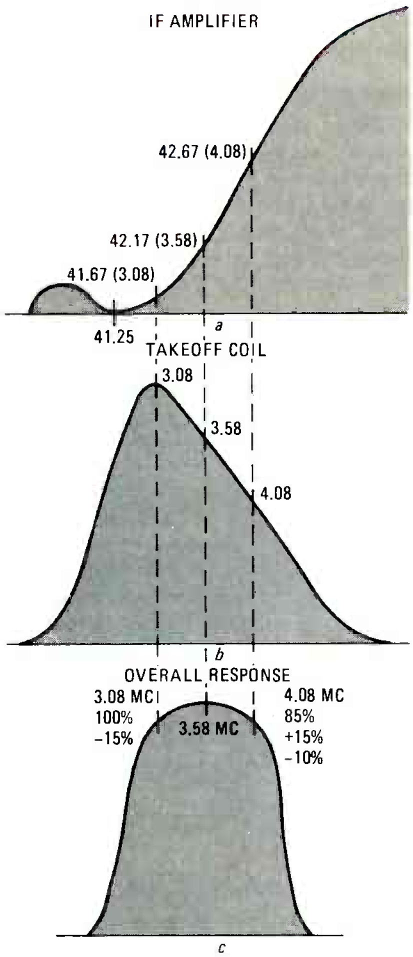

FIG. 1—A COLOR BANDPASS CURVE. Two opposite-slope responses—IF and color takeoff coil—give the needed "haystack curve."

Easy. You deliberately cause the *color takeoff coil* to have an equal but *opposite* slope. Figure 1 shows how that is done. Figure 1-a shows the response of the IF, and Fig. 1-b shows the response of the takeoff coil. In this, the 4.08-MHz frequency is low on the curve, while the 3.08-MHz frequency is high on the response curve. When you add the two responses together you get a nice symmetrical hump (see Fig. 1-c), that is fed into the double-tuned bandpass transformer. The output of that signal will also be a haystack or a hump.

As you can see, the alignment of this stage *must* be right to avoid unequal amplification of the color sidebands. There are several ways of obtaining a suitable test signal.

One way is to feed in a swept signal, centered at 3.58-MHz, with 3.08-MHz and 4.08-MHz markers. That signal can be fed *into* the video detector at the same point at which the output was removed for IF alignment. From here, the signal passes through the video-amplifier stages, and is taken off and fed to the color stages just as a real TV signal is. Figure 2 shows that hookup.

To observe the output curve, connect the scope to the output of the bandpass amplifier. It is connected to

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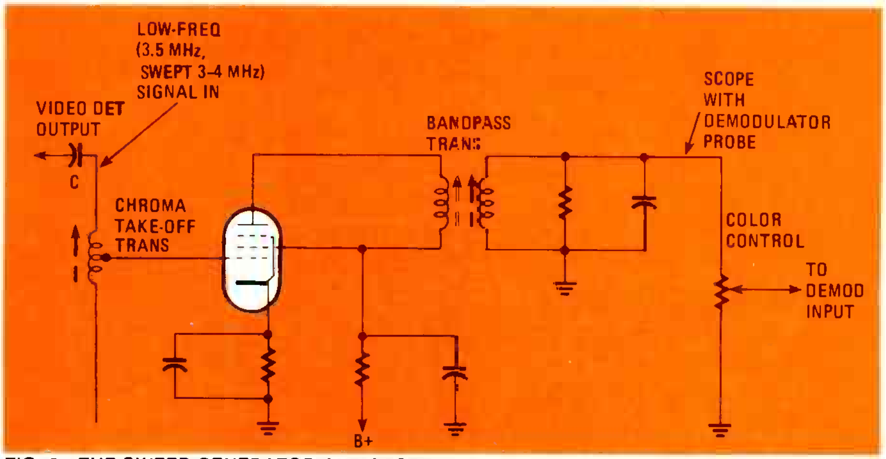

FIG. 2—THE SWEEP GENERATOR AND SCOPE connections for aligning color bandpass stages.

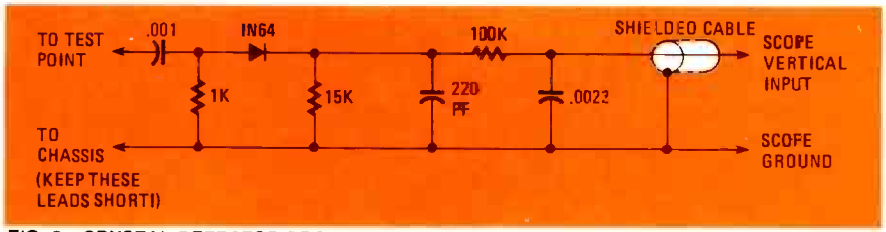

FIG. 3—CRYSTAL DETECTOR PROBE you can build yourself for use with any scope.

the grids of the color demodulators. (In quite a few sets, this is the color control itself, an easy point to locate.)

At this point (and all the way through, in fact) these signals are RF signals. So you must use a demodulator probe on the scope to see a curve. If your scope doesn't have a probe, you can build one. Figure 3 shows a simple version that can be constructed on a small piece of perfboard, with a 50-ohm cable leading to the scope. (Note—practically all new sweep generators provide a demodulator probe just for this job.)

Video sweep modulation

The other way to obtain the bandpass signal curve is to use video sweep modulation (also called *Chroma Sweep Modulation* in one TV set). You feed a sweep signal into the mixer test point, but this time you add a 45.75-MHz picture carrier signal to it. Also, you use IF color markers at 42.67, 42.17 and 41.67 MHz. In the video detector of the TV set, those frequencies beat together to result in a +3.58 MHz sideband signal just the same as with a TV signal.

No matter which method you use, the signal at the bandpass-output will be the same haystack curve with band-limit markers. The 3.58-MHz marker must be in the center of the curve, and the two band-limit markers should be on the shoulders of the curve, as shown in Fig. 1-c. The curve should be symmetrical. Incidentally, although you *can* hook up the scope and observe the unbalanced curve of the color-takeoff coil, you usually won't have to. If you can see the *overall* response curve, you can adjust all three tuning adjustments to obtain the desired shape. The bandpass transformer tuning affects the height and shape of the curve; the takeoff-coil tuning has quite an effect on its *shape*, especially on the tilt at the top.

Finding color problems

When you obtain the curve on the scope, you might see a curve similar to that shown in Fig. 4. In this scope photo, the 4.08-MHz marker is on a sharp peak, the 3.58-MHz marker is halfway down the left side and the lower-limit 3.08-MHz marker is down on the baseline. (This set had *very* fuzzy color!) The small marker on the right baseline is a 4.5-MHz marker that can be used, although it isn't necessary.

In general, you can do something like this: Peak the bandpass coils to obtain some kind of curve, and then adjust the color takeoff coil and bandpass tuning to observe the correct curve shape. Figure 5 shows the results. The two markers on the shoulders of the curve are the band limits. In Fig. 5, the 3.58-MHz marker has been turned off. The small pip in the middle is from the TV set's 3.58-MHz oscillator. You can almost always use it; the generator's 3.58-MHz marker sometimes beats with it, causing a slight smear.

Here, too, you may have to go back over the adjustments several times since they interact quite a bit.

Sound trap adjustment

One more trap needs to be checked—a 4.5-MHz trap, usually in the input or output of the first video amplifier stage. Its purpose is to keep the 4.5-MHz sound IF signal from passing through the video stages to the screen. If it does, it makes a fine-line beat signal in the picture.

To set that, connect your cable to the marker output of the sweep generator. Feed its output directly into the set's video-detector output. Connect your scope to the video amplifier plate, grid, etc., at a point *past* this trap. Turn on the 400-Hz or 1000-Hz modulation of the sweep generator. It will be detected and appear on the scope as an audio signal (see Fig. 6). (If you want to, you can feed this signal into the input of the last video IF stage; sometimes that gives better results.)

Now, locate the 4.5-MHz trap, and simply adjust it for *minimum audio* signal, as shown on the scope. If the trap is set exactly right, you may not

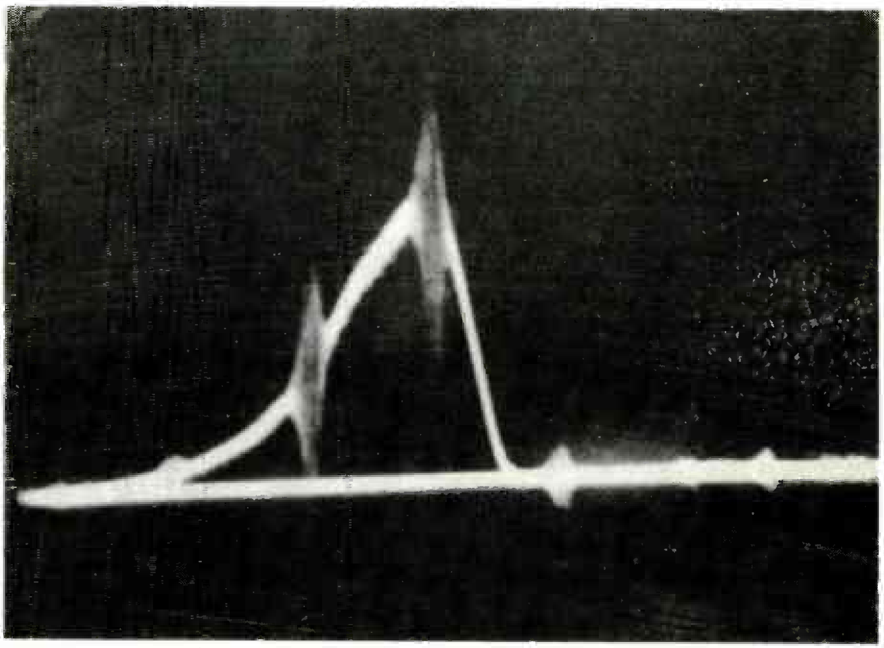

FIG. 4—CURVE BEFORE ALIGNMENT. Color on this set was very fuzzy.

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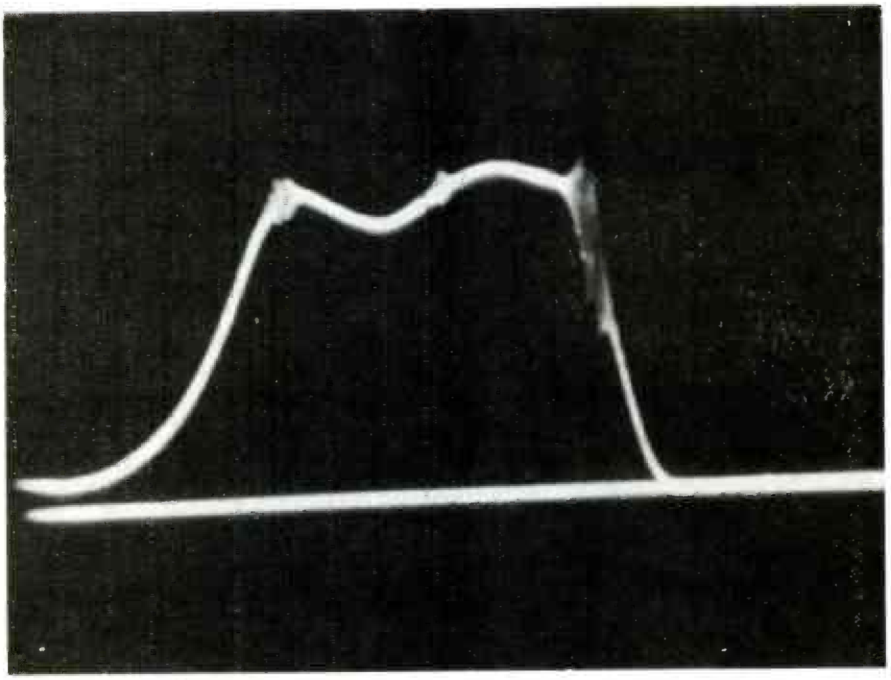

FIG. 5—IMPROVED COLOR CURVE. After alignment, markers are in their places.

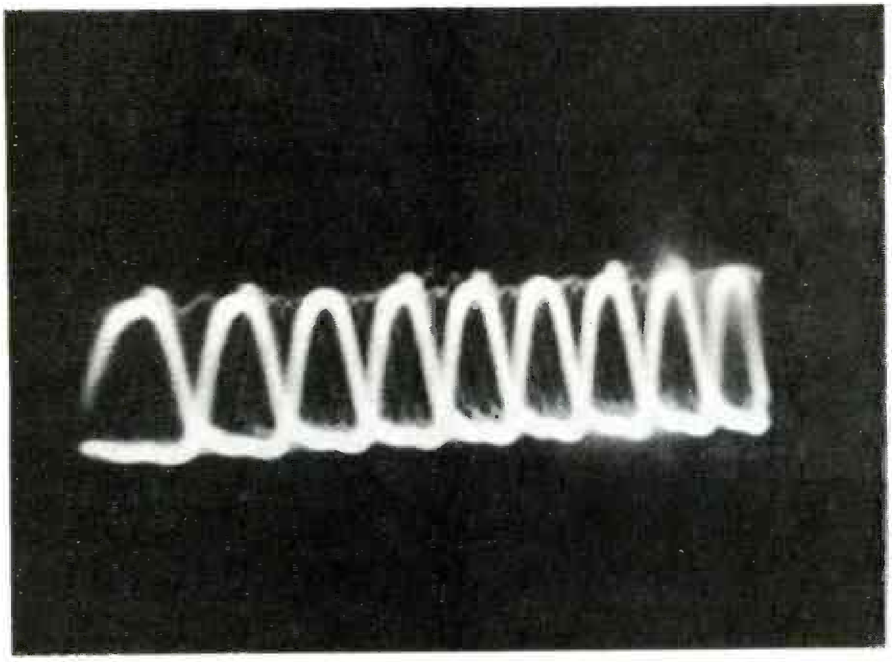

FIG. 6—SOUND TRAP ADJUSTMENT. This audio-modulated sweep signal is used.

see any audio signal. Detune it slightly in either direction to see the audio signal. Some of those signals are sharp enough so that you can actually get rid of all the audio signal, leaving only a straight line on the scope. You can also turn up the marker gain control of the sweep generator to make sure that you have the trap set to the exact point.

Incidentally, you can use the same method for setting any of the traps—the 41.25-MHz sound trap, etc. Feed in only the marker signal, with amplitude modulation, connect your scope to the video detector and tune the trap for minimum displayed audio signal. This method is considered by some to be more accurate than using the whole curve; I find that both methods work very well.

Final checks

To familiarize yourself with these adjustments, hookups, etc., try them out on a TV that's working right. Make all the correct connections, then simply *look* at the curves in the various places. *Don't* move any of the alignment adjustments—this is very good practice!

Common sweep problems

We've covered a lot of sweep-alignment problems, but here are a few reminders. You run into these problems at regular intervals, so watch out for them.

1. Incorrect bias. Symptom: no response curve at all. This usually means that the negative bias (in tube sets; can be positive or negative in solid-state TV's) is too great: the IF stages are simply cut off! Test: Reduce the bias and watch the curve. The bias, as well as the sweep-generator output, should *never* make any difference in the *shape* of the curve—only in its amplitude, as seen on the scope. Juggle the RF output, bias and scope gain to obtain the correct curve.

2. No curve but markers show. That one is easy. The RF output connection to the mixer test point has fallen off. Or it may be accidentally grounded to a shield. Or you forgot to turn up the RF output control of the sweep generator. In some generators, the video-detector connection may also have fallen off. Recheck all your connections.

3. Loops in the curve. Instead of a straight baseline, with the curve rising above it, you obtain something that looks like a figure-8 showing the curve and some of the markers. Cure: Replace the *ground lead* to the scope probe. It has probably fallen off or isn't making good contact. The loop you see is a stray 60-Hz AC frequency.

Helpful ideas

In conclusion, here are a few helpful nuts-and-bolts ideas. Some of the older scopes have good probes, but they tend to be somewhat massive. They are hard to hold when connected to the tiny lances and test points. You can often make a loop of test-lead wire with stout clips on each end and tape it to the body of the probe. Those wire ends can be clipped to the chassis, above the probe, to hold its weight.

For direct scope connections, construct special test leads, using miniature 50-ohm coaxial cable and miniature test clips. Use terminal fittings to match the input jacks of your scope. Those test clips are much lighter and easier to handle in the crowded spaces found in the later-model sets. Be sure to use the little slip-on rubber insulators to keep the clips from being grounded to the chassis.

Summary

We've tried to cover all possible alignment procedures and problems. Alignment work has been a bugaboo to too many technicians in the past. However, using the methods and techniques outlined in this article, you'll find that you can do a good job, even with older equipment. The work won't go quite as fast as with some of the newer models, but it *can* be just as accurate. **R-E**

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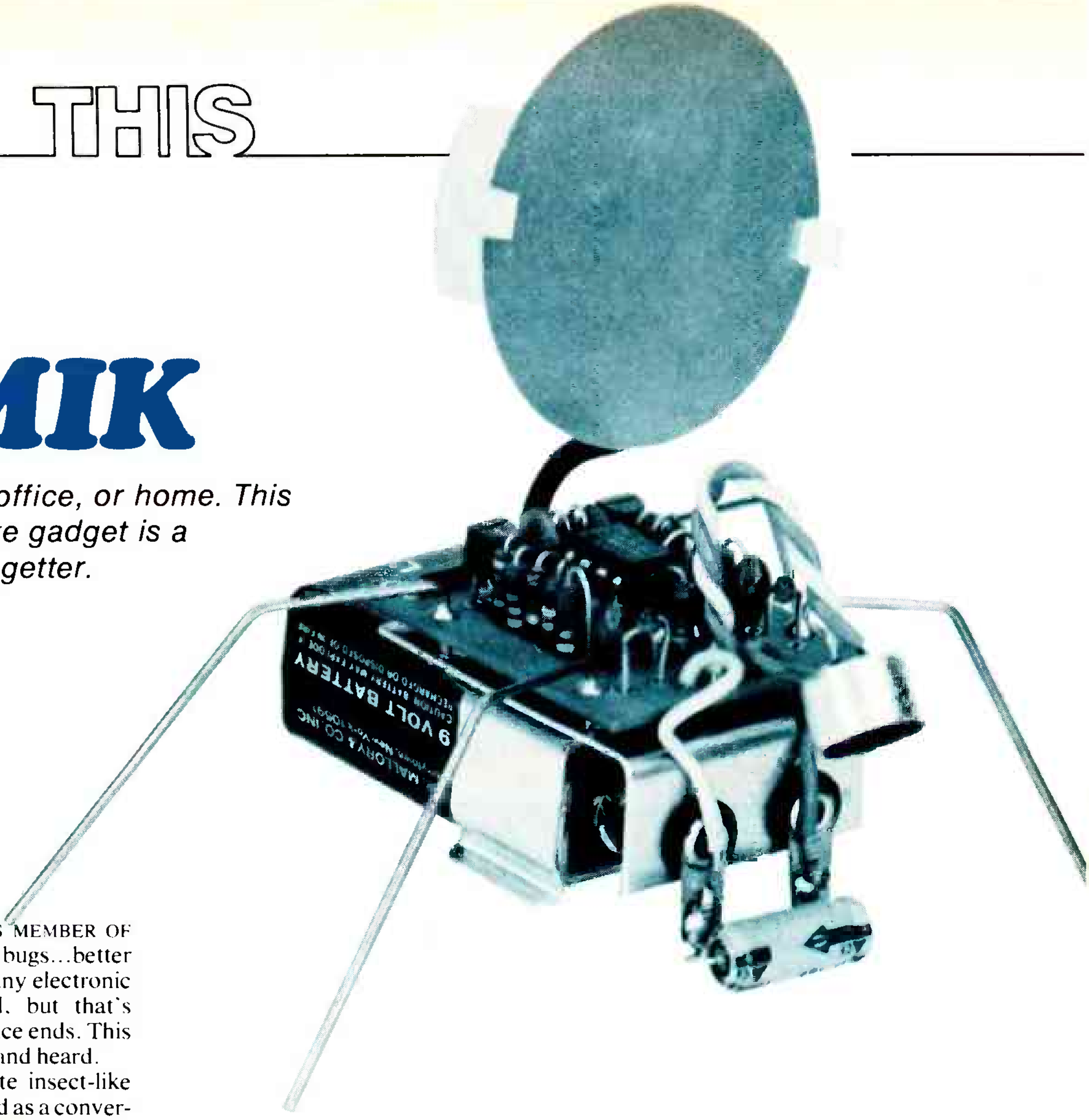
LIMIK



Bug your friends, office, or home. This harmless insect-like gadget is a sure-fire attention-getter.

MERRITT KEPPEL

THE LIMIK IS A HARMLESS MEMBER OF the species of electronic bugs...better make that insects. Like many electronic bugs it's sound-activated, but that's about where the resemblance ends. This bug is intended to be seen and heard.

The Limik has a definite insect-like appearance and can be used as a conversation piece, a psychological "watch-dog", or even as a noise-level meter in the office. If you want to attract someone's attention, just set the Limik down and watch what happens.

The Limik responds to noise by turning on its audio oscillator for a brief period of time. It emits a sound similar to a cricket's chirp and its eyes—two LED's—light up.

Its head is a miniature condenser microphone element and its tail is a piezoelectric sounder (see the September 1980 issue of **Radio-Electronics**). Its body is made up of a small PC board atop a 9-volt battery, and is supported by four brass legs.

How it works

The circuit is divided into three sections: an audio amplifier, a comparator/timer, and an audio oscillator—all of which are somewhat interactive. Refer to Fig. 1, as we discuss its operation.

The oscillator (output section) is the easiest to understand—it's a standard transistor multivibrator circuit, gated when the output of IC1-a goes negative. The frequency of the oscillator is determined by R11-C6 using the formula:

$$f = 1.38RC$$

where R11 = R12 and C5 = C6 to give a

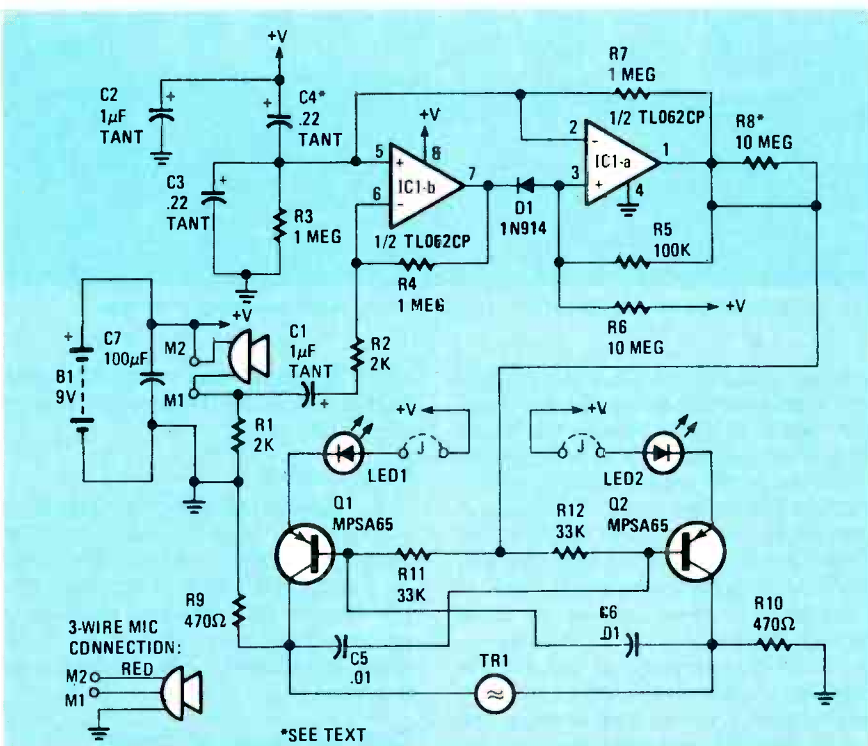


FIG. 1—ASTERISKS indicate components added for physical symmetry. Jumper across R8 effectively eliminates it from circuit. Connections for 3-lead microphone are shown at lower left.

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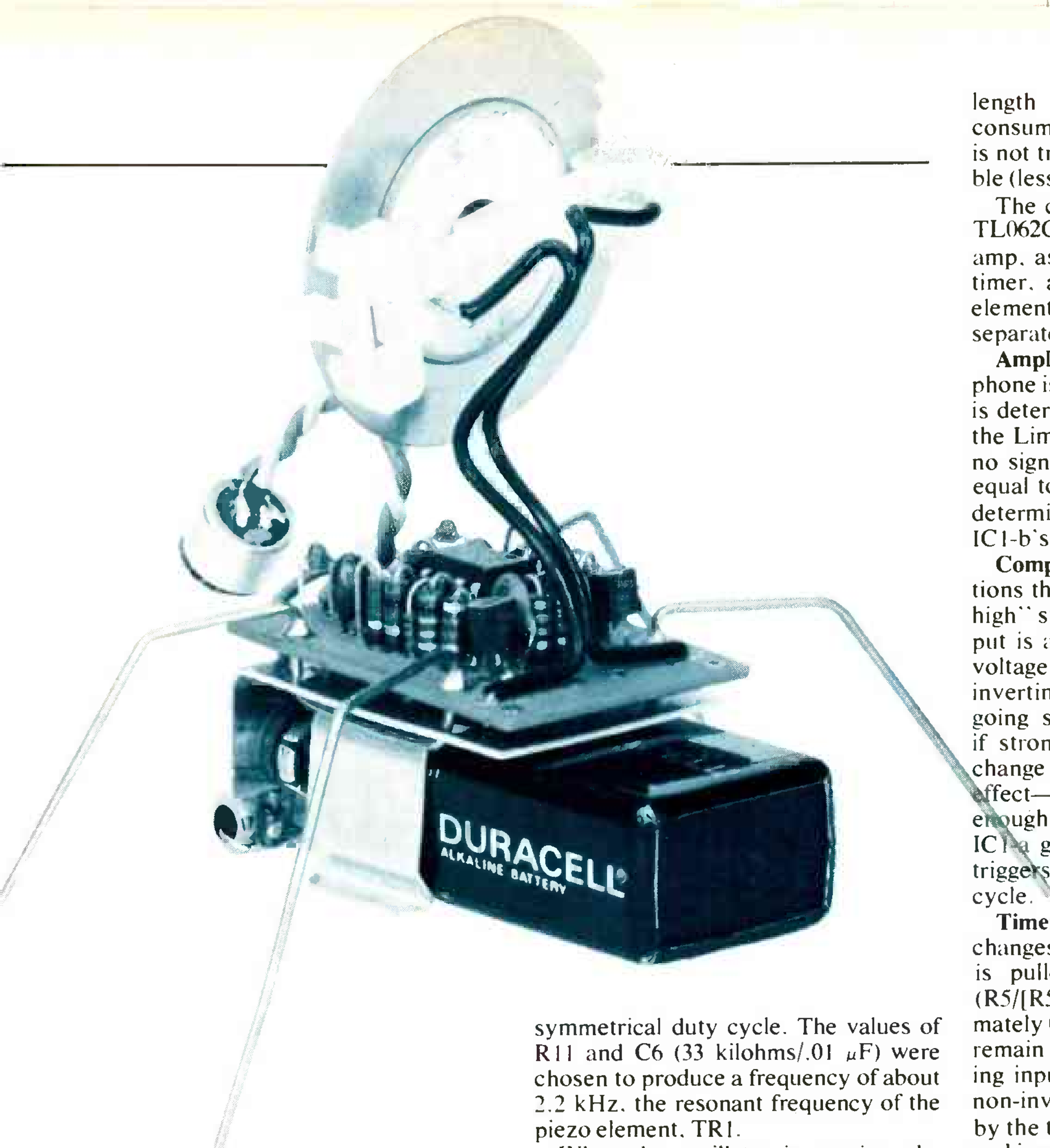

length of time the oscillator runs—it consumes the most power. If the Limik is not triggered, current drain is negligible (less than 1 mA).

The circuit is designed to use IC1, a TL062CP dual low-power FET op-amp, as an amplifier, comparator, and timer, all in one. Let's examine each element of that section of the circuit separately.

Amplifier: The output of the microphone is amplified by IC1-b, whose gain is determined by the ratio of R4:R2. In the Limik, that gain factor is 500. With no signal input, the output of IC1-b is equal to approximately ½ V_{CC}, a value determined by resistors R7 and R3 and IC1-b's logic-high state.

Comparator: Under no-signal conditions the output of IC1-a is at a "logic-high" state because its non-inverting input is at ½ $V_{CC}+V_D$ (where V_D is the voltage drop across diode D1) and its inverting input is at ½ V_{CC}. Negative-going signals at the output of IC1-b, if strong enough, will cause IC1-a to change states. That gives a comparator effect—if the input signal is not strong enough, nothing will happen; if it is, IC1-a goes to a "logic-low" state and triggers the timer phase of the Limik's cycle.

Timer: As soon as the output of IC1-a changes state, its non-inverting input is pulled to a level determined by $(R5/[R5\text{-}R6])V_{CC}$ + 0.6 volt—approximately 0.7 volt. The output of IC1-a will remain low until the voltage at its inverting input becomes less than that at its non-inverting input. This is determined by the time constant of R7, R3, and C3, and is set at about 200 ms.

When the output of IC1-a returns to its high state, C3 charges through R7 towards a state of equilibrium (where it is neither charging nor discharging). Equilibrium, however, is not obtained

symmetrical duty cycle. The values of R11 and C6 (33 kilohms/.01 μF) were chosen to produce a frequency of about 2.2 kHz, the resonant frequency of the piezo element, TR1.

When the oscillator is running, the "eyes," LED1 and LED 2, are forward-biased, and light. Resistors R9 and R10 develop a load for the oscillator and limit the current to the transistors and LED's. Battery life is determined by the

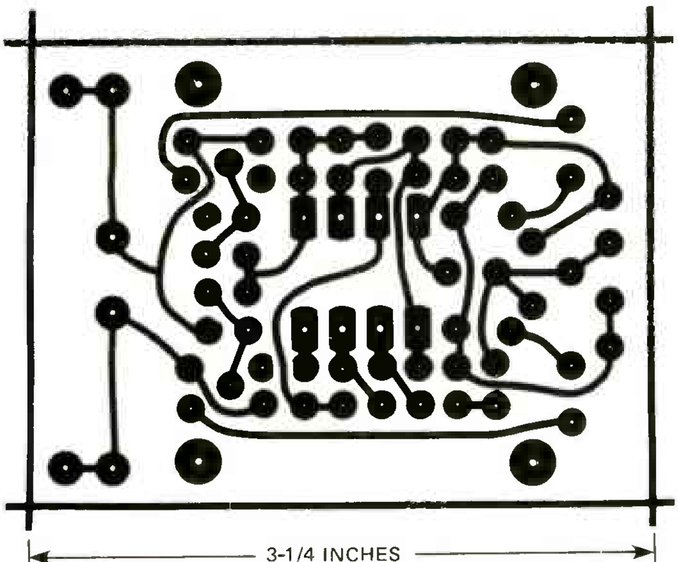

FIG. 2—PC BOARD measures just 1.2 by 1.6 inches. A prefabricated board is available if you do not wish to make your own.

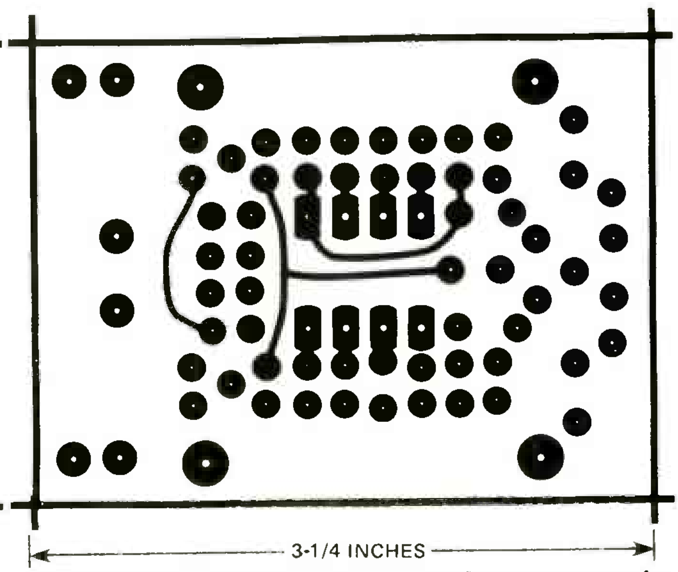

FIG. 3—TOP SIDE OF BOARD contains several traces necessary for proper operation. Since board is not plated-through, those traces may be replaced by jumpers.

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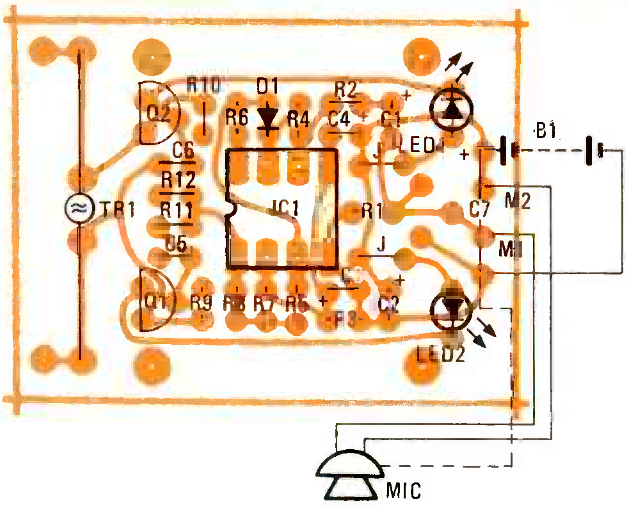

FIG. 4—LIMIK'S HEAD is at right; tail at left. Dashed line indicates connection for 3-lead electret microphone.

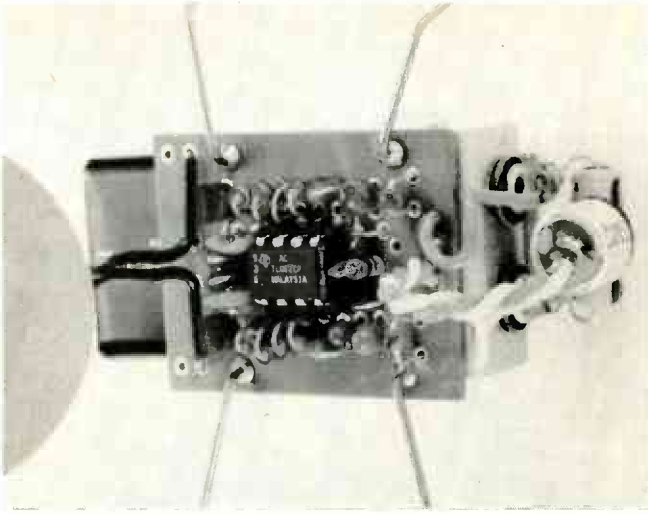

FIG. 5—COMPLETED CIRCUIT BOARD. Piezo sounder is visible at left and microphone and C7 at right.

PARTS LIST

All resistors ¼-watt, 5%
R1, R2—2000 ohms
R3, R4, R7—1 megohm
R5—100,000 ohms
R6, R8—10 megohms
R9, R10—470 ohms
R11, R12—33,000 ohms
Capacitors
C1, C2—1.0 μF, 35 volts, tantalum
C3, C4—0.22 μF, 35 volts, tantalum
C5, C6—0.01 μF, 25 volts, ceramic
C7—100 μF, 10 volts, electrolytic
Semiconductors
IC1—TL062CP or equivalent FET-type 747 dual op-amp
Q1, Q2—MPSA65 Darlington pair
LED1, LED2—MV-50 subminiature LED
D1—1N914 or 1N4148
TR1—piezo sounder (Gulton 105-CFB or equivalent)
B1—nine-volt battery
Miscellaneous: PC board, 2 or 3-lead electret microphone, holder for piezo sounder, battery holder (Colectro No. 86 or similar), 3/64-inch brass rod for legs, etc.

The following are available from MK Enterprises, 8911 Norwick Road, Richmond, VA 23229: complete kit, $18.95; PC board only, $5.00; piezo element with holder, $2.25; microphone, $2.00; TL062CP, $1.50; battery clip, $2.00. VA residents please add 4% tax.

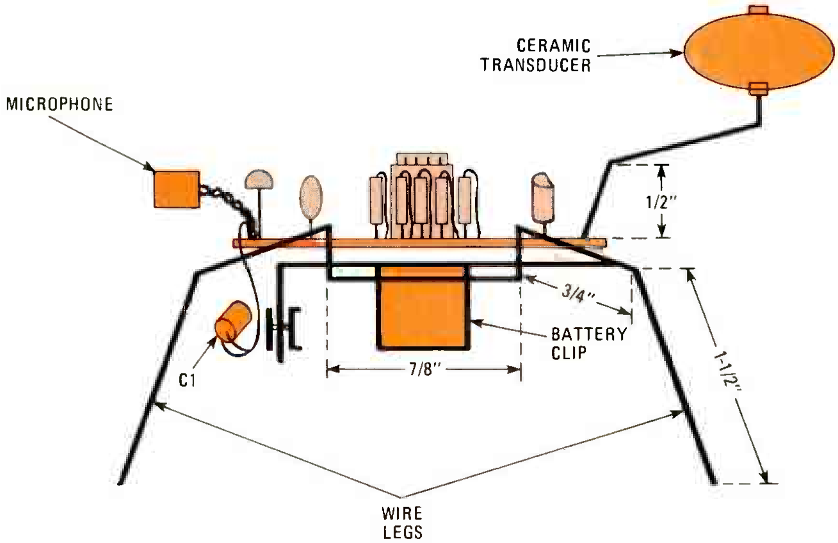

FIG. 6—SIDE VIEW OF LIMIK. Legs are made of 3/64 brass rod bent as shown and splayed out to sides.

because C1 inhibits the process by trying to charge itself to a state of equilibrium. That effect, coupled with the hysteresis effect caused by the offset voltage of IC1-b causes the output of IC1-a to gate the oscillator (Q1 and Q2) for several seconds and a chirping sound is heard from the piezo sounder. A one-shot action prevents the tone emitted by the sounder from retriggering the circuit and prevents "feedback."

The component values used in the circuit produce a sound similar to a cricket's chirp. They may be changed, if desired, to modify the sound. For good performance, though, make sure that C3 is no more than six times the value of C1. If less gain is desired, reduce the value of R4.

Capacitor C7 stabilizes the battery voltage. The TL062N consumes only about 150 μA (microamps) and the microphone bias-current is about 700 μA. The nine-volt battery should last for a fairly long time as long as the Limik doesn't chirp too frequently.

Construction

The Limik's components are mounted on a 1.2 × 1.6-inch PC board, which forms the top of the bug's body. Figures 2 and 3 provide foil patterns for the bottom and top of the board, respectively, but because plated-through holes are not required, a single-sided board with wire-wrap wire jumpers on the top can also be used. An already etched and drilled board is also available—see the Parts List.

To give the Limik a symmetrical appearance, several components are added which serve no real functional purpose. If you like, you can eliminate resistor R8 without altering the Limik's operation. Capacitor C4 is optional; it can be added without seriously affecting the quality of the sound.

Refer to Figs. 4 and 5 as you install the components on the board. You'll find it easier to start at the oscillator (tail) end and work toward the front. All resistors should be mounted vertically, with the body of the resistor toward the outside of the board and the bare lead bent over toward the inside. That makes the board visually appealing.

Because of the density of the board, use a very fine-tip soldering iron and be extra careful about solder bridges. Be sparing with the solder.

After the resistors have been inserted, soldered, and had their leads clipped, the remaining parts can be installed in any order. (If you use jumpers on the top side of the board, make sure they're in place before you mount the IC socket.)

Be sure to observe the polarities of

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C1, C2, C3, and C4, if used, as well as those of the two LED's and D1. Also, make sure that the two jumpers indicated by "J" are in place.

When all the on-board components are mounted, it is time to install the microphone and piezo sounder. First, cut four 2-inch lengths of No. 22 solid wire and strip the ends. (If the wires are of different colors—say red and yellow—they'll enhance the appearance of the Limik.) Solder the red wires to the positive battery and microphone pads, and the yellow wires to the negative ones.

Connect the battery leads to the appropriate terminals on the battery clip and install capacitor C7 across them. Again, watch the polarity.

The original Limik used a 2-terminal microphone. The red wire from point "M2" was attached to the mike's positive terminal, and the yellow one from point "M1" to its negative (case) terminal. If you use a 3-terminal microphone, connect the mike's red lead to +V (point "M2"), its audio lead to "M1", and its ground lead to −V.

Form two lengths of No. 22 solid wire as shown in Fig. 6 and connect them to the piezo sounder. The original Limik used a "naked" sounder that was mounted in a Molex holder. The one you use may have a case, and the wires can be threaded through the holes in the "ears" for added support. The other ends of the wires are soldered to the PC board as indicated in Fig. 6.

Checkout

Before you attach the battery clip to the PC board, it's a good idea to check out the circuit to make sure that it works. Now is a good time to make other last-minute adjustments—such as the height of the "eyes" (about 0.2-inch)—too.

Plug IC1 into its socket and then slip a 9-volt battery into the clamp and connectors. When you make a noise (whistle, clap your hands, shout...) the LED's should light and you should hear the Limik chirp.

If nothing happens, first check to see that everything—including the battery—is inserted properly and in its proper place. Make sure that you've soldered all the points necessary, and if you're using jumpers, that they are in place.

You can verify the condition of the LED's by temporarily bridging a 1K resistor from their cathodes (banded ends) to the negative battery terminal. That should cause them to light.

If the sound from a "naked" sounder is raspy, or erratic, check its mounting in the holder. The contact pins may need to be bent to provide more pressure.

Finishing up

When the circuit is working properly, clip or file the leads on the foil-side of the board as short as possible. Again, check for proper operation.

Now, referring again to Fig. 6, form the legs from two 6-inch lengths of $^3/_{16}$-inch brass rod. Insert them from the battery-side of the holder up through the PC board. Solder the legs firmly to the PC board (bottom *and* top, if possible) and adjust them so the Limik's body is parallel to whatever surface it stands on.

With that, your Limik should be complete. Have fun—but don't let it "bug" you. **R-E**

HI-FI CX DECODER

continued from page 46

millisecond attack time and a 30-millisecond decay time, to handle high-level transients, consists of C4, R15, R16, and Q3. The output of Q3 feeds into summing amplifier IC2-c through R17, where it joins the gain-control signal that is summed through R18. Op-amp IC2-c and transistor Q4 make up a voltage-to-current converter, and the collector of Q4 supplies the control current for the left- and right-channel transconductance amplifiers.

The LED-indicator circuit consists of a dual-element (red and green) LED driven by two voltage comparators (IC4-b and IC4-c). When S2 is in the OFF position, the LED's common cathode is unconnected; when S2 is ON, the common cathod is grounded. The comparators' reference voltages are derived from the +15-volt power supply through R49, R50, R51, and R52. The reference voltages are slightly higher and lower than 5 volts, which is the DC voltage that should appear at TP1 when a 0-dB reference signal is supplied to the expander. For low-level signals where the voltage at TP1 is less than 5 volts, IC4-c supplies a current through R53 to the green element of the dual LED, causing it to light. For signals where the voltage at TP1 is exactly 5 volts, IC4-b supplies a current through R54 to the red element of the dual LED, causing *it* to light. Since, at that voltage, both elements of the LED are lit, the LED will glow with an orange color. If the voltage at TP1 slightly exceeds 5 volts, the voltage from IC4-c is cut off, leaving just the red element of the LED lit.

That concludes the theory section of the *CX* expander. A foil pattern for the single-sided PC board required is shown in Fig. 4 for those of you who want to be ready for the construction portion of this article, which will appear next month. **R-E**

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A winner of a circuit to keep any young person amused.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

WITH THE HOLIDAY SEASON ALMOST upon us, this seems as good a time as any to close down the idiot box "contest." Those of you who are regular readers of this column know that we have been looking for circuits that have no useful purpose, yet put on an interesting visual and/or audio show—they just *seem* to do a lot. The idea is to build one or more of those devices and install them into a box that youngsters could use as a control panel of an imaginary space ship, or in some similar way. Just the thing if you need a "different" last-minute gift for some young person.

While I have not counted how many circuits have been sent in, I can assure you that there have been a great many. You have seen some of them here over the past few months, and I'll show you others from time to time, although the competition is closed. By the way, even though the contest is over, if you come up with a good one, be sure to send it in and let us have a look at it.

For now, however, here is the "winner." I will admit that the call was a close one. In fact, it was a four-way tie nearly until the end. The honors must go to MSGT Jerry Duke (APO New York) for the circuit that follows.

Jerry's entry is shown in Figs. 1 and 2. He uses a CD4060 oscillator/divider to drive the rest of the circuit. That IC drives a 74154 demultiplexer, the output of which is latched by four CD4044 quad R-S latches. The output of the latches are displayed on an array of LED's that are arranged to spell out anything you wish. For good measure, Jerry throws in an XR2242 long duration timer to add appropriate (or inappropriate) sound effects.

One way to arrange the LED's is shown in Fig. 2. Each array is made up of from two to four LED's. The arrays are wired into the main circuit at the points indicated. You can arrange the LED's to spell out anything you wish, of course.

Those LED's do not just turn on and off. The circuit goes through 16 cycles. On the first cycle, the first array is lit; on the second cycle, the first and second arrays are lit, and so on. While the lights are going through their paces, the time constant that determines the frequency of the XR2242 is being changed by the CD4060. The result of that is a varying whooping and wailing sound that accompanies the LED patterns.

All-in-all, Jerry's circuit is just right for the idiot box; it is fascinating, yet useless! Thanks to him, and all of you for sharing your ideas.

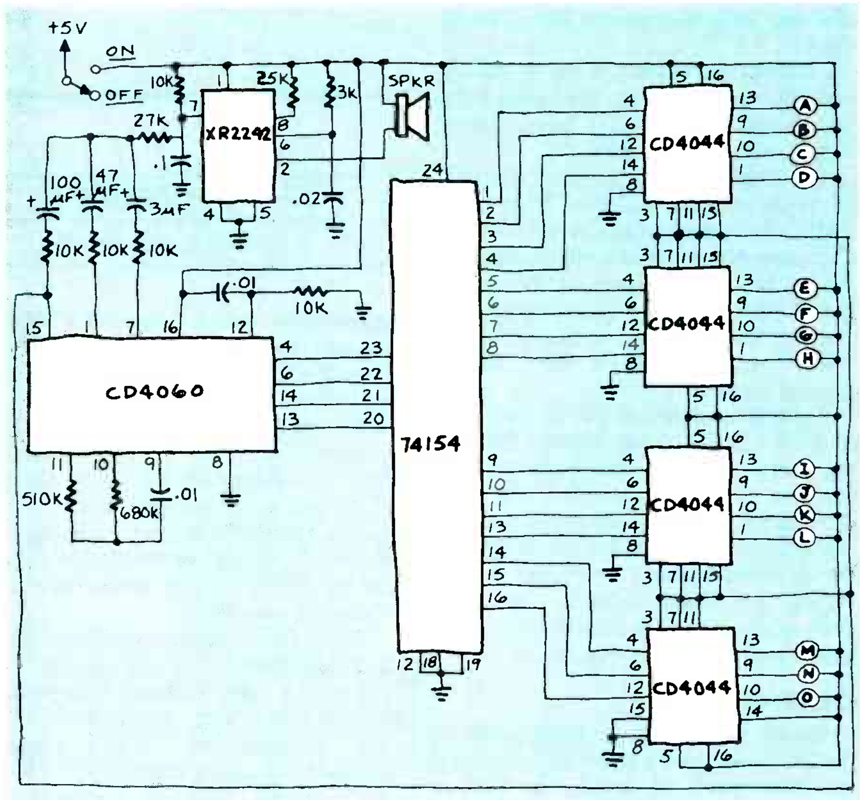

FIG. 1

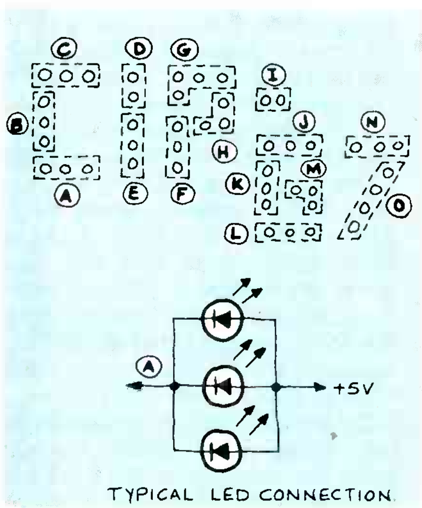

FIG. 2

Sidereal clock

Back in the August 1981 "Hobby Corner," I told you about H.C. Gernhart's search for a sideral clock circuit. It seems it wasn't astronomy that I had forgotten—just logic! Alan Gee (Sunnyvale, CA) tweaked me gently about the fact that the clock must run *faster* than a normal clock.

He, and a couple of other readers, called attention to an article in the July 1976 issue of *Sky and Telescope* magazine. That article includes a schematic and description of a sidereal clock that looks quite good. It is highly accurate, and does not appear too difficult to build.

The basic idea behind that, and most other similar clocks, is to supply an extra timing pulse periodically to a

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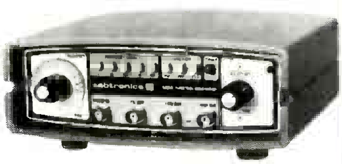

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- Square wave: Rise/fall time <250nsec. Symmetry <98%
- Triangle wave: Non-linearity <1% to 100kHz
- Output: Impedance: 600Ω short-circuit proof. Amplitude (continuously variable): 10V P-P open circuit; 5V P-P into 600Ω max. Low Level: -40dB of high output. TTL square wave: >10 std. TTL loads
- Sweep input: Impedance: 27kΩ. Range: >100:1. Input voltage: Up to ±10V.

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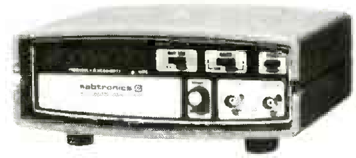

Features:
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- Sampling rate: Two times per second
- Power consumption: 5mW typically
- Power supply: Two 1.5V batteries, type UM-3 or AA
- Battery life: 300 hour continuous operation
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☆ Difference Measurements: This instrument can be used like a galvanometer
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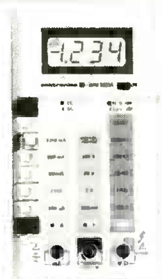

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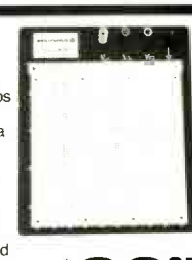

Features:
☆ 3 terminal strips 5 distribution strips
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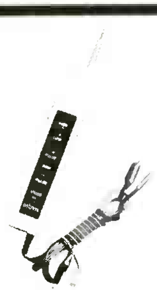

Features:
☆ Input impedance: 100KΩ
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☆ Min. detectable pulse width: 50nsec.
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HOBBY CORNER

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standard digital-clock IC. It seems that if an extra pulse is provided after every 365th regular pulse, the clock will differ from sidereal time by less than a minute a year. While additional circuitry can be added to increase the accuracy, the small difference should not be a problem for most applications.

Paul Beckman (Texas A&M University) and Bob Schalk (Clearwater, FL) both sent in good looking designs that they developed themselves. Space doesn't permit showing them here, but Paul makes the point that provision should be made for a battery back-up in case of a power failure.

Thomas Troutman sent us some helpful information and also said that by the time you read this he will have available clock kits and assembled units. You can contact him at Antares Electronics, PO Box 32802, Phoenix, AZ 85064.

Thanks to all of you for helping out.

Catching up with the mail

The mailbag has been unusually heavy the last few months, and I want to thank each of you who has sent in a suggestion or question. I especially enjoy seeing those solutions to other readers' questions—you come up with some good ones. Thanks for taking the time to write.

For those of you who enclosed self-addressed, stamped envelopes and are looking for direct responses, please be patient. In addition to the increased mail, I am still having trouble catching up because of a recent change of address. Eventually I will get caught up with everything. (Well, I can dream, can't I?)

Remote flash trigger

Many of you have written to say that the light-activated SCR (LASCR) used in the slave-flash circuit (July 1981) is no longer stocked by Radio Shack. Palmer Swails (San Antonio, TX) wrote to let us know that a suitable replacement is available from Solid State Sales (PO Box 74D, Somerville, MA 02143). Their toll-free telephone number is 1-800-343-5230.

While we do try to keep things as current as possible, you should be aware that considerable time may elapse between the development of a circuit, my write-up of it, and its appearance in your copy of **Radio-Electronics.** Occasionally, unanticipated changes will take place. In such a case, do what Palmer did—he just called the toll-free numbers of our advertisers when he could not find the part locally.

Reader requests

W.D. Ennis of Idaho Falls, ID is looking for a circuit to measure the velocity of a bullet. That would be handy for those who load their own ammo.

Leonard Eisner of New York, NY needs a circuit that will turn on an LED at 9 volts, and turn it off when the voltage falls below that point. He wants the device to be safe up to at least 15 volts. I'm not sure what he wants to use it for, but what can you come up with?

Lester Jernigan of Jacksonville, FL wants to expand the bandwidth of his oscilloscope. Short of a major rebuilding job, do you know of anything that will convert the signal down in frequency and will also provide a useful display?

Ward Pearce of La Grange, GA is looking for a way in which he can display all eight ignition patterns in parallel on his scope.

Donald Carter of Cincinnati, OH is looking for a way to make a bank of potentiometers programmable. That would be useful for music synthesizers and other sound generators—it often takes a long time to set the controls on those for exactly the sound you want. Any help on this one? **R-E**

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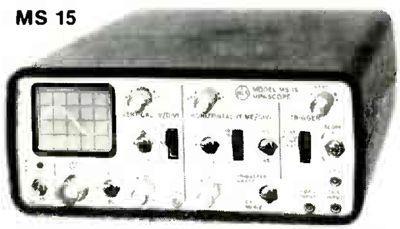
MS 230

MS 15



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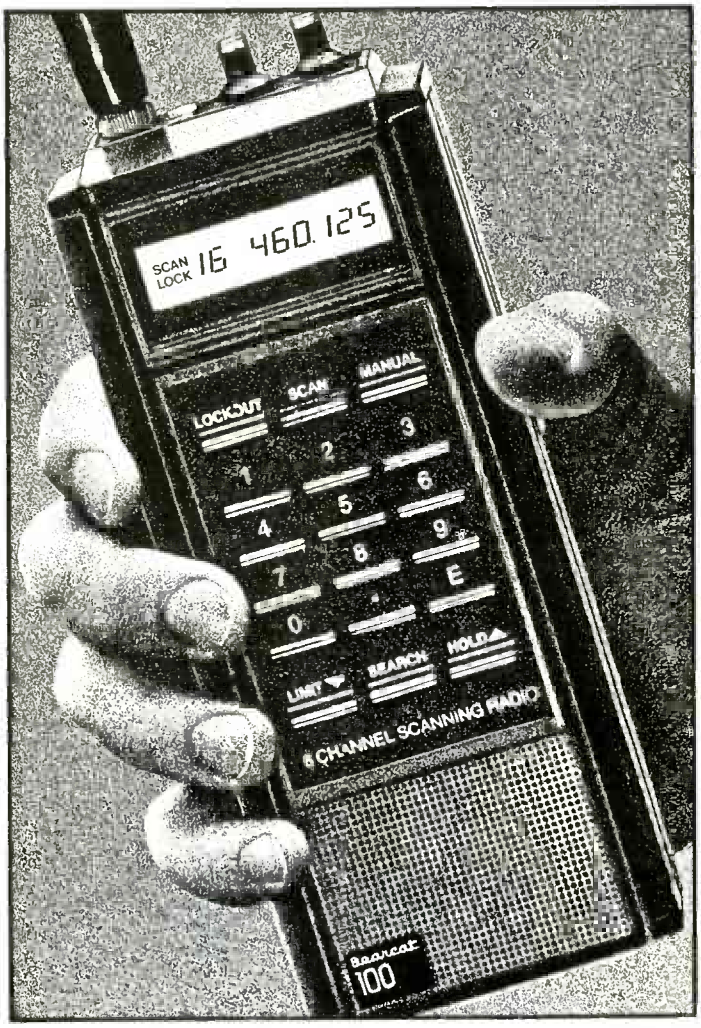

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COMMUNICATIONS CORNER

FM for CB: Won't they ever learn?

HERB FRIEDMAN, COMMUNICATIONS EDITOR

CITIZENS-BAND OPERATORS AND THE FCC have been at odds since the inception of the service. The problem, at least as seen by the FCC, is that the public has refused to fit the mold of an "uplifted" citizens' radio-service. Instead, the result has been a new class of lawbreakers, with more unlicensed CB'ers now using the service than "legals."

Do you think that anyone has learned anything from our CB version of Prohibition? Probably not, judging from the contortions that the FCC's European counterparts are now going through in an attempt to hold off those who want an "unrestricted" CB service on the Continent. The contention this time, though, is over an interesting technical variation—a CB service using FM.

The first reaction to FM for the CB service is approval. After all, FM would reduce impulse-noise interference, greatly increasing the "effectiveness" of CB communications. In fact, using FM for the U.S. CB service had once been considered and recently the idea has been revived because of the European interest.

But is FM really an improvement for CB? Consider the reasons behind the European interest in FM-CB. European manufacturers, who have always preferred a protected market for their products, are trying to avoid the fate of the U.S. CB industry—which, although initially successful, was eventually wiped out by the imports. The feeling among the Europeans is that, since the Asian manufacturers are currently producing AM transceivers for the U.S. market, they are unlikely to retool their facilities to produce FM units for the much smaller European one.

That, however, has nothing to do with the question of FM's benefits. For an answer, you have to consider whether or not FM really improves the effectiveness of the service—and it all depends on who is defining the term "effective." It appears that the European officials equate *effectiveness* with *short range*—European output-power levels are unusually low. In fact, the Dutch originally permitted a maximum output of only 0.5 watt, AM. Because of that, the signal range was next to useless, and the system bombed. Finally, in an attempt to prevent the high-power bootlegging that occurs here, the Dutch instituted a 40-channel FM-CB service with a maximum output of 2 watts. Unfortunately, many Dutch CB'ers are studiously avoiding that service.

Elsewhere in Europe, CB'ers have shunned FM like the plague. Tune across 11 meters in France and you'll notice that the band is bursting with AM. The same holds true in Germany. In fact, if you get stuck anywhere in Europe and call for assistance using AM, you'll probably raise someone.

Capture effect

Why the opposition to FM? Simply because it does not work for CB. One of FM's strong points is the *capture effect*—the ability of the strongest signal on or near the frequency to wipe out *completely* any weaker signal. Technical experts claim that because of the capture effect FM enjoys sharply reduced interference from co-channel signals. While a co-channel AM signal with only 1/100 of the strength of the other can cause considerable interference, even poorly designed FM detectors have no problem in locking onto signals in the presence of co-channel interference as much as 1/10 as strong.

But that is precisely what the European CB'ers object to. They claim that using FM they cannot hear "breakers," and that distant emergency signals cannot avoid being "killed" by the capture effect, making 11 meters useless.

FM is easy

What about the hope that an FM-CB system will remain immune from foreign competition for a long time? That hope is based on the belief that the conversion of American transceivers (as all AM transceivers are called in Europe, regardless of their place of manufacture) to FM at a reasonable cost will be impossible until new IC's are developed. However, that IC is already here.

Figure 1 is a schematic for an FM detector that can be added to any AM receiver with a 455-kHz IF. The circuit originally appeared as a "weekend project" in the March 1981 issue of *Ham Radio* magazine. It can be built on a piece of perforated board not much larger than two postage stamps.

The heart of the circuit is an MC1358 IC. It was originally intended for use in TV-sound circuits, where the transmitted FM-deviation is 25 kHz. It also works well for NBFM (*N*arrow *B*and *FM*). The device contains an IF amplifier, an FM detector, a limiter, and an audio preamplifier. Alignment could not be

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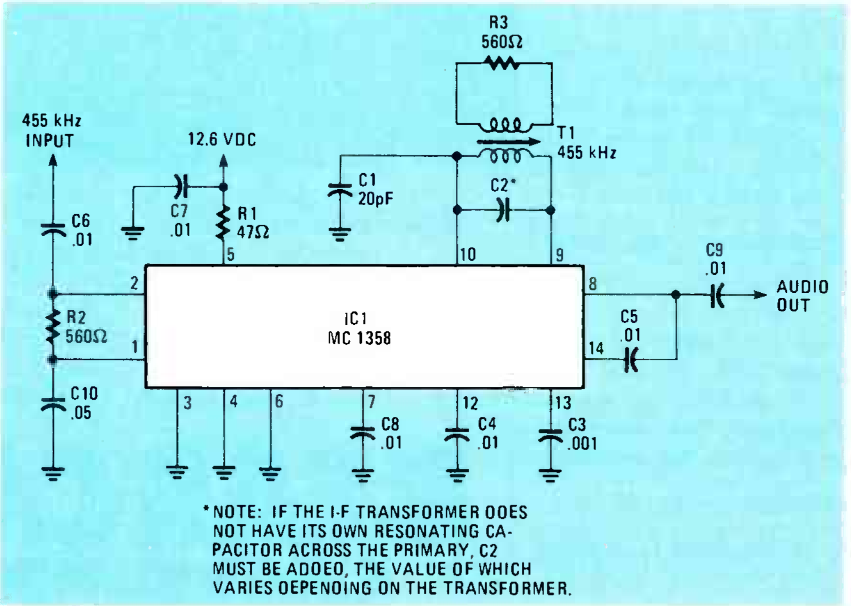

FIG. 1

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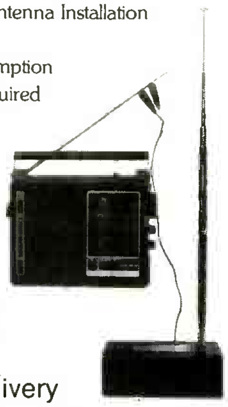

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easier: simply adjust the slug of the IF transformer for the "cleanest" audio output from a received signal or a tone-modulated FM signal-generator. In fact, most inexpensive AM signal-generators have so much FM modulation that you can use an AM test-signal and adjust the transformer for the least-distorted sound between two peaks of a high-level (but distorted) tone.

You can convert the transmitter section of a transceiver using standard techniques. (**Editorial note:** *FM is illegal for CB use in this country. The conversion mentioned is for use by licensed radio amateurs in the appropriate amateur bands.*) The whole project should not cost more than $25.00.

For you amateur-radio operators itching for something to build, consider converting an unused CB transceiver for 10-meter FM. For amateur use, FM works well. FM is essentially noise free, and the capture effect is an asset on the 10-meter band because the "breaking" procedure is not a problem for an experienced operator who is already used to pausing for a second or two before transmitting. The conversion shouldn't take more than a long weekend to complete. R-E

STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION

1. Title of publication: RADIO-ELECTRONICS — Publication no.: 0 0 3 3 7 8 6 2 — Date of filing: Oct. 1, 1981
3. Frequency of issue: Monthly — No. of issues published annually: 12 — Annual subscription price: $13.00
4. Complete mailing address of known office of publication: 200 Park Avenue South New York City, NY 10003
5. Complete mailing address of the headquarters or general business offices of the publishers: 200 Park Avenue South New York City, NY 10003
6. Full names and complete mailing address of publisher, editor and managing editor:
Publisher: Larry Steckler 200 Park Avenue South NYC, NY 10003
Editor: M. Harvey Gernsback 200 Park Avenue South NYC, NY 10003
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10. Extent and nature of circulation	Average no. copies each issue during preceding 12 months	Actual no. copies of single issue published nearest to filing date
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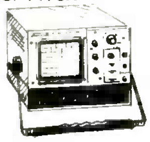

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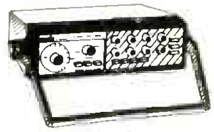

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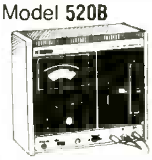

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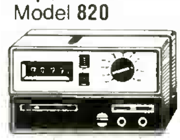

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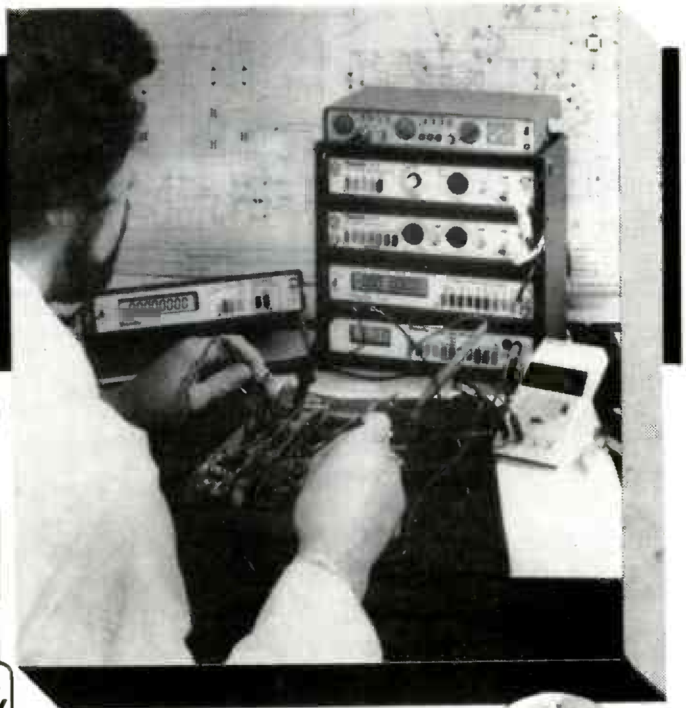

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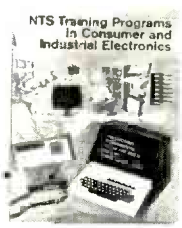

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COMPUTER CORNER

What software is, and what it does.

LES SPINDLE*

IN THE MOST GENERAL SENSE, SOFTWARE is what you need to get a computer to perform its intended function. Software can be recorded on the printed page, on cassette, or on disk. Reading the data off a page and feeding it manually into the machine (most commonly via a typewriter-like keyboard like the one shown in Fig. 1) is also the most time-consuming method. Feeding the data into the computer's memory from a pre-recorded cassette or disk is a much more efficient process.

FIG. 1

The computer user's first encounter with software is usually the documentation supplied with the hardware. Operating procedures, the user's manual, tips on the particular language syntax—and all the other information needed to prepare the machine for operation—is classified as "documentation." How clearly and thoroughly the step-by-step guidelines are set down will determine how successful the user is in operating the equipment.

Of special importance is the user's understanding of the computer language(s) used by his or her equipment. Just as people have devised physical sounds to represent objects, actions, and ideas, computers must have methods of accepting symbols that can be understood in order to be processed as data. Humans communicate by producing symbols (words) with their voices; the computer communicates by using symbols in the form of electrical impulses. And, just as humans have devised letters to convey their language on the printed page, a computer language needs to have its own set of symbols that can be read and understood by the user. When the user punches the various symbols on a keyboard, the computer translates the symbols into the electrical signals that tell the computer which function it is to perform.

Just as there are many different languages spoken around the world, there are many different computer languages. The most basic, machine language, is a rudimentary method of communicating directly to the computer through a system of binary digits. All computers have electronic circuits designed to detect voltage levels designated as 1's or 0's. Those are coded to represent a set of instructions.

The instruction codes are built into the microprocessor, or central processing-unit (CPU), and are usually different for each type of microprocessor. By inputting data using the machine's elemental binary language, communication is possible; but the process is long, tedious, and undesirable for efficient use of the computer.

One of the major problems with using machine language is that every computer instruction is a long string of 1's and 0's. To make those instructions more understandable, assembly languages were devised. Those languages made it easier to work with computers by assigning a name or "mnemonic" to each instruction.

While assembly language is easier to use than machine language, it is still machine-dependent, and programming with it is still a long and tedious process. That is why various high-level languages were developed; they allow the user to work in a language that is closer to English, thus improving efficiency and simplifying communications. Those languages include BASIC, Fortran, Cobol, and Pascal.

BASIC (*B*eginners *A*ll-Purpose *S*ymbolic *I*nstruction *C*ode), the most widely used and familiar language, is easy to learn because of its English-like statements and simple syntax. It is used in business and commercial applications, as well as for education. In BASIC, each line begins with a number that identifies it and specifies the order in which the statements are to be performed. The computer does the sorting of the program before it is run, so statements do not need to be input in any particular order.

Fortran (*FOR*mula *TRAN*slation) is used most commonly for mathematics, engineering, and science problems. Cobol (*CO*mmon *B*usiness *O*riented *L*anguage) is used most often in business and data-processing applications. Like BASIC, its format is simple and understandable for those with little technical knowledge. Pascal, named after the 18th century French mathematician Blaise Pascal, was developed in 1970 by Nilus Wirth of Zurich, Switzerland, to alleviate the burden of long lists and cumbersome sequential processes required by BASIC. It standaridizes the language structure, making it easier for one person to understand programs written by others. It is used in a rapidly growing number of applications.

As important as the language is the choice of an operating system. Essentially an "agent" between the hardware, the software, and the user, an operating system is a set of programs that manage collectively all of the resources available to the computer—including the CPU, the peripheral devices, and the software. For example, few users would be able to tell a disk drive to pick a track and sector to write data on. The file-management system will handle that task.

One advantage of an operating system is software compatibility. Software written in a high-level language is usually designed to interface to an operating system, which then interfaces to the hardware. Such software is easy to adapt to different hardware configurations—and even to a different computer entirely, as long as the operating system is the same.

An operating system is essential for the user who plans to write his or her own programs, as it provides a number of utility programs that make the development of application programs faster and less expensive. The primary duties of an operating system can be divided into four main categories. The first is file and software management. The system will include a large library of programs and files generally needed

continued on page 90

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COMPUTER CORNER

continued from page 88

by the user. Upon request by the user, the system will retrieve the desired program from disk and bring it into main memory for immediate accessibility.

A second important function is managing input/output devices and peripherals—printers, terminals, etc. When to communicate with the peripherals.

Third: the system will manage the computer's memory. The transfer of programs into and out of memory is done automatically; the system determines where the program is to be stored in memory.

Finally, but certainly not least important, the system works as a sort of taskmaster for the CPU. Since the CPU performs all of the arithmetic and logic less essential, perhaps, in a one-user system or a very small business; but in demanding situations, it is the quickest and most efficient way to accomplish the tasks at hand.

Several operating systems have become standards in the computer industry, but the most widely used, by far, is CP/M (Digital Research). It is compatible with 8080 or Z80 microprocessors using the S-100 bus, or the Intel

NEW IDEAS

Speaker overload protector

MANY OF THE LOWER-PRICED AMPLIFIERS available today do not provide any overload protection for your speakers. The purpose of the circuit shown in Fig. 1 is to remedy that shortcoming.

Relay RY1 is six-volt DPDT unit rated at 3-5 amps. One set of contacts is wired in series with each speaker so that when the relay is *not* energized, the contacts are closed and the circuits between the speakers and the amp are complete.

The input to the circuit is taken from your amplifier's speaker-output terminals or jacks. If the right-channel signal is sufficiently large to charge C1 to a potential that is greater than the breakdown voltage of Q1's emitter, a voltage pulse will appear across R7. Similarly, if the left-channel signal is sufficiently large to charge C2 to a potential that is greater than the breakdown voltage of Q2's emitter, a pulse will appear across R7. The pulse across R7 triggers SCR1, a sensitive gate SCR ($I_{GT} < 15$ mA, where I_{GT} is the gate trigger-current), that latches in a conducting state and energizes RY1. The action of the relay will interrupt both speaker circuits, and the resulting silence should alert you to the problem. Cut back the volume on your amplifier, then press and release S1 to reset the circuit and restore normal operation.

The circuit can be adjusted to trip at any level from 15 to 150-watts RMS. To calibrate, deliberately feed an excessive signal to the right input of the speaker protector and adjust R3 until RY1 energizes. Do the same with the left channel, this time adjusting R4. The circuit is now calibrated and ready for use.

—*Willie Ward*

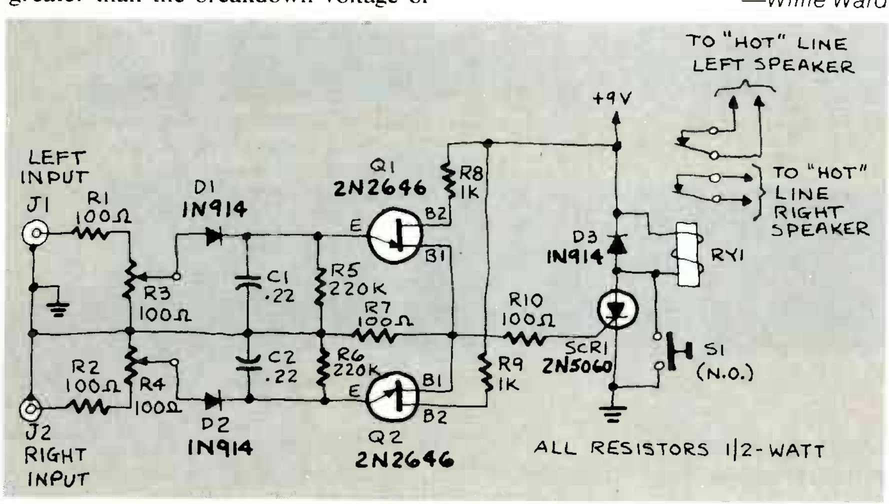
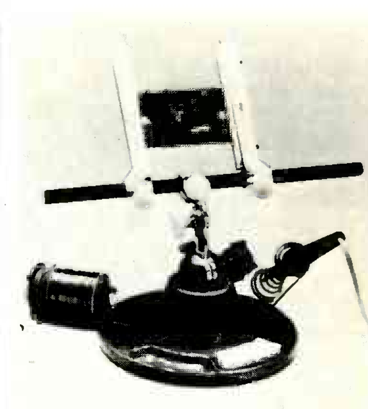


FIG. 1

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 324 Electronic Work Center, having a value of $49.95. It combines their circuit-board holder, tray base mount, and solder station (see photo below). Selections will be made at the sole discretion of the editorial staff of **Radio-Electronics.**



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"*Look, Mom—They've got books here, too!*"

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TOYS FOR THE HOLIDAYS

continued from page 54

laying-out the circuit is not to route the output of IC1 near the input to that IC. If possible, use a 100-mA current-limited power-supply in place of battery B2 while adjusting the circuit; doing that will protect transistors Q5 and Q6, and prevent draining the battery.

The first thing you'll need to do is to find the proper value for R3. Start by shorting Q1's collector to ground. Then, increase the value of R3 until the current drain from the power supply is less than 60 milliamperes. When that is done, remove the short from Q1.

To see if the device is operating properly, close switch S1 and reduce the resistance of R11. Wait 10 seconds, then rotate R11 slowly, and you should hear a sound similar to that of a steam locomotive picking up speed.

There you have it—four simple toys that any child would enjoy. We have built several of each and submitted them to some very tough "critics"—several children that we know! The results were very positive! **R-E**

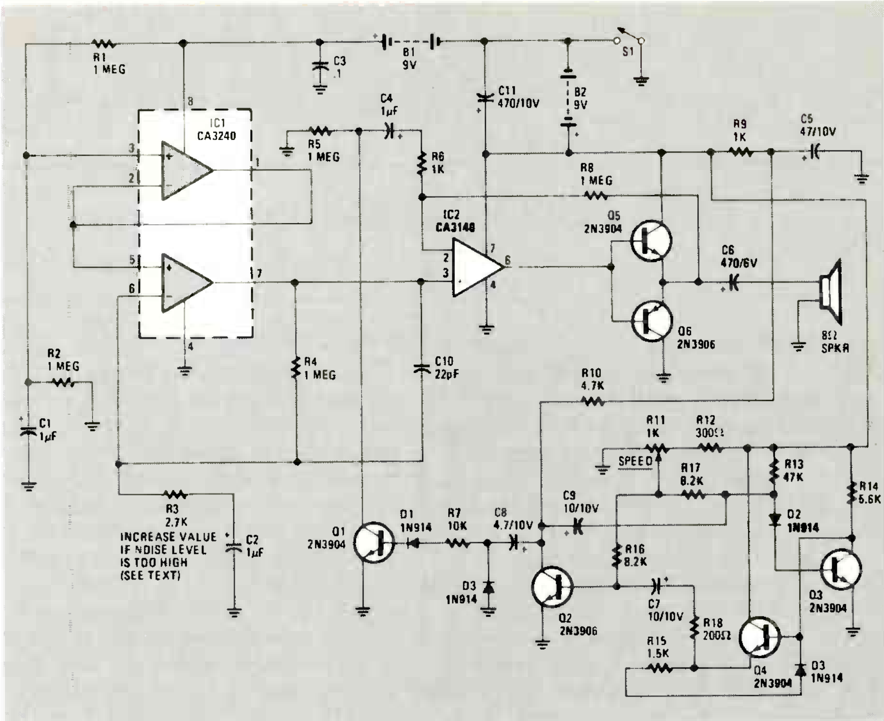

FIG. 4—THE CHUG-CHUG TOY simulates the sound of a steam locomotive. A dual MOSFET-input op-amp, IC1, is used as a white noise generator in this circuit.

PARTS LIST—CHUG-CHUG

Resistors, ¼ watt, 5%, unless otherwise noted
- R1, R2, R5, R8—1 megohm
- R3—2700 ohms
- R6, R9—1000 ohms
- R7—10,000 ohms
- R10—4700 ohms
- R11—1000 ohms, potentiometer, linear taper
- R12—300 ohms
- R13—47,000 ohms
- R14—5600 ohms
- R15—1500 ohms
- R16, R17—8200 ohms
- R18—200 ohms

Capacitors
- C1, C2, C4—1 μF, 10 volts or higher, electrolytic
- C3—0.1 μF, Mylar or ceramic disc
- C5—47 μF, 10 volts or higher, electrolytic
- C6—470 μF, 6 volts or higher, electrolytic
- C7, C9—10 μF, 10 volts or higher, electrolytic
- C8—4.7 μF, 10 volts or higher, electrolytic
- C10—22 pF, mica or ceramic disc
- C11—470 μF, 6 volts or higher, electrolytic

Semiconductors
- D1-D3—1N914 or equivalent silicon diode
- IC1—CA3240 (RCA) or equivalent dual op-amp
- IC2—CA3140 (RCA) or equivalent op-amp
- Q1-Q5—2N3904, 2N2222, or equivalent NPN transistor
- Q6—2N3906 or equivalent PNP transistor
- B1, B2—9-volt battery, transistor-radio type
- S1—SPST switch

Miscellaneous: Wire, solder, miniature 8-ohm speaker, etc.

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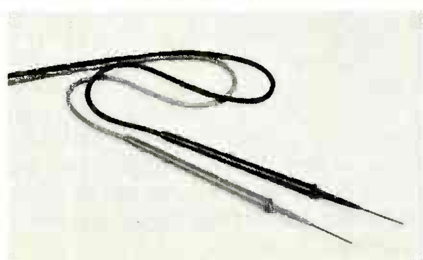

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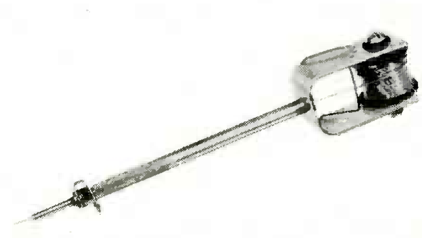

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SERVICE CLINIC

Some hints to help you revive a "dead" set.

JACK DARR, SERVICE EDITOR

IT USED TO BE THAT A "DEAD" SET (NO picture, no sound) was one of my favorite service jobs. All I had to do was to take the back off and have a look. If the rectifier tube was lit, the problem was in the B+; if not, the problem was an open choke or resistor, or something equally simple. The whole thing took about 10 minutes to troubleshoot and fix.

Unfortunately, those days are gone. Many of the sets made in the last five years or so use a dual power-supply system. That system has a line-connected DC-voltage supply with outputs of +145 volts using a half-wave rectifier, +250 volts with a full-wave bridge, +300 volts with a half-wave doubler, and so on.

That line-connected, or primary, supply provides the operating voltage for the secondary DC-supply system, including the flyback transformer and the horizontal-output transistor. The secondary supply provides the actual operating voltages for the rest of the set. It also serves to isolate the chassis from the AC power-line. Windings on the flyback provide pulses that are rectified and filtered to obain the DC voltages for all the signal circuits and even the picture-tube heaters. A block diagram of the power-supply circuit is shown in Fig. 1.

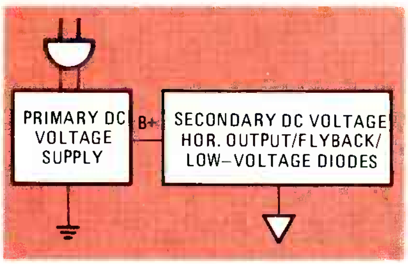

FIG. 1

That brings us to the question of why this type of power supply is more difficult to service than the older ones. Instead of only one ground, we now have two. One of the grounds is used for the line-connected primary DC supply, and is often common to the AC-line ground side. The other ground is isolated, and is used for all of the other circuits. That eliminates any possibility of a shock from touching the metal parts of the cabinet.

A two-step test

Because of that dual power-supply, it will require at least two steps to make the initial tests on a dead set. First, you'll need to check the switch, circuit breaker, fuse, and the rest to make sure that you are getting AC voltage to the set. Then you'll have to check the primary supply. If the DC voltage from it is missing or way off, the procedure is the same as in the older, single-supply sets. The DC voltage from the primary supply must be normal before you can go any farther. All of that takes almost less time to do than it does to explain.

The second step is to check the secondary supply—the voltages coming from the flyback. If the voltage for the picture tube's heaters comes from the flyback, that step is easy. If the heaters are lit, the flyback/output-transistor circuit is working. If that is the case, your trouble could be in one of the low-voltage supplies, and that could be killing a vital stage. If none of the flyback-derived DC voltages are present, turn off the set and check the horizontal-output transistor. If that transistor is open, it could be the cause of your problems. Do *not* substitute a good transistor and turn the set on. There may be a dead short elsewhere in the set that blew that transistor. (If that is the case, you'll wind up with *two* very dead, very expensive power-transistors!)

Make continuity and resistance tests on the low-voltage DC-supply circuits; be sure to check all of the diodes for shorts. If those tests don't turn up anything, with the output transistor out of the circuit, turn the set on and check for the presence of the primary DC-voltage where the collector would normally be connected. If the voltage is not there, but is OK at its source, check to see if the set has a fuse between those two points.

If everything seems to check out in the output stage, again leave the output transistor out and check the horizontal-oscillator stage. That stage generally has a "starter" circuit that feeds a small pulse of DC to get the oscillator going. Once it starts, it drives the output transistor, which then gets its power from the low-voltage windings of the flyback. To test the starter circuit, turn the set on; if the oscillator does not start, feed a DC voltage (from a bench supply) equal to the normal output of the starter circuit to that circuit's DC output-point. If the oscillator starts and the set works normally, the problem lies in the starter circuit.

There are several different starter circuits around; check your schematic to see which one you have. One interesting circuit uses the high pulse of charging current that flows into the input filter-capacitor at turn-on; that pulse is passed through the primary winding of a transformer. The changing current in the primary induces a pulse in the secondary, and that is rectified, filtered, and then used as the starter pulse. When the filter capacitor is fully charged, and the current no longer changes, the circuit becomes inoperative.

Watch those grounds

When testing any dual-supply circuits, check the schematic to make sure of which ground you should be using. The dual-ground system has brought back a symbol that used to be quite common in AC/DC radios. The standard ground symbol is a triangle of horizontal lines; the isolated-ground symbol is a hollow triangle (see Figs. 2-a and -b). The service data should tell you which parts of the chassis are connected to which ground. Using the wrong ground can give you some very strange readings, but is of no help at all in finding the problem. Not too long ago, we were checking a video-amplifier stage with an oscilloscope and found a sound signal on it! It turned out that we were using the wrong ground.

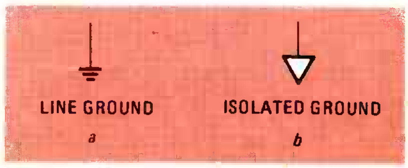

FIG. 2

One note of caution: If the set that you are working on uses a full-wave bridge rectifier that is directly across the AC line, the chassis will *always* be hot—at least 60-volts AC. If the grounds of some of your test equipment are returned to the line ground, you can damage the set or your equipment just by

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hooking up the ground lead. Always use an isolation transformer for safety when you are working on those sets. In fact, it's not a bad idea to use an isolation transformer on any dual-ground set.

In cases where the trouble is not an open circuit, but rather a short (indicated by a blown fuse or tripped circuit-breaker), you should make several tests before turning the set on. Check the resistance to ground from the primary supply; also check for shorted rectifiers, etc. If that is OK, check from the DC supply to the collector of the horizontal-output transistor, from its collector to ground, and also check the transistor for shorts. You can pull the transistor and apply primary power. If the short "disappears," the problem is either a shorted output-transistor or a short in one of the low-voltage supplies from the flyback.

A variable-output transformer can also be handy when you are looking for shorts. If the output transistor is OK, or if you have put in a new one, place an ammeter in series with the primary DC supply, and a voltmeter across it. Start the transformer with a very low line-voltage, and bring it up *very* slowly. Watch the ammeter; if the current is normally 500 mA, and you see 300-350 mA when the supply voltage is just ⅓ of normal, you still have a problem. The short is still there, but the low voltage holds down the power dissipation and keeps the transistor from blowing. You can also use a variable-output transformer to make some DC-voltage tests around the circuit. If you are using ⅓ of the normal supply voltage, look for a point that should have ⅓ of its normal voltage, but has zero. A lot of solid-state sets will try to work at an amazingly low line voltage. **R-E**

SERVICE QUESTIONS

LOW BRIGHTNESS

I have a low-brightness problem with the picture tube on this Zenith 14A9C50. Tried a brightener but it did not help. The boost is quite low, as is the boosted-boost. Replaced the boost rectifier but that didn't help either. The B++ reads only about +400 volts instead of the +870 volts that it should. I need a new idea.—J.M., Pettus, WV

I think you are already in the right place. Find out why the B++ is so low. That feeds the picture tube's screen controls, and if they are low, they hold the brightness down. With a new rectifier you may have some shunt leakage to ground—not a dead short, but enough to overload the B++ circuit.

(Feedback: "The 'raw boost' was up to about +850 volts as it should be, but the boosted-boost was down. Finally found a very leaky .01 μF bypass capacitor that was between B+ and the boosted-boost. Had to replace one worn screen control, and the set now works fine.")

Comment: The leaky capacitor was "shorting" the boosted-boost to B+, which is only +400 volts.

INTERMITTENT TRANSISTOR

I had a dead Sony TV-132. The problem was in the low-voltage supply. Transistor Q601 appeared to be open, but when I took it out of the circuit it checked out as good. That threw me for a while. That transistor is in a TO-220 case; on a hunch I bent the leads to make them easier to get to and rechecked the device. The emitter now checked out as open! The lead was broken inside the case. When the leads were returned to their original position, the way they are when the transistor is mounted on the PC-board, it again checked out as good.

Thanks to Yusuf Bandukwala of Houston, TX for that feedback. I've run into similar problems with TO-220 transistors. If you suspect one of them, it's a good idea to take it out and wiggle the leads a little for luck.

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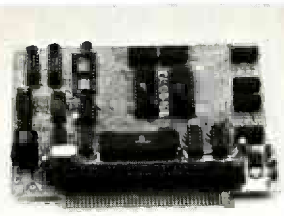

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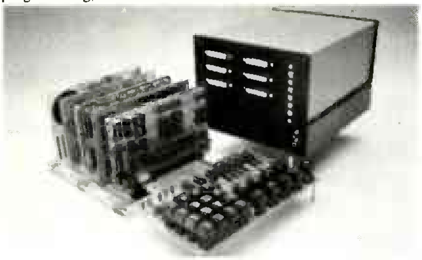

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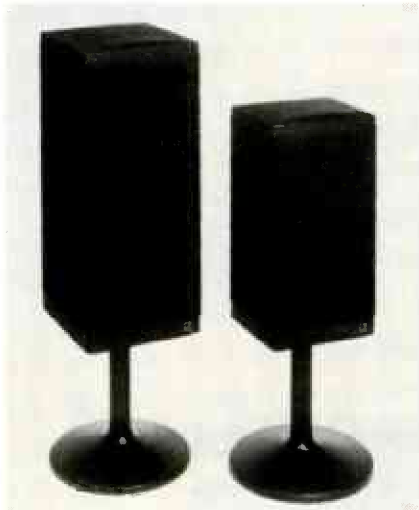
The frequency response of the *model F-V3T* is 100-12,000 Hz, with an output level of 58.8 dBm, making it suitable for many home and office recording situations. Measuring approximately 7 inches in length and weighing 6.4 ounces, it is extremely portable and constructed to assure years of efficient operation. The *model F-V3T* is priced at $29.95. — **Sony Corporation of America,** 9 West 57th Street, New York, NY 10019.

SPEAKER SYSTEMS, *model 303 Series II* and *model 304 Series II,* combine attractive styling with the latest developments in loudspeaker engineering. Both models are finished in grille cloth on all four sides of the cabinet, and are available in either black or brown with matching metal stands. An exclusive feature of the two



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systems, however, is the capability of changing the grille cloth quickly and easily to beige, blue, red, green, or gray; the color grille cloths are available as optional accessories.

The *model 303 Series II* is a 2-way system using an 8-inch bass unit and a newly-developed 1-inch tweeter. It is capable of achieving output levels higher than 100-dB sound-pressure level. The price of the *model 303 Series II* is $225.00 each.

The *model 304 Series II* is a medium-size loudspeaker system combining the newly-developed 1-inch tweeter with two 8-inch bass units to give extended bass performance. The two identical bass units are arranged to work together over the lower part of the frequency range, and a unique crossover network insures the absence of irregularities at the crossover frequency. The maximum output is 107 dB sound-pressure level. The price of the *model 304 Series II* is $350.00 each. — **KEF Electronics, Ltd.,** P.O. Box 17414, Washington, DC 20041.

SCREW-HOLDING DRIVERS, *Set No. 89906,* is a 4-piece screw-holding driver set containing four frequently-used screw-holding drivers in a colorful box. Included

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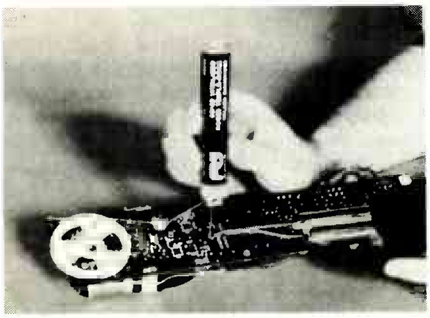

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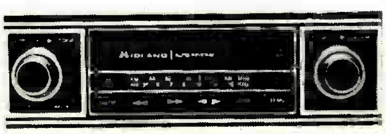
Used with a soldering iron or gun, the kits come with application information and are ideal for electrical wiring, antennas, speaker leads, appliances, TV's, and radios.

The *solder repair kits* range in price from $1.30 to $4.50. — **Fry Metals, Inc.,** 50 Sims Avenue, Providence, RI 02909.

CAR CASSETTE PLAYER, *model 67-458,* is a fully-automatic-reverse stereo cassette player with a highly sensitive, selec-



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tive AM/FM/FM-stereo receiver. The player features a low-distortion amplifier. The *model 67-458* has FM muting, local/distance, and stereo/mono for maximum receiver performance. There is also an easy-to-read illuminated analog AM/FM frequency scale; a tone control that adjusts bass/treble response; balance and fader controls that adjust stereo separation for up to four speakers, and distinctive styling with the side-loading cassette player hidden behind a dust cover.

The *model 67-458* is priced at $149.95. — **Midland International Corp.,** PO Box 1903, Kansas City, MO 64141.

PULSE/FUNCTION GENERATORS, *model 514* and *model 514A*, are combination bench-top instruments: each model has separate pulse and function generation sections.

In the *model 514* (shown) the function-generator section operates from 0.001 Hz to 5 MHz and offers sine, square, triangle, trigger and gate operation with output waveforms of 20-volts P-P at the high output. A low output delivers 2-volts P-P. A 40-dB variable control attenuates both the high and low outputs simultaneously. Additional features are variable DC offset. VCF (Voltage Controlled Frequency) input, and sync input. The frequency/period dial operates in a 10-turn resolution mode, or in a dial mode that gives 3-decade single-turn operation.

The pulse-generator section offers single pulse, double pulse, and delayed

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pulse over a frequency range of 0.001 Hz to 20 MHz. The frequency/period dial sets the repetition rate and/or period. The period is adjustable from 1000 seconds to 50 nanoseconds. Pulse width and delay are set by individual calibrated controls. The pulse width and delay are both adjustable from 100 milliseconds to 10 nanoseconds. A squarewave mode is also provided, and the pulse generator can be triggered and gated. Pulses can have their baseline at zero volts or have up to ± 10 volts of DC offset. The *model 514* is priced at $645.00.

The *model 514A* adds simultaneous outputs from five individual connectors to give TTL, $\overline{\text{TTL}}$, ECL, $\overline{\text{ECL}}$, and pulse outputs from the main output amplifier. Eighty dB of attenuation is added in 10-dB steps plus 20-dB of variable gain, and replaces the low-output connector. Pulse rise and fall times are 2 nanoseconds at the ECL outputs, 7 nanoseconds at the TTL outputs, and less than 40 nanoseconds at the main output. There is also variable symmetry and a variable start-stop point on triggered and gated waveforms. The *model 514A* is priced at $725.00. — **Exact Electronics**, PO Box 347, Tillamook, OR 97141.

PROBE, *model 4800*, is a miniature test probe with a right-angle banana plug, and is equipped with a replaceable needle and a finger guard that prevents the

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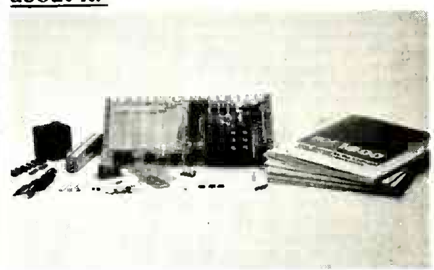

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lium copper, heat-treated, nickel-plated spring is attached to the probe by a polypropylene insulated, 20-AWG wire. The length of the wire is 1219.2 millimeters (48 inches). The unit is available in red or black.

The *model 4800* is priced at $4.85. — **Pomona Electronics**, 1500 East Ninth Street, PO Box 2767, Pomona, CA 91766.

PENCIL BOX LOGIC DESIGNER, *model LD-1*, is a new, portable logic-design and breadboarding instrument, available either in kit or assembled form. The *model LD-1* provides major design needs in a portable molded plastic case with an integral hinged cover. Some of the features are a variable clock, two pulsers, eight LED readouts, eight logic-level switches, and the E & L *model SK-10* solderless breadboarding socket. Power is supplied through batteries or an op-

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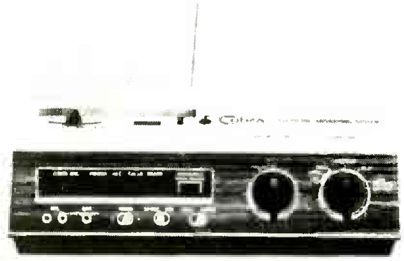
tional AC supply. The *model LD-1* is priced at $75.00 for the kit (P/N 325-4301); assembled (P/N 325-1301), it costs $99.50. — **E&L Instruments Inc.,** 61 First Street, Derby, CT 06418.

TELEPHONE-ANSWERING SYSTEMS, *model AN-3300* and *model AN-3500* are microprocessor controlled, dual-cassette systems, featuring voice-activated or fixed-time incoming messages. With VOX, or voice-activated mode, messages can be as long as three minutes; fixed-time messages are 30 seconds long.



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The *model AN-3300* (shown) has monitor capability through the built-in speaker or earphone (jack provided). There is also a built-in condenser microphone, plus two external mike jacks. LED indicators tell the operator when power is on; when calls have been received; when incoming or outgoing message tapes are being recorded, and when the outgoing message tape is ready for recording. The function selector switch has five posi-

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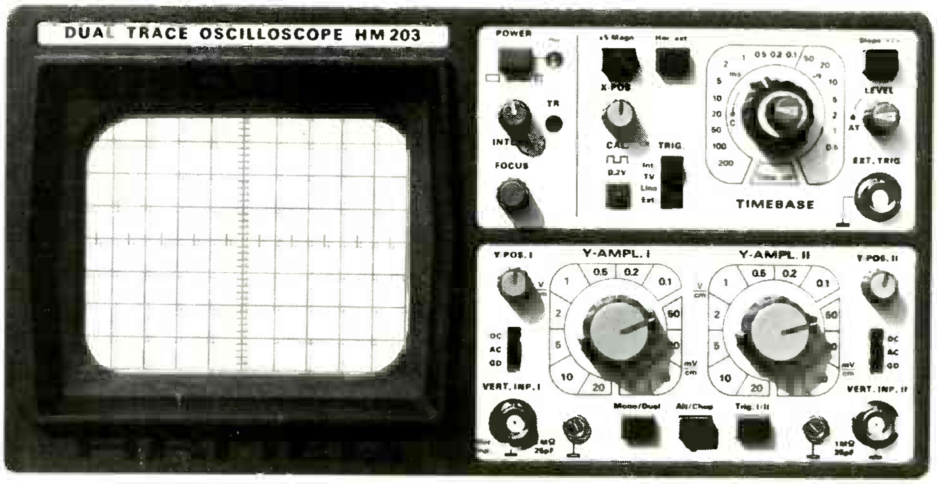

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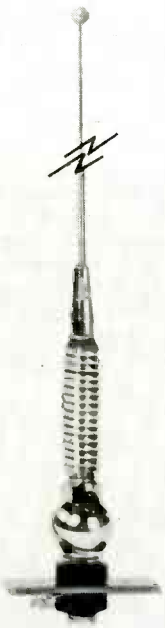
tions: RECORD and CHECK (outgoing messages): ANSWER and PLAYBACK (incoming messages). and 2—WAY RECORD/DICTATE.

The *model AN-3300* is priced at $189.95.

Model AN-3500 is identical with the above except for the added remote key, which permits calling in from anywhere in the world to pick up recorded messages. Functions include rewind (to play back messages); backspace (to replay any portion of a message just listened to), and reset (to set tape back to the beginning for new messages coming in to be recorded). The *model AN-3500* is priced at $239.95. — **Cobra Communications,** 6460 W. Cortland St., Chicago, IL 60635.

MOBILE ANTENNA, *model ASP-775,* for small cars, is a 39-50 MHz, quarter-wave whip that needs only a 1-inch wide and 2½-inch long flat mounting area. It will handle 150-watts maximum RF power, and has a VSWR of less than 1.5:1 across the specified 3.5-MHz bandwidth.



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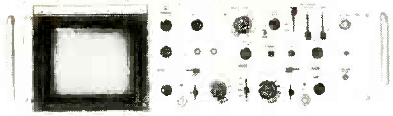
The *model ASP-775* featured a tapered, stainless-steel whip, compactly designed shock spring, and swivel base. A back-up plate is provided to reinforce the mounting area: cable, connector, and Allen wrenches are also included. The user should specify operating frequency to the nearest 1/10 MHz when ordering. The *model ASP-775* is priced at $45.00. — **The Antenna Specialists Co.,** 12435 Euclid Avenue, Cleveland, OH 44106.

OSCILLOSCOPE, *model 1479R,* is a dual-trace 30-MHz oscilloscope enclosed in a rugged, rack-mount case for manufacturing, educational, military, and wireline-logging applications.

Switch-selectable front- and rear-channel inputs allow use as a general-purpose oscilloscope, and as a dedicated device with permanent connection to other rack-mounted equipment.

The 2 mV/cm vertical sensitivity allows observations and measurements of low-level signals. A signal-delay circuit permits viewing of fast rise-time pulses, with



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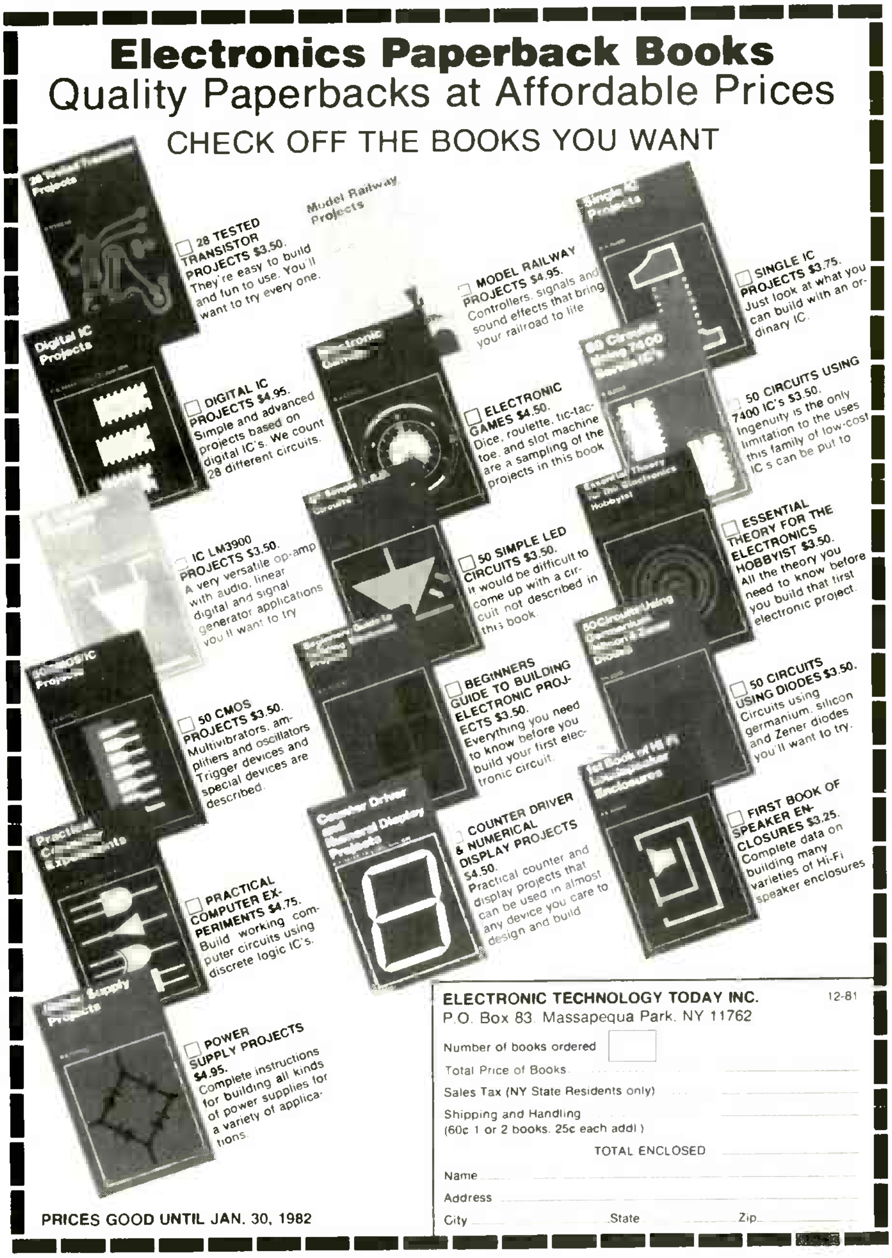
a maximum sweep time of 0.1 ms/cm. In addition, the *model 1479R* provides single-sweep operation for easier observation and photographing of irregular waveforms. Video coupling allows synchronization to video frame and line.

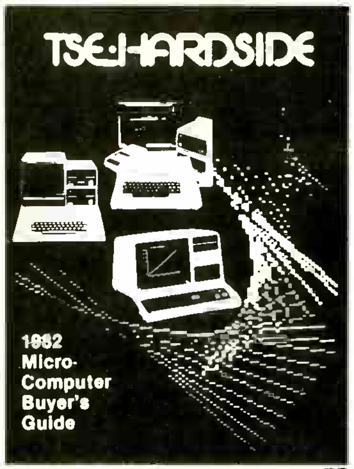
Other features include variable hold-off, alternate trigger, trigger fix, sweep and gate outputs, etc., which normally are found only in more expensive oscilloscopes. The *model 1479R* is priced at $1495.00. — **B&K Precision Product Group,** Dynascan Corporation, 6460 W. Cortland Ave., Chicago, IL 60635.

PORTABLE LIGHT, *Bend-A-Light,* features a high-intensity light beam coupled with a flexible shaft that reaches and illuminates areas where conventional hand-held lighting fails. It combines a miniature, prefocused optical lens and lamp, rated at 2.5 volts, that focuses and concentrates a brilliant light into a pinpoint beam.

Bend-A-Light uses a ⅛-inch ultra-slim, special-alloy shaft 10 inches long; that shaft allows repeated bending in any configuration. It can reach around corners and into areas as small as ¼-inch wide. It



The TSE-HARDSIDE 1982 Micro-Computer Buyer's Guide



is now available! We've included such valuable information as print samples from each of the printers we carry, feature-by-feature comparisons of micro-computer systems in an easy-to-read table format, an informative article on Micros, and pages and pages of complete product descriptions. We're making this valuable reference available for only $2.95 (credited toward first purchase from TSE-HARDSIDE). Just clip the coupon (or send a note) with your check for $2.95 to the address below. THE TSE-HARDSIDE 1982 BUYER's GUIDE will soon arrive postpaid to your door.

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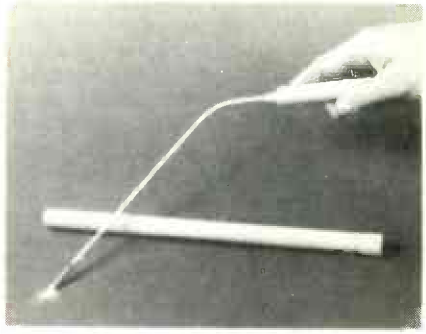
extends to 27 inches, with an unbreakable PVC dual-purpose extension tube that also serves as a casing to protect the shaft. Also featured is a stainless-steel

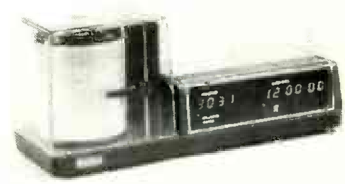


CIRCLE 122 ON FREE INFORMATION CARD

tip that will not rust. Conventional AA cells are used. Optional features include a heavy-duty shaft pick-up magnet and a handle clip-on magnet for versatility.

Bend-A-Light is priced at $24.50; with all the accessories, the cost is $36.95. — **L&W Enterprises, Inc.,** 200 S. Washington, Royal Oak, MI 48067.

BAROGRAPH, *model ID-2090,* designed as a kit, provides digital readings of current barometric pressure and makes a permanent record of pressure changes. Barometric pressure — in inches of mercury (Hg), millibars, or kilopascals — is recorded on the drum chart. The chart can be adjusted to record at 7-day or 31-day speeds (with appropriate chart paper.) Written notations can be made by the user on the chart, during or after recording.



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A four-digit LED display shows the current pressure (28-32 inches of mercury, 948-1083 millibars, or 94.8-108.3 kilopascals) at the same time it's recorded on the chart. An LED indicates the unit of measurement currently in use (Hg, MB, or KPA). Cabinet switches allow the user to recall maximum and minimum barometric readings (since last cleared) with the time and date they occurred from the *model LD-2090's* memory. A separate 6-digit display alternately shows the current time (in 12- or 24-hour formats) and a 4-year calendar, or continuously displays time or date.

The easy-to-build kit features a transparent, smoked plastic dust cover for the chart-recorder drum. A one-year supply of chart paper is provided; additional chart paper and a replacement pen are available separately. The *model ID-2090* is priced at $295.95, mail order. — **Heath Company,** Benton Harbor, MI 49022.

continued on page 104

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What's News

National Semiconductor, Motorola sign bubble agreement

National Semiconductor Corp. and Motorola Inc. have signed an alternate-source agreement which will allow them to develop, manufacture, and market 256-kilobit and 1-megabit magnetic bubble memory devices, and LSI (*Large-Scale Integration*) bubble-memory controllers.

To insure that there is a true alternate source, National Semiconductor will provide Motorola with a full design data base, including basic device architecture and test procedures.

National's three-year-old bubble program produces the smallest bubble-memory devices available. That economy in size, plus the devices' standard 16-lead pin-out, promises to make them industry standards, National believes.

New watch "tells time"

A watch has at last been developed that justifies the old expression "tells the time." Press the "speak" button and the watch gives the hours and minutes, AM or PM, using a synthesized human voice.

The Omni *Voice Master* is built in a square case, and can be worn on the wrist, used as a pocket watch or, when mounted in a stand supplied with it, used as a miniature desk clock or attached to the dashboard of an automobile.

The alarm wakes the sleeper with gentle music, gives the time, then follows with another 20 seconds of music. If not turned off, five minutes later it says: "Attention!" gives the time, and tells the sleeper to "please hurry!" That is repeated later.

In the "chime" mode, the watch "tells the time" every hour and half hour. It is also a stopwatch. When used to time an event, it tells the elapsed time every five seconds, and, when stopped, gives the total elapsed time in minutes and seconds.

The *Voice Master* uses four standard UC393 cells that will operate the watch for eight or nine months of normal use. **R-E**

THE OMNI VOICE MASTER can be used four ways: as a pocket watch (above); worn on the wrist (below); on an automobile dashboard, or as a desk clock.

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NEW LIT.

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TRAINING-TAPE CATALOG is a complete reference guide to Sony's video training-tape library. The catalog is divided into three categories: basic fundamentals, technical training on specific products, and special programs.

The section on basic fundamentals describes the courses on a wide variety of video-related subjects in easy-to-understand language. The technical-training category explains the Sony tapes dealing with specific video products. Usually consisting of eight tapes in a series, they begin with tapes on "operation" and "technical overview" for the non-technician, and then cover hard technical information for those requiring more detailed knowledge. The special-programs tapes, best used by dealers and salespeople, are released as new equipment is introduced. The catalog describes those tapes available now, including product-demonstration tapes on the Sony *Video Responder* and *model DXC-1800* color camera and visual demonstration method. Free upon request.—**Sony Video Communications,** Tape-Production Department, 700 West Artesia Boulevard, Compton, CA 90220.

CIRCLE 151 ON FREE INFORMATION CARD

CROSS-REFERENCE LIST, two-color, 8 pages, 8½ × 11 inches, is a comprehensive cross-reference list of TRW part numbers. There are more than 1900 entries, showing EIA numbers in conventional order and the corresponding TRW number. Free upon request.—**TRW Power Semiconductors,** 14520 Aviation Blvd., Lawndale CA 90260.

CIRCLE 152 ON FREE INFORMTION CARD

TEST INSTRUMENT/DIGITAL PANEL METER CATALOG, 190 pages, illustrated, 8½ × 11 inches features a complete glossary of terms and conditions, as well as introductory material on test instruments and portable digital multimeters in general.

Included in those two categories are multimeters, oscilloscopes, AC and DC voltmeters, temperature meters, frequency monitors, frequency meters, counters, and logic probes. The individual instruments are shown in clear photos, and with each there is a list of specifications, applications, and descriptions. Free upon request.—**Non-Linear Systems, Inc.,** Box N, Del Mar, CA 92014.

CIRCLE 153 ON FREE INFORMATION CARD

ELECTRONICS CATALOG, 32 pages, tabloid size, is fully illustrated and lists all manner of electronics equipment and components, such as color converters, transistors, filter capacitors, liquid crystal displays, light sources, channel-selecting keypads, digital printers, humidity controllers, blowers, air compressors, motors, timers, transformers, power supplies, noise suppressors, heat sinks, switches, pots, relays, digit counters, bridges, microphones—and many others. Free upon request.—**Technical Electronics,** PO Box 2361, Woburn, MA 01888. **R-E**

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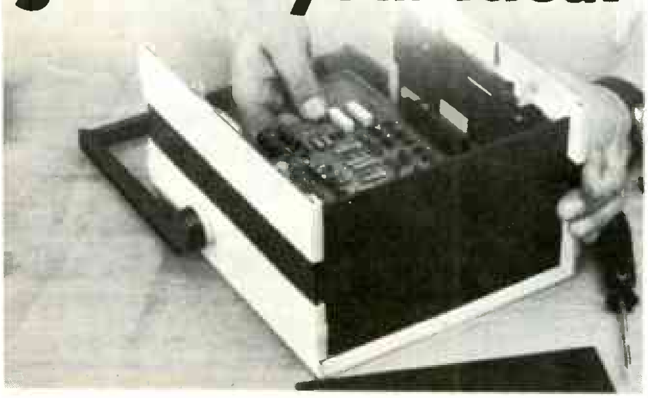
An enclosure as good as your idea.



You've turned a good idea into a piece of equipment—now you need a good enclosure. Here's how PacTec can help you with our versatile enclosures:
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NEW BOOKS

For more details use free information card inside back cover.

ELEMENTS OF SOLID STATE PHYSICS, by M. N. Rudden & J. Wilson. John Wiley & Sons, Inc., One Wiley Drive, Somerset, NJ 08873. 186pp.; 6⅛ × 9¼ inches; hardcover. $40.00.

Unlike many other introductory texts on solid-state physics, this one assumes no prior knowledge of quantum or statistical mechanics on the part of the student, but relies on simple models to illustrate the physical principles. As a basic introduction to those principles, it is designed for first-year students in physics, materials science, and electrical/engineering courses.

The student is provided with a wide range of numerical problems with solutions and hints, together with a large number of descriptive questions that can serve as a means of self-testing.

Following the preface and prologue, the six chapters are titled "Some Aspects of Modern Physics," "Classical Theories of Conduction and Magnetism," "Energy Bands in Solids," "Quantum Theory of Conduction," "Structure of Crystalline Solids," and "Semiconductor Devices." The book is illustrated with charts, diagrams, and line drawings. There are also discussion questions, answers to the problems posed at the end of each chapter, a suggested reading list, appendices, and an index.

CIRCLE 141 ON FREE INFORMATION CARD

SON OF CHEAP VIDEO, by Don Lancaster. Howard W. Sams & Co., Inc., 4300 West 62nd St., Indianapolis, IN 46268. 223pp, including appendices; 5⅜ × 8½ inches; softcover. $8.95.

This, like its predecessor, *The Cheap Video Cookbook*, is a build-it-yourself hardware book for hardware fans. It will show you very low-cost ways of getting alphanumeric and graphic video out of a microcomputer and onto an ordinary TV set.

For example: you can build a complete video-display system (called "scungy video") for $7.00. It eliminates one or both of the custom PROM's used in "cheap video," and it needs far less address space. It's also easier to interface to different microcomputers, is much simpler, and is more versatile. You'll get all the details on how to do it in the first chapter.

The second chapter shows you how to run a video display and compute at the same time without interaction. The sneaky device that permits this operation is called "the snuffler," and it can be built for under one dollar.

Further ingenious ways of getting good electronic results without more than a modicum of the conventional cost include custom characters; a music display; cheap video—Heath *H8* hardware; 8080 cheap video—Heath *H8* software, and lower-case hardware and software for the *Apple II* (one chapter on each of those). The appendices at the back of the book show pinouts of selected IC's, printed-circuit patterns, and more character-generator details.

CIRCLE 142 ON FREE INFORMATION CARD

HANDBOOK OF ELECTRONIC METERS: Theory and Application, by John D. Lenk. Prentice-Hall, Inc., Englewood Cliffs, NJ 07632. 228pp., including index; 6⅛ × 9¼ inches; hardcover. $18.95.

This revised and enlarged edition is designed to be both a basic textbook for student technicians, hobbyists, and experimenters, and a factual guidebook for experienced, working technicians. Much of the material from the first edition has been revised for clarification or simplification. Existing information has been updated to reflect present-day trends, particularly the extensive use of digital meters.

As in the original edition, this handbook can be used to supplement the operating instructions that accompany any meter (digital or analog), whether it be a low-priced shop type or a precision laboratory instrument. That is done by providing a variety of test, measurement, service, and troubleshooting procedures using the meter as the basic tool. The procedures are presented in "cookbook" fashion. Each procedure is preceded by a brief descriptiion of the "why" and the "where" for the particular test. Each operation is illustrated with test connection diagrams.

Chapter 1 discusses the basics; chapters 2 and 3 cover accessory probes and fundamental operating procedures. Test and calibration of meters are then dealt with (chapter 4). Special measurement procedures are covered in chapter 5, then chapter 6 deals with the use of meters to check individual components, and chapter 7 is concerned with circuit functions. The final chapter (8) concentrates on servicing specific circuits with meters.

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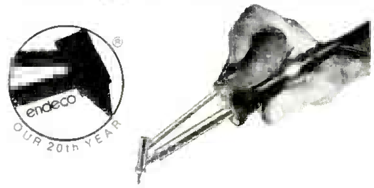

Be safe. Desolder PC components with Endeco irons. Get *proper* HEAT TO MELT and *strong* VACUUM ACTION TO LIFT solder and *cool* both PC board and component without damage.

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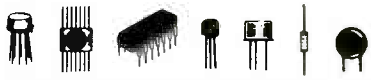

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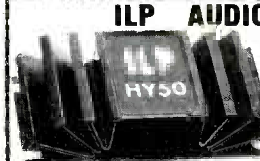

- Built-in heatsinks
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- No external parts required
- 5 connections
- 5 year warranty!

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30 WATTS RMS $28.95
High performance amp with rugged aluminum heatsinks. Measure only 4" × 2" × 1" thick! Mounts with 2 screws. Gives 30 watts RMS at 0.02% distortion. Response 10 — 45 KHz. 4 to 16 ohms. ± 25 V/2A.

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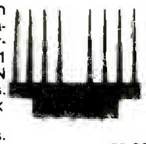

High performance amplifier with large heatsink area for cool operation. Fully protected circuitry. Distortion only 0.01% at 120 watts RMS (1 KHz). Response 10 Hz — 45 KHz. S/N ratio 100 db. Only five connections. Amazingly compact — only 4½" × 4" × 2" D. Mounts with 2 screws. Requires ± 45 V/3A. 4 to 16 ohms.
HY120. 60 W RMS. Specs/size as HY200. ± 35 V/2A 59.95

HY400. 240 Watts RMS (4 ohm). Double the power, double heatsink area! Same specs as HY120/200. May be used into 8 ohms at reduced output. ± 45 V/4A $99.95

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HY66 Stereo Preamp 48.95

Inputs for RIAA phono, tape with monitor, tuner, auxiliary and microphone; full tone control circuitry. Incredible performance: Response DC to 100 KHz, distortion .005%, S/N 90 db. Output to 4.5 V RMS. Supplied with edge connectors. Compact. Reliable. Internal voltage regulation — use from 15 to 50 V safely!

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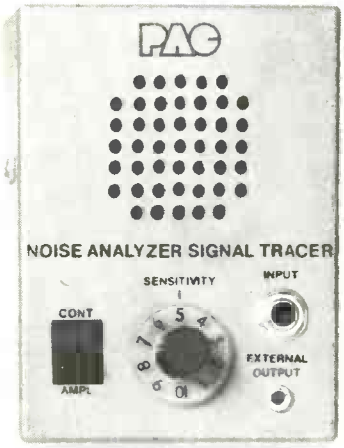
NEW PRODUCTS

continued from page 100

NOISE ANALYZER, *model NA-1,* enables the operator to hear noise currents; picks up and identifies radiating noise fields; traces signals; tests speakers, and checks circuit continuity.

The unit is designed for autosound installers, marine electronic installers, audio technicians, and commercial sound installers. It troubleshoots the cause of a noisy stereo installation quickly and accurately, thereby saving many hours of service time. The maximum input sensitivity is 20 microvolts; maximum voltage to 32-volts DC; it picks up noise currents to 2 microamps without hum, and has pin-type conductive probes and in addition, there is a directional inductive probe.

The *model NA-1* is priced at $149.95. — **Pacific Accessory Corporation,** 3613 W. MacArthur Blvd. #603, Santa Ana, CA.



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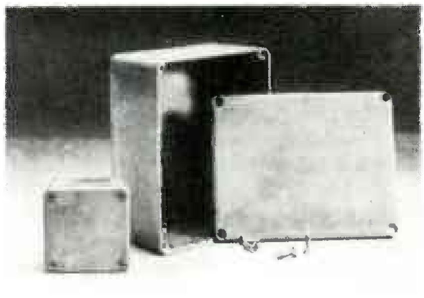
BOXES, made of improved diecast aluminum alloy have good RF shielding that makes the smaller sizes excellent for RF connectors. The countersunk lids have interlocking flanges, and the boxes are drilled and tapped for screws provided. The boxes have an attractive ground and tumbled finish, which may be painted if required. The boxes are priced between $3.40 and $36.00, depending on size — **Hammond Manufacturing Company (US) Inc.,** 1690 Walden Ave., Buffalo, NY 14225.



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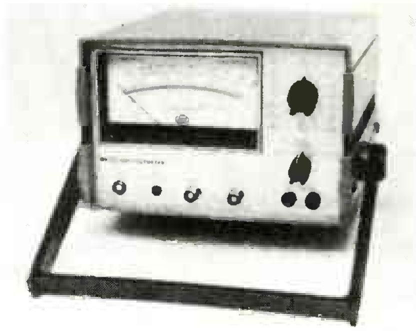
VOLTMETER, *model MV-800,* is an RMS analog instrument that accurately presents the effective power of waveforms which depart from a true sine wave. Fifteen ranges are provided, from 30 μV full scale to 300 volts, and from −90 dB full scale to +50 dB in decades. Readings as low as −105 dB can be made.



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A front-panel bandwidth switch permits a choice of wide-band measurements, standard first-order audio bypass (20 Hz – 20 KHz) or "external filter." A group of standard or custom plug-in filter modules are also available.

Internal, rechargeable Nicad batteries allow the *model MV-800* to be isolated completely from the power line and external grounds.

The *model MV-800* is priced at $495.00. — **IET Labs, Inc.,** 761 Old Country Road, Westbury, NY 11590.

continued on page 106

INTERNATIONAL FM-2400CH

FREQUENCY METER FOR TESTING MOBILE TRANSMITTERS AND RECEIVERS

Portable • Solid State • Rechargeable Batteries

The **FM-2400CH** provides an accurate frequency standard for testing and adjustment of mobile transmitters and receivers at predetermined frequencies.

The FM-2400CH with its extended range covers 25 to 1000 MHz.

The frequencies can be those of the radio frequency channels of operation and/or the intermediate frequencies of the receiver between 5 MHz and 40 MHz.

Frequency stability: ±.0005% from +50° to +104°F.

Frequency stability with built-in thermometer and temperature corrected charts: ±.00025% from +25° to +125° (.000125% special 450 MHz crystals available).

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- **Measures FM Deviation**

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EQUIPMENT REPORTS

continued from page 41

digit LED display. The timebase uses a 3.58 MHz crystal. The temperature stability is said to be ± 10 parts-per-million from 0 to 40 degrees centigrade. Setability is said to be ± 1 part-per-million, which seems to agree with our findings. The input impedance is 1 megohm shunted by 24 pF. Maximum input voltage is 150-volts RMS up to 100 kHz. From there, the maximum input voltage decreases in a linear fashion as the frequency increases; the maximum input at 225 MHz is 5-volts RMS. Inputs are coupled to the meter using front-panel-mounted BNC-type connectors. No test leads are supplied with the unit.

Standard IC's, installed in sockets, are used throughout, and the circuit-board layout is such that most parts are easy to get to. All of that greatly simplifies troubleshooting and servicing. As always, there is an ample section covering troubleshooting in the manual, including a large schematic, and a parts list that gives acceptable substitutes where available. Of course, the company provides back-up service if you should run into a problem that you can not correct yourself. Incidently, our unit operated properly immediately upon completion; that's not a rare occurrence with Heathkit products.

The power requirements for the counter are 108-132-volts AC at 50-60 Hz. In addition, the dual primary of the power supply can be rewired for 206-264-volt operation. That change can be made either during assembly, or at a later date. Power consumption is 25 watts.

In general we found the unit to perform as claimed and could find very few negative points. The power transformer was a bit noisy, but ours could be an isolated case; in any event, it was not bad enough to be distracting. Although the 225-MHz upper limit may seem a trifle low, the counter is an excellent buy, considering the price. In addition, the low upper limit is not really a problem in a majority of applications. The *model IM-2410* kit sells for $124.95; the assembled *model SM-2410* sells for $170.00. **R-E**

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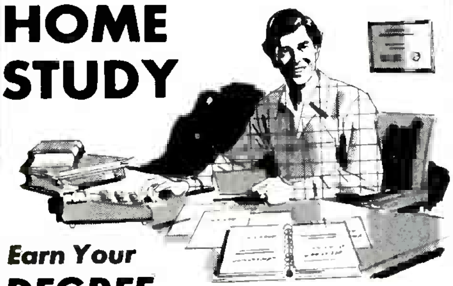

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COMPUTER CORNER

continued from page 90

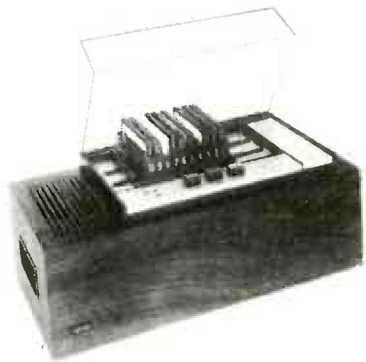
But how do you determine the quality of the software, and decide which program best fits your needs? Some companies offer demo disks, and that may be a good way to begin your shopping. The best way, however, is to ask someone who has used the software, and has dealt with the dealer. Reputable firms will be more than happy to give you some references. Speak with those users and find out how they used the software, and any problems that they may have had. Taking the trouble to do that can also save you some time in getting the software running if you do decide to buy it.

Also, while you are finding out about the software, make sure to ask about the producer and the dealer. Make especially sure to ask about the after-sale support: That is subject of the most often-heard complaints among computer users. Purchasing and setting up a computer system is not a simple matter of taking it home, plugging it in, and work. It requires education, experimentation, and a period of adjustment. Self-education before you make a purchase can help, but not as much as choosing a reliable vendor. **R-E**

NEW PRODUCTS

continued from page 104

CASSETTE CHANGER, *model RAC-10 MK II*, is an improved version of the *model RAC-10*, which has been in extensive use in hotels, restaurants, doctors' offices, department stores, and other areas where background music is required.



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The *model RAC-10 MK II's* extra refinements include volume-level control, automatic shutoff and pinch roller disengagement, and electronic noise-limiting circuitry. The frequency response is 35 Hz-14 kHz ± 3 dB. It is priced at $850.00 — **Benjamin Electroproducts. Inc.,** 180 Miller Place, Hicksville, NY 11801. **R-E**

HI-FI MINI SPEAKER

continued from page 63

made from particle board or plywood. The supports are made from square lengths of wood. Dimensions are given in the Parts List. With the exception of the screws required to hold the sides of the enclosure together, to mount the speakers, and to connect the support-ends to their attachment points, glue can be used to secure one piece of the enclosure to the other. A hot-melt glue gun and glue sticks are recommended.

The L-pads, crossovers, and terminals should be mounted before the rear panel is installed—it would be virtually impossible to work on them afterwards. The mid-range speaker should be mounted off-center to prevent standing waves from developing and its enclosure should be filled with an acoustic insulating-material such as fiberglass. Glue the crossover coil and capacitors in place so they will not shift when the speaker is moved.

Partition 1 (see Fig. 2 for partition numbers) has two smaller partitions mounted on it to prevent standing waves. A thin layer of fiberglass, not more than ¼-inch thick, should be placed over the entire partition-1 assembly, again to aid in preventing standing waves.

Finally, remember that the enclosure and sub-enclosure joints must be air-tight for the mini-SAFE speaker to work properly. Bear that in mind when you glue your joints!

Now for the assembly instructions—read them thoroughly before you begin:

1. Cut all parts to size, using the dimensions given in the Parts List and Fig. 6. Don't forget the 4-inch-square center holes in partitions 2, 4, 6, and the enclosure bottom; and the holes for the speakers and L-pad shafts (see step 11).
2. Using four partition supports, mount partitions 1 and 3 on partitions 2 and 4, respectively.
3. Mount four partition supports on partition 6. *Do not* mount partition 5 at this time!
4. Mount the two squares on top of partition 1.
5. Assemble the four-sided tube.
6. Attach the four bottom supports to the enclosure bottom.
7. Attach the four top supports to the enclosure top.
8. Place the enclosure's front, rear, and side pieces on a flat surface. Assuming that the sides facing up will become the inside of the enclosure, use a marking pen to indicate the function of each piece ("front," "left side," etc.). Also indicate which end of each piece will be at the bottom.
9. Draw three parallel lines on each panel as shown in Fig. 7.
10. Attach the front and sides to the enclosure bottom. *Do not* attach the rear panel yet.
11. Mount and connect all the crossover components, L-pads, binding posts, and the mid-range speaker in the sub-enclosure bottom. Use the area between the enclosure bottom and the lower lines on the inside of the front and sides for this so that the square tube will be able to fit into its center hole in the enclosure bottom.
12. Place the tube in the center hole in the enclosure bottom and glue it in place. Then fill the empty spaces in the sub-enclosures with a loosely-fluffed acoustical material such as fiberglass.
13. Attach the rear of the enclosure to the rest of the assembly.
14. Glue the partition mounting strips to the front, rear, and sides of the enclosure so that the bottom edge of each strip is even with the lowest line marked on the bottom of those panels. They should form an even

continued on page 141

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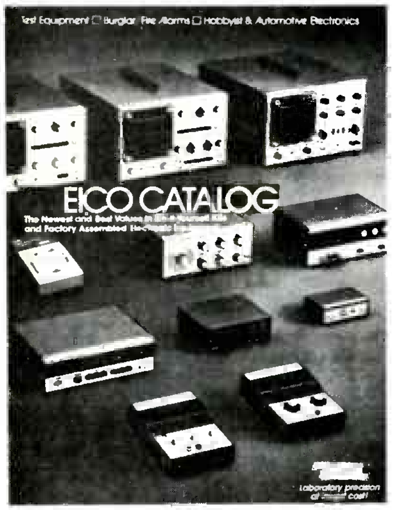

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CIRCLE 80 ON FREE INFORMATION CARD

LETTERS

continued from page 13

tember 1981) to my letter in the June 1981 issue, but the editorial agreement with his arguments demands comment, so I must write again.

What efficient law enforcement, aimed at saving lives from irresponsible drivers, has to do with Hitler and "Big Brother" is beyond me. One need only look at the statistics on highway deaths caused by speeding to realize that some action must be taken. I agree that a computerized ticketing system should be designed carefully, to avoid abuse; but when we talk about saving lives, we have to look where the greatest risk is. People who think that the law should have no authority over them are not only killing themselves, but millions of other people who respect those laws.

I oppose too much big government as much as anyone else; but people like Mr. Recob are demanding it. Laws exist for a reason. Just because you disagree with a posted speed limit does not give you the right to ignore it; and claiming that enforcement is an invasion of privacy is no excuse.

No—radar is not 100% foolproof. (It's so unreliable that it is used at nearly every airport and military base in the world. The police are using a simplified version, but the same principles of physics apply there.) Like any other high-technology device, radar requires proper training for correct use. Of course, such training should be required by law for all police radar operators. But to argue against a technology because untrained (or poorly trained) persons make mistakes in using it is absurd. By that kind of fuzzy logic, we should condemn all other kinds of electronics, too. Even with the poor training programs in existence in some (but by no means all) areas, errors are the exception rather than the rule.

Mr. Recob says: "...a receiver is still a receiver, whether it provides communications or not." But to be protected by an unforeseen loophole in the *Communications* Act, the communications aspect is obviously the key issue. At the very least, certain types of receivers can (and should be) banned from moving vehicles. No one has any objection to Mr. Recob's (or anyone else's) using a radar detector in his bedroom. But it shouldn't be used in public to break laws when such violations clearly endanger life and limb.

His comment, "...our only defense is offense: radar detectors..." would be funny, if it wasn't so frightening. If you are driving within the local legal speed limit, a radar detector is of no use to you at all! It only tells you that you are being watched at that moment. What can you do with that information? If you've been driving carefully and observing the law, nothing—you do nothing at all—you just continue as you were.

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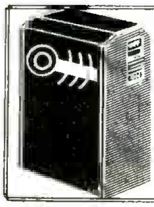

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7404N	.26	7446N	.84	74111N	.72	74163AN	.64
7405N	.26	7447AN	.65	74116N	1.38	74164N	.64
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7407N	.36	7451N	.29	74121N	.48	74166N	.68
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7413N	.42	7474N	.36	74128N	.64	74175N	.58
7414N	.42	7475N	.42	74132N	.45	74176N	.77
7416N	.36	7476N	.42	74136N	.52	74178N	1.17
7417N	.36	7483AN	.48	74141N	.84	74179N	1.35
7420N	.29	7484AN	1.36	74142N	3.27	74180N	.75
7422N	.37	7485N	.66	74143N	3.79	74182N	.52
7423N	.37	7486N	.39	74144N	3.79	74184N	2.39
7425N	.32	7490AN	.42	74145N	.67	74185N	2.36
7426N	.39	7491AN	.44	74147N	1.32	74190N	.68
7427N	.32	7492AN	.38	74148N	.89	74191N	.68
7428N	.48	7493AN	.38	74150N	1.44	74192N	.68
7430N	.22	7494AN	.68	74151N	.44	74193N	.72
7432N	.42	7495AN	.54	74153N	.38	74194N	.72
7433N	.42	7496N	.59	74154N	1.44	74195N	.55
7437N	.38	7497N	1.89	74155N	.48	74196N	.79
		74100N	1.56	74157N	.52		

74197N	.72	74S05N	.69	74S153N	1.10	74S280N	2.29
74198N	1.50	74S08N	.48	74S157N	1.10	74S283N	3.39
74199N	1.55	74S09N	.86	74S158N	1.16	74S299N	6.54
74221N	.68	74S10N	.48	74S161N	4.74	74S373N	2.98
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74278N	2.38	74S38N	1.17	74S181N	3.95	74S476N	5.95
74279N	.59	74S40N	.44	74S182N	2.10		
74283N	1.10	74S51N	.69	74S189N	4.95	**74LS00N**	.19
74293N	.89	74S74N	.66	74S194N	1.68	74LS01N	.22
74298N	.84	74S85N	2.19	74S195N	1.79	74LS02N	.22
74351N	2.20	74S86N	.78	74S201N	5.99	74LS03N	.22
74365AN	.69	74S112N	.78	74S225N	5.99	74LS04N	.22
74366N	.69	74S114N	1.96	74S240N	2.95	74LS05N	.22
74367AN	.58	74S124N	2.69	74S241N	2.95	74LS08N	.22
74368AN	.58	74S132N	1.24	74S244N	3.49	74LS09N	.28
74390N	.96	74S133N	.98	74S251N	1.49	74LS10N	.22
74393N	1.29	74S134N	.72	74S253N	2.29	74LS11N	.28
		74S135N	1.58	74S257N	1.42	74LS12N	.24
74S00N	.44	74S138N	.96	74S258N	1.09	74LS13N	.29
74S02N	.48	74S139N	1.10	74S260N	1.89	74LS14N	.39
74S03N	.72	74S140N	.89	74S274N	17.99	74LS20N	.22
74S04N	.69	74S151N	1.10	74S275N	16.77	74LS21N	.28

74LS26N	.39	74LS109N	.36	74LS170N	1.59	74LS259N	1.29	74LS375N	.84
74LS27N	.29	74LS112N	.36	74LS173N	.59	74LS260N	1.25	74LS377N	1.25
74LS30N	.18	74LS122N	.48	74LS174N	.44	74LS266N	.38	74LS378N	.99
74LS32N	.29	74LS123N	.59	74LS175N	.44	74LS273N	1.19	74LS379N	1.09
74LS37N	.29	74LS125N	.44	74LS181N	1.99	74LS275N	4.69	74LS390N	.96
74LS38N	.29	74LS126N	.44	74LS189N	4.45	74LS279N	.48	74LS393N	.96
74LS42N	.44	74LS132N	.54	74LS190N	.72	74LS280N	1.98	74LS395N	1.19
74LS47N	.68	74LS133N	1.68	74LS191N	.72	74LS283N	.78	74LS447N	.37
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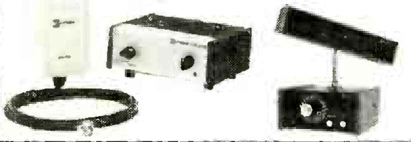

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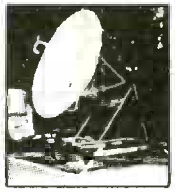

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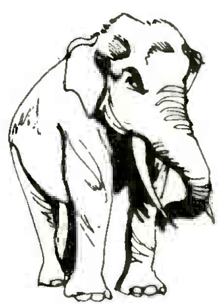

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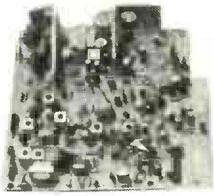

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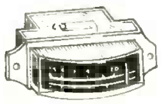

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VALUE/MFD	VOLTS	DIAM./LGTH.	PRICE
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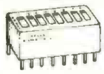
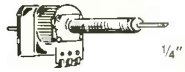
10,000	@ 20V	1½" x 5¾"	$3.00 ea.
2,700	@ 25V	1¼" x 2¼"	$2.00 ea.
2,900	@ 25V	1¼" x 2"	$2.00 ea.
100,000	@ 30V	3" x 5½"	$6.00 ea.
39,000	@ 30V	1" x 5¾"	$4.00 ea.
34,800	@ 50V	3" x 5½"	$3.00 ea.
450	@ 75V	1¼" x 2¼"	$2.00 ea.
500	@ 100V	1½" x 3¼"	$2.00 ea.
240	@ 300V	1¼" x 3¼"	$2.00 ea.
50	@ 450V	1¼" x 2"	$2.00 ea.

DIP SWITCH



5 POSITION **$1.00** ea.
8 POSITION **$1.50** ea.
10 POSITION **$2.00** ea.
12 POSITION **$2.50** ea.

SUB-MINI 10K POT

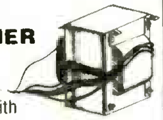


with On-Off
¼" hole mount,
⅛" D shaft,
¾" thread section

5/$1.00

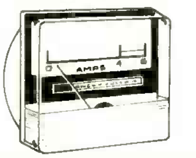
POWER TRANSFORMER

$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

AMP METERS



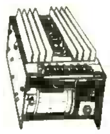
2¼' square, no shunt required. Easy to read dial.
Movement: 0-6, 0-10, 0-17

$2.50 ea.

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.



24 Volt POWER SUPPLY

5.4 AMPS

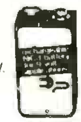
$45.00 ea.

MFG by ACDC Electronics Inc. Model OEM 24N5.4-1

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.

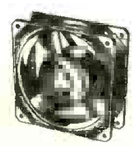
9 VOLT NiCd RECHARGEABLE BATTERY

NEW. Replaces the popular 9V Transistor Battery.



$4.75 ea.

MUFFIN FANS



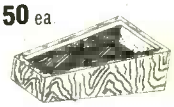
MFG By Rotron Inc.
3 Blades 4¾" Square

USED
110 VAC **$5.95** ea.

NEW
230 VAC Model MU3A1
$12.00 ea.

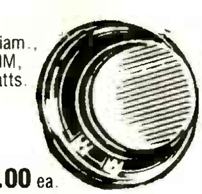
PROJECT BOX

$1.50 ea.



4⅝" w x 7⅜" l x ¾" to 1½" h
Has a lip for recessed face plate and a felt bottom

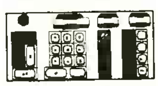
SPEAKER



3" Diam.,
8 OHM,
5 Watts

$2.00 ea.

TEXAS INSTRUMENT KEYBOARD



Has 3 slide switches, 26 different keys, key pad removable by 4 screws

$1.95 ea. 5/**$8.00**

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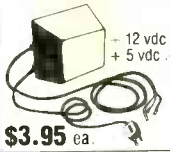
3.3 uF @	25V	12/$1.00
1 uF @	35V	12/$1.00
2 uF @	150V	12/$1.00
25 uF @	25V	15/$2.00
3 uF @	50V	15/$2.00
5 uF @	50V	15/$2.00
10 uF @	50V	15/$2.00
250 uF @	25V	10/$2.00
50 uF @	75V	10/$2.00

POWER SUPPLY



– 12 vdc .1 amps
+ 5 vdc .4 amps

$3.95 ea.

NEW SPRITE FAN

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Model SU2A5
115v AC. 19 amps.
(Impedance protected.)
3¼" x 3¼" x 1¾"

$12.00 ea.

7' POWER CORD

HEWLETT PACKARD TYPE

Molded 3 Prong Plug with molded receptacle
Belden 16 AWG

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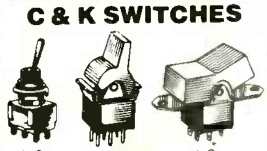
UG-83B/U N-F/UHF-M	$4.50
UG-175 RG-58 Adapt	$ .20
UG-176 RG-59 Adapt	$ .20
UG-1094 BNC-F/Panel	$1.00

S0239 **50c**
PL259 **60c**

COAXIAL CABLE

50 OHM-RG 174
$4.95/100' $3.00/50'
75 OHM-RG 62/U
$12.00/100'

C & K SWITCHES



Part #		Movement
J-60	7101	SPDT
J-60	7103	SPDT (center off)
L-3	7108	SPDT (momentary)
J-3	7201	DPDT (special large rocker)

$1.00 ea. **6/$5.00**

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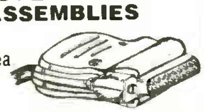
14 pin **40c** ea.
16 pin **45c** ea.
40 pin **$1.75** ea.

MODEM CABLE ASSEMBLIES

$5.50 ea.

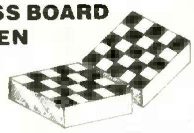


Conn & Hood	22 AWG # Cond	Length
25 P	14	15'
25 S	10	17'

MAGNETIC CHESS BOARD WITH MEN

Folds in half to carry men
11" w x 11" l x 1" h

$4.00 ea.



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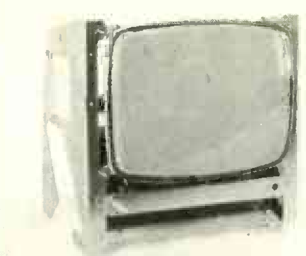

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- Low profile
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- YOUR CHOICE — TIN OR GOLD
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TIN INLAY SOLDER TAIL

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- Standard profile
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Solder Tail Single Beam Dip Sockets

Body — 94 V-O polyester with Copper Alloy contacts. Accommodates standard IC leads up to .014" thick and .025" wide. Contact is designed and oriented to the insulator to grasp the broad "face" of the IC lead, allowing for low insertion and high retention forces. Socket is designed to achieve maximum density on boards.

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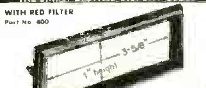

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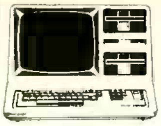

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1-999	$.10	.25	.45	2.00
1000-	.10	.25	.40	1.90
5000-	.10	.20	.40	1.80

METAL FILM ±1%
RN60 (R.Ohm CRB60FY) 1/4watt
Low temp coef - 50ppm/°C
.138"dia X .355"long (body)
color banded

METAL FILM RESISTORS 1/4W

Total qty	ea	pk-5	pk-10	pk-25	pk-100
1-999	$.25	.65	1.10	2.00	7.50
1000-	.25	.60	1.00	1.90	7.00
5000-	.25	.55	.95	1.80	6.50

STANDARD 1% METAL FILM VALUES FROM 10 OHM TO 1.21 MOHM

POLYESTER FILM CAPACITORS
100V ± 10%

	ea	pk-10	pk-100
.001uf	$.15	.95	6.50
.0015uf	.15	.95	7.50
.0022uf	.15	.95	7.50
.0033uf	.15	.95	7.50
.0047uf	.15	.95	7.50
.0068uf	.15	.95	7.50
.01uf	.15	.95	7.50
.015uf	.15	.95	7.50
.022uf	.15	.95	7.50
.033uf	.20	1.00	10.00
.047uf	.20	1.15	10.50
.068uf	.25	1.30	12.00
.1uf	.30	1.75	13.50
.15uf	.35	2.25	14.00
.22uf	.40	2.55	20.00
.33uf	.45	2.75	25.00
.47uf	.50	3.50	30.00

POLYESTER CAPACITOR KIT
5 ea of above $14.95

SPECIAL 15% Off

DIPSWITCHES

		10-	25-
4sw 8pin SPST	$1.55	$1.45	$1.39
8sw 16pin SPST	1.95	1.85	1.79
10sw 20pin SPST	2.10	2.00	1.95

SOCKETS

low profile - solder tail

	ea	10-	100-	1000-
8 pin	$.20	.18ea	.16ea	.14ea
14 pin	.25	.21ea	.19ea	.16ea
16 pin	.26	.22ea	.20ea	.17ea
18 pin	.32	.28ea	.26ea	
24 pin	.45	.40ea	.38ea	
28 pin	.55	.52ea	.50ea	
40 pin	.65	.62ea	.60ea	

Wire Wrap
3 level gold plate contacts
tin plate tails

	ea	10-	100-
14 pin	.55	.52ea	.49ea
16 pin	.60	.57ea	.51ea

ELECTROLYTIC CAPACITORS

axial leads

	1-	10-	100-
1mf/50V	.15	.12	.10
2.2mf/25V	.15	.12	.11
2.2mf/50V	.15	.12	.11
3.3mf/50V	.16	.13	.11
4.7mf/63V	.16	.13	.11
10mf/35V	.16	.13	.11
10mf/50V	.17	.14	.11
10mf/150V	.18	.16	.14
22mf/16V	.17	.13	.12
22mf/50V	.18	.14	.13
25mf/25V	.18	.14	.12
30mf/25V	.18	.14	.12
33mf/25V	.18	.16	.13
47mf/35V	.18	.16	.13
100mf/10V	.19	.16	.14
100mf/16V	.20	.18	.16
100mf/35V	.22	.19	.17
150mf/25V	.23	.20	.18
220mf/16V	.25	.21	.19
220mf/25V	.27	.22	.20
330mf/16V	.29	.24	.22
470mf/16V	.30	.25	.22
470mf/35V	.34	.29	.26
500mf/15V	.29	.24	.22
1000mf/16V	.90	.85	.80
1000mf/35V	.95	.90	.85
2200mf/16V	1.25	1.15	1.05
2200mf/40V	1.35	1.10	1.00
4700mf/16V	1.35	1.25	1.10
4700mf/50V	1.45	1.30	1.15

radial leads

	1-	10-	100-
1mf/50V	.15	.12	.10
2.2mf/350V	.18	.15	.11
4.7mf/35V	.18	.15	.13
10mf/16V	.15	.13	.12
10mf/160V	.18	.15	.13
20mf/50V	.17	.14	.12
47mf/35V	.18	.16	.14
80mf/40V	.15	.13	.11
100mf/25V	.18	.16	.14
220mf/35V	.25	.22	.20
470mf/25V	.33	.28	.25
1000mf/16V	.85	.80	.75

DIODES

		100-	1000-
1N3064	15/$1.00	.05ea	.04ea
1N4001	12/$1.00	.07ea	.06ea
1N4007	10/$1.00	.11ea	.10ea
1N4148 (1N914)	15/$1.00	.05ea	.04ea

SPECIAL 15% Off

TRANSISTORS

			ea	10-	100-
MPSA06	TO-92	NPN	$.25	.17ea	.12ea
2N2222A	TO-92	NPN	.30	.18ea	.15ea
2N2222A	TO-18	NPN	.45	.35ea	.25ea
2N3053	TO-5	NPN	.55	.50ea	.45ea
2N3904	TO-92	NPN	.25	.17ea	.12ea
2N3906	TO-92	PNP	.25	.17ea	.12ea

TANTALUM CAPACITORS

solid dip - radial

	1-	10-	100-
.1mf/35V	.35	.30	.28
.22mf/35V	.35	.31	.29
.33mf/35V	.35	.31	.29
1mf/35V	.37	.32	.30
1.5mf/20V	.37	.32	.30
2.2mf/20V	.40	.35	.33
3.3mf/35V	.45	.40	.35
4.7mf/16V	.45	.40	.35
4.7mf/25V	.50	.45	.40
5.6mf/10V	.50	.45	.40
6.8mf/6V	.50	.45	.40
6.8mf/16V	.55	.50	.45
10mf/20V	.65	.55	.50
15mf/6V	.60	.50	.45
15mf/20V	.65	.55	.50
22mf/10V	.65	.55	.50
22mf/16V	.68	.57	.52
33mf/6V	.65	.55	.50
33mf/10V	.70	.65	.60
47mf/6V	.75	.70	.65
56mf/6V	.85	.75	.70
100mf/10V	1.25	1.10	1.00

LEDs

Jumbo diffused .20"d x .34"l

	pk-10	pk-25	100-	1000-
RED	$1.00	$2.25	.08ea	.078ea
WHITE	1.10	2.50	.09ea	.085ea
YELLOW	1.40	3.25	.11ea	.10ea
GREEN	1.40	3.25	.11ea	.10ea

TRI-State (change from red to green by reversing polarity)

1-	10-	100-
.95ea	.75ea	.65ea

Subminiature diffused
.125"d x .21"l

	pk-10	pk-25	100-	1000-
RED	$1.00	$2.25	.08ea	.078ea
CLEAR	1.10	2.50	.09ea	.085ea
GREEN	1.40	3.25	.11ea	.10ea
YELLOW	1.40	3.25	.11ea	.10ea

LED MOUNTING CLIP & RING
For .20" (jumbo) LED

pk-10	pk-25	pk-100	1000-
$1.25	2.75	7.00	.06ea

LED DISPLAYS

	ea	10-
XAN72 (MAN72 equiv) .3" CA RED LHD	$.95	$.85ea
XAN74 (MAN74 equiv) .3" CC RED RHD	.95	.85ea
XAN6920 .6" CA RED LHD	1.25	1.10ea
XAN6940 .6" CC RED RHD	1.25	1.10ea

SPECIAL 15% Off

TANTALUM CAPACITOR KIT
SOLID DIP ±20%

.1uf/35V	2.2uf/20V	10uf/25V
.22uf/35V	3.3uf/35V	15uf/20V
.33uf/35V	4.7uf/25V	22uf/35V
1uf/35V	6.8uf/35V	33uf/15V
1.5uf/20V		

T-5	5ea of above	$27.50
T-5C	5ea supplied in cabinet (15 drawer)	37.50
T-10	10ea of above	49.50
T-10C	10ea supplied in cabinet (15 drawer)	59.50
T-5C or T-10C	shipping	$3.00

ELECTROLYTIC CAPACITOR KIT
AXIAL LEADS

1uf/50V	22uf/50V	220uf/50V
2.2uf/50V	33uf/25V	470uf/35V
3.3uf/50V	47uf/35V	1000uf/35V
4.7uf/50V	100uf/35V	2200uf/40V
10uf/50V	150uf/25V	

EA5	5ea of above	$19.50
EA5C	5ea supplied in cabinet (15 drawer)	29.50
EA10	10ea of above	27.50
EA10C	10ea supplied in cabinet (15 drawer)	37.50
EA5C or EA10C	shipping	$3.00

TTL - 7400 — 10% OFF ON $25.00, 15% OFF ON $50.00

7400	$.18	7464	.30	74155	.50
7401	.20	7465	.30	74156	.64
7402	.20	7470	.49	74157	.60
7403	.21	7472	.32	74158	.75
7404	.22	7474	.22	74160	.70
7405	.25	7475	.49	74161	.79
7406	.20	7576	.49	74162	.85
7407	.20	7480	.35	74163	.85
7408	.27	7482	.25	74164	.85
7409	.27	7483	.58	74166	.85
7410	.20	7485	.50	74170	1.50
7415	.29	7486	.42	74173	1.25
7416	.20	7489	1.75	74174	1.05
7417	.20	7490	.59	74175	.85
7420	.20	7491	.64	74176	.70
7425	.39	7492	.59	74177	.70
7426	.35	7493	.35	74180	.35
7427	.25	7494	.59	74181	1.85
7430	.25	7495	.35	74182	.35
7432	.20	7496	.35	74189	.50
7437	.20	74105	.48	74190	1.15
7438	.20	74107	.35	74191	1.15
7440	.22	74121	.35	74192	.50
7441	.59	74122	.39	74193	.79
7442	.35	74123	.39	74194	.85
7443	.55	74125	.50	74195	.69
7444	.60	74126	.50	74196	.80
7445	.50	74132	.75	74197	.75
7446	.59	74141	.35	74198	1.40
7448	.59	74145	.50	74199	1.25
7450	.18	74148	1.25	74S200	3.75
7451	.22	74150	1.35	74279	.65
7453	.18	74151	.50		
7454	.18	74153	.35		
7460	.18	74154	1.45		

74LS SERIES — 10% OFF ON $25.00, 15% OFF ON $50.00

74LS00	.25	74LS90	.50	74LS181	2.00
74LS01	.25	74LS95	.75	74LS192	.60
74LS02	.25	74LS107	.40	74LS195	.90
74LS03	.25	74LS109	.40	74LS196	.85
74LS04	.27	74LS112	.40	74LS197	.85
74LS05	.27	74LS113	.40	74LS199	.95
74LS10	.25	74LS114	.50	74LS251	.95
74LS11	.27	74LS125	.50	74LS256	.95
74LS15	.35	74LS126	.50	74LS258	.95
74LS20	.25	74LS136	.50	74LS260	.75
74LS22	.25	74LS156	.95	74LS266	.45
74LS26	.35	74LS162	1.00	74LS290	.75
74LS28	.35	74LS163	.90	74LS298	.85
74LS32	.35	74LS164	.90	74LS365	.85
74LS40	.35	74LS165	.90	74LS367	.70
74LS42	.50	74LS168	1.25	74LS378	1.10
74LS54	.25	74LS170	1.70	74LS490	1.75
74LS74	.45				

CMOS - 4000 — 10% OFF ON $25.00, 15% OFF ON $50.00

4000	$.25	4020	1.14	4050	.45
4001	.39	4021	.95	4051	1.15
4002	.25	4022	.95	4066	.79
4006	.95	4023	.30	4069	.39
4007	.39	4024	.75	4071	.29
4008	.95	4025	.22	4072	.39
4009	.46	4027	.59	4073	.39
4010	.45	4028	.85	4078	.39
4011	.45	4030	.49	4081	.39
4012	.25	4035	.95	4082	.30
4013	.59	4040	1.15	4528	1.50
4014	.95	4041	1.20	4585	1.50
4015	.95	4042	.95	4901	.59
4016	.64	4043	.85		
4017	1.08	4046	1.69		
4018	.95	4049	.45		

LINEAR CIRCUITS — 10% OFF ON $25.00, 15% OFF ON $50.00

301N-8	$.25	741N-8	.32
307N-8	.32	741N-14	.29
309H	1.05	748N-8	.25
311N-8	.79	1310N-14	2.50
318N-8	1.45	1414N-14	.35
324N-14	.95	1456N-8	1.29
339N-14	.29	1458N-8	.65
376N-8	.30	1496N-14	.89
380N-14	1.09	1800N-16	2.40
380N-8	.45	2208N-8	.79
386N-8	.89	2209N-8	.79
387N-8	.89	3046N-14	1.29
555N-8	.45	3081N-16	1.25
556N-14	.79	3082N-16	1.25
560N-16	2.95	3900N-14	.45
565N-14	.95	75150N-8	.35
567N-8	1.09	75450N-8	.35
703N-8	.49	75453N-8	.35
723N-14	.39	75491N-14	.75
733H	.45	75492N-14	.89

VOLTAGE REGULATORS

7805	+5V	$1.19	7905	-5V	$1.19
7808	+8V	1.19	7912	-12V	1.19
7812	+12V	1.19	7915	-15V	1.19
7815	+15V	1.19			
7824	+24V	1.19			

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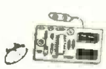
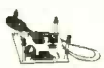
Chaney Electronics has been providing quality electronic kits for high schools, tech schools, universities and hobbyists for over 10 years and we hope you will join the thousands of satisfied Chaney Electronic kit builders. All of our kits contain a quality etched and drilled glass epoxy pc board, all necessary electronic parts (except as noted on a few kits) and easy to understand assembly instructions. You provide a battery for the battery operated kits and if desired you may wish to provide a case. We recommend that you use a low wattage soldering iron and good quality rosin core solder when assembling your kits. Building our kits is both rewarding and fun because they are thoroughly tested and designed so that with proper assembly they work the first time! If you have any questions please call or write; we are here to assist you.

TIME REACTION TESTER KIT
If you ever thought that your sense of timing was good here's an electronic device to prove it! A LED flashes at a precise interval and you are to push a button at the exact moment it is to light. If your timing is good the led will stay on, if not the LED continues to flash. Size of board: 1" x 2". Operates on 9V battery.
C4516 $3.50



ELECTRONIC "COIN TOSSER" KIT
This kit features an electronic way to "toss a coin". Push the button and a speaker clicks while two readouts flash "0" and "1". Use it to electronically replace the tossing of a coin in games, sporting events, etc. Operates on 9V battery. Size of board: 1½" x 3¼".
C4389 $8.95

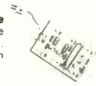


SUPER LED FLASHER KIT
One of our most popular display kits, this unit is perfect for use in robot projects. Simple to build kit features IC circuitry to alternately flash 4 LEDS: 2 red, 1 yellow and 1 green. Produces a bright and colorful display. Operates from 9V battery. Size of board: 2" x 2".
C4407 $4.98

120VAC VARIABLE STROBE LIGHT KIT
Complete variable rate strobe light kit produces brilliant flashes of light. For parties, dances, display, discos, etc. Operates from standard 120VAC. Reliable design — thousands of these are in use throughout the world. Contains XF-1 straight xenon flashtube. Overall size of completed board: 3"L x 2"W x 3"H.
C3071 $7.50

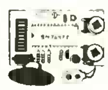
SINGLE CHANNEL COLOR ORGAN KIT
Simple to build kit uses SCR to flash a Christmas tree lamp to the beat of music. Connect this up to your stereo or radio and watch the display. Operates from 120VAC and features audio input transformer for isolation and impedance matching. Size of board: 2" x 1".
C4489 $3.50

GREEN NEON WINKER KIT
This long time favorite now has a new twist. We have designed it with green neons instead of the usual orange glow type. Features 6 green neons that ramdomly flash. Provides a unique display in the dark. Operates on standard 120VAC. Size of board 4.8" x 2.8".
C4488 $4.75



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 for bicycle riders, skiers, hikers, boaters, campers, etc. Transistorized kit uses high output XF-2 xenon flashtube. Operates on 3VDC (two 1.5V batteries). Size of board. 2½"L x 2"W.
C3207 $7.95

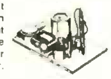
ELECTRONIC WHEEL OF FORTUNE KIT
Very popular game device! Push the start button and a bright red ball (LEDS) appear to spin around ten numbers gaining speed as you hold the button down. When you release the button the electronic ball appears to slow down and finally comes to a stop on one number. As 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. A programming chart is included for many different sounds! The kit produces good volume and tone from 2" speaker. Operates from 9V battery. Size of board: 3.25" x 2".
C4422 $12.95

HIGH POWER 120VAC STROBE LIGHT KIT
Variable rate high power strobe light similar to our standard 120VAC kit except produces flashes many times more brilliant. This kit has variable rate control and uses a XF-4 xenon horseshoe flashtube. This kit also includes a reflector for the flashtube. Operates from standard 120VAC. Overall size of board: 4½"L x 3"W.
C4162 $15.95

6VDC ELECTRONIC STROBE FLASHER KIT
This kit is similar to our 3V Warning Flasher, however it requires 6VDC for operation and produces an even brighter flash. Although supplied with the XF-3 straight flashtube it can even power the optional horseshoe flashtube, XF-4. This unit makes a great safety device or attention getter. Can also be used with optional adapter. Size of circuit board: 3" x 1⅜".
C3808 $7.95 AC ADAPTER C3804 $1.49



PHASOR GUN SOUND AND LIGHT KIT
Here's a simple kit which makes an excellent first project. Uses special IC, darlington transistor and LED to produce "outer space phasor gun" sound and flashing red light. Uses 2" speaker and small size board. Operates from 9V battery. Size of board: 1" x 1.2".
C4484 $4.00

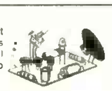
EXECUTIVE DECISION MAKER KIT
Here's another easy to build kit which is fun to use. Each time you need to make an "important" decision just operate the switch and one of two neon lamps will stay on. Features green "yes" lamp and orange "no" lamp. Operates from standard 120VAC. Size of board 2" x 1".
C4510 $3.75

3 CHANNEL COLOR ORGAN
Very popular 3 channel color organ causes lights of your choice to flash to the beat of music. Has 3 different filter stages for low, medium and high notes. 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

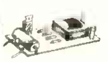
AUDIO OSCILLATOR KIT
Very useful for demonstration or testing speakers, earphones, etc. Kit produces pleasant tone rich in harmonics. Features output transformer for coupling to speaker of your choice. Two transistor circuit is simple to construct. Operates from 9V battery. Requires speaker. Size of board: 2" x 1".
C4511 $3.00

STROBOSCOPE KIT
Reliable IC design kit for use in physics experiments, troubleshooting or demonstrating optical phenomena. Optically stops motion of fans, wheels, pulleys, flywheels, etc. The stroboscope operates from standard 120VAC and features bright xenon flash tube and IC design. Continuously variable flash rate from 100-5000 RPM. Size of board: 3.5" x 4.75".
C4070 $29.95

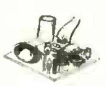
METRONOME WITH SOUND AND LIGHT
One of our most popular kits now has a new feature. Not only does it produce beats in precise time but also it flashes a red LED in time. Features variable control and small speaker. This kit is perfect for music practice and is easy to build. Operates from 9V battery. Size of board: 1" x 2".
C4533 $3.50



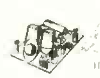
LIGHT SENSITIVE SOUND GENERATOR KIT
Simple to build kit creates a tone which varies depending on amount of light. Uses CDS cell and IC circuitry to provide this unusual effect. In total darkness the unit is silent, as light increases the unit goes from a clicking sound to a loud tone. Uses 2" speaker and operates from 9V battery.
C4164 $4.95



DIGITAL POWER SUPPLY KIT
Regulated power supply, perfect for TTL or CMOS circuits. Regulated output voltage is 5VDC. Maximum output current is .500 amp. Features fused input, neon indicator light and IC regulator. Kit uses heavy duty transformer for trouble free performance. Operates from standard 120VAC. Size of board: 2" x 4".
C4430 $6.50



46WS PHOTO STROBE FLASH KIT
Here's your chance to make a quality high power strobe flash for your camera. Can also be used as the master strobe with any of the slave kits. Features quality long life straight flashtube, heavy duty photoflash capacitor, neon ready light, transistorized inverter circuitry and shutter cord for connection to camera. Operates from 4.5VDC to 6VDC. Size of board: 3" x 2.5".
C4512 $9.95

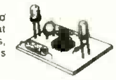


100WS SLAVE STROBE AC KIT
This kit is similar in operation to the DC slave strobe, however, this unit is more than double the light power output. Features heavy duty horseshoe flashtube, two heavy duty photoflash caps, neon ready light, solar cell sensor, and manual test button. Operates from 120VAC. Size of board: 3.6" x 4". NOTE: This kit is NOT for beginners since due to the power of the flash, hazardous potentials are present.
C4491 $34.95

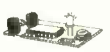
AC TESTER KIT
This kit is perfect for testing AC outlets or determining which breaker operates a particular outlet. There's no need to be in the same room as the unit emits a penetrating tone as long as AC is present. Features green "ON" light and piezoelectric tone alert in a compact unit. Size of board: 2" x 1.6".
C4485 $4.50

DUAL LAMP FLASHER KIT
Ultra miniature lamp flasher kit uses tiny grain of wheat bulbs and IC to flash 2 bulbs at the same time or alternating. Unit produces bright flashes and can be used on model planes, boats, attention getters, warning lights, etc. Operates from 9V battery. Size of board: 1.2" x 8".
C4487 $2.50

LED FLASHER KIT
Easy to build functional kit uses the amazing 555 timer IC to alternately flash a red and green led. The kit makes a great attention getter and can be used in robots, warning lights, outer space models, convention badges, etc. Operates from 5 to 9VDC. Size of board: 1.5" x 1"W.
C3287 $2.49



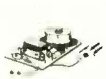
SIGNAL INJECTOR KIT
Signal injectors are useful for troubleshooting all types of radios, amplifiers, tuners, etc. This simple to build transistorized kit produces an output signal rich in harmonics. Every tool kit and test bench should have one of these. Small size allows use of compact cases if desired. Operates from 3VDC. Size of board. .5" x 1.5".
C4513 $3.00



TRI STATE LED FLASHER KIT
Simple to build kit which flashes a tri-state led. The kit has a trimmer control which can be rotated to provide continuous green, alternating red/green, or continuous red. Kit features IC circuitry and jumbo tri-state LED, which, even though it's only a two lead device, can flash red or green. Operates from 9V battery. Size of board: 1.4" x 1".
C4069 $2.95

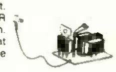
46WS SLAVE STROBE DC KIT
Sensitive slave unit flashes in synchronization with your master strobe. Perfect way to obtain more light for portrait pictures. Comparable units sell for many times this low kit price. Features quality long life straight flashtube, neon ready light, solar cell sensor, heavy duty photoflash capacitor and transistorized inverter circuit. Operates from 4.5VDC to 6VDC. Size of board: 3.6" x 2.5".
C4490 $18.95

AC FAILURE ALARM KIT
Have you ever been late because the AC went off and your clock radio didn't work; well that need not happen again! Simply plug this unit into the wall outlet and if the AC goes off the unit emits a tone. Features green ready light and piezoelectric tone device. Operates on 9V battery. Size of board: 2.8" x 2.3".
C4483 $4.75

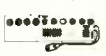


FASCINATION STAR KIT
Produces an "Exploding Star" visual effect using 25 LEDS and IC circuitry. The center LED lights first then the next group of LEDS light and then another set lights until the outer edge of the star lights up. The process then reverses itself. Great attention getter for game rooms, discos, etc. Operates from 9V battery.
C4432 $10.95

PHOTO SLAVE TRIGGER KIT
Probably the most sensitive slave trigger kit on the market. Not affected by ambient light. Much superior than LASCR types. This kit can operate from bounce or indirect flash. Simply connect shutter cord (included) to the strobe that will be used as the slave. When the master strobe is fired the slave strobe will also flash. Size of board: 1.5" x 1".
C4450 $6.00



10 WATT SIREN KIT
This kit is perfect for use in burglar alarms, panic buttons, attention getters, etc. Kit provides a loud alternating tone output. Uses two IC's and a power transistor to provide reliable performance. Features variable sound control and 6 to 12VDC operation. Requires 8 ohm speaker. Size of board: 3.5" x 1.5".
C4068 $5.00



SEQUENTIAL LED FLASHER KIT
This kit combines CMOS IC circuitry and 10 jumbo red LEDS to produce a unique visual display. LEDS continuously light sequentially from right to left. Easy to build kit makes a great conversation piece and attention getter. Operates from 9V battery. Size of board: 5.25" x 1.5".
C4431 $6.75

NEW KITS FROM CHANEY ELECTRONICS

CIRCLE 10 ON FREE INFORMATION CARD

www.americanradiohistory.com

CPU'S & SUPPORT CHIPS

8080A	3.75	8226	2.75
8085A	7.50	8228	4.50
AMD 2901	8.95	8251	5.50
8212	2.25	8255	6.95
8214	3.60	8259	6.95
8216	2.90	8257 (AM9517)	7.95
8224	3.25	Z80A CPU	6.75
MM5307	9.95	Z80A S10	12.95
		8275	16.95

RAM's

2114L-3	2.75
4116-3	2.50
4116-2	3.50
21L02-3	90
2102-4	80
MK4027-3	3.50
MK4096-11	2.95
TMS4045-25	4.50
MS4050NL	3.95
2101-1	2.45
MM5270	3.45
MK4008P	1.95
IM7001	4.95
5101E	2.95
2111AL	2.45

ROM's

2708	3.95
2716 + 5V	7.50
2732	16.95
2532	16.95
82S23	1.95
82S112	4.95
82S115	4.95
82S123	2.25
82S126	1.95
82S129	1.95
82S130	1.95
82S131	2.25
82S181	6.95
3628A-3	6.95
AM9218C	2.95
8256.5 (74188A)	1.25

UART's

AY5-1013	3.75	M8868A	8.95
TR1602B	3.95	COM2017	3.75
PT1482B	3.25	AY3 8500 1	1.95
		AY3-8700	2.25

INTERFACE & DRIVERS

1771	19.95
1488	90
1489	1.10
8130	2.50
8830	2.50
8833	2.50
8834	2.00
8837	2.00
8838	2.00
8T380	2.00
8531N	2.75
MM5321	9.50
MM5369	2.50

SHIFT REGISTERS

MM1402	1.75
MM1403	1.75
MM1404	1.75
MM5013	2.50
MM5016	2.50
MM5055	2.50
MM5056	2.50
MM5057	2.50
MM5058	2.50
MM5060	2.50

14 PIN HEADERS .... 3/$1.00
16 PIN HEADERS 40
24 PIN HEADERS .... .75
40 PIN HEADERS 1.10
50 PIN EDGEBOARD CONN. 3.95
26 PIN EDGEBOARD CONN. 2.50
50 PIN RIGHT ANGLE CONN. 3.95
20 PIN RIGHT ANGLE CONN. 2.25

50 PIN RIBBON CONNECTORS $3.25
40 PIN RIBBON CABLE CONN $2.75
20 PIN RIBBON CABLE CONN $2.25
10 PIN RIBBON CABLE CONN $1.50

PRINTED CIRCUIT BOARD
4" x 6" DOUBLE SIDED EPOXY BOARD 1/16" THICK $.60 ea. .... 5/$2.60

EPOXY GLASS VECTOR BOARD

1/16" thick with 1/10" spacing
4½" x 6½" $1.95

DATEL'S DAC-08EQ
8 bit DAC — $7.95
INTERSIL DG11BP ANALOG SWITCH/ 2 CHANNEL DRIVERS $11.50
INTERSIL ICL 7104-12 CPL 12 BIT A/D CONVERTER $26.50
REOICON SAD 1024 ANALOG DELAY LINE ... $10.95

74S00	30	74S74	70		
74S02	.30	74S86	60	74S158	1.25
74S03	30	74S89	1.90	74S169	1.75
74S04	40	74S112	85	74S174	1.40
74S05	45	74S133	1.40	74S175	1.40
74S08	40	74S135	1.50	74S194	1.10
74S10	30	74S138	1.25	74S257	1.50
74S11	35	74S139	1.10	74S258	1.40
74S15	40	74S140	1.00	74S260	1.50
74S20	40	74S153	1.10	74S280	1.50
74S30	40	74S151	1.25	74S373	2.25
74S32	40	74S157	1.25		

7 WATT LD 65 LASER DIODE IR $8.95

25 watt Infra Red Pulse (SG 2006 equiv.) Laser Diode (Spec sheet included)! $24.95

2N3820 P FET .... $ .45
2N 5457 N FET .... $ .45
2N2646 UJT .... $ .45
ER 900 TRIGGER DIODES ..... 4/$1.00
2N 6028 PROG. UJT .... $ .65

DISC CAPACITORS
.1UF 16V ..... 10/$1.00 ..... 100/$8.00
.01UF 35V ..... 16/$1.00 ..... 100/$5.00

IN4148 (IN914) 15/1.00

TANTALUM CAPACITORS

.47UF 35V	5/$1.00	10UF 35V	$ .40
.68UF 35V	5/$1.00	22UF 10V	$ .30
1UF 35V	5/$1.00	15UF 16V	3/$1.00
2.2UF 20V	5/$1.00	30UF 6V	5/$1.00
3.3UF 20V	4/$1.00	33UF 20V	$ .60
4.7UF 35V	4/$1.00	47UF 20V	$ .85
6.8UF 35V	3/$1.00	120UF 6V	$ .75
		200UF 20V	$1.75

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS .$ 7.50
Si 1020 G 20 WATTS .$12.50
Si 1050 G 50 WATTS .$27.50

200 PRV 1A LASCR .95

RS232 CONNECTORS

DB 25P male $2.75
DB 25P female 3.75
HOODS 1.25

C/MOS

4001	20	4027	.40	4081	20	74C74	50
4002	.20	4028	55	4082	.20	74C76	.70
4006	.65	4029	.75	4093	.60	74C83	1.30
4007	27	4030	.35	4099	1.75	74C85	1.40
4008	.65	4034	2.25	4501	.95	74C86	50
4009	.45	4035	.75	4510	.65	74C90	90
4010	.45	4040	.65	4511	.65	74C93	.95
4011	20	4042	.55	4514	1.40	74C151	1.75
4012	.20	4043	.65	4515	1.60	74C157	1.75
4013	30	4044	55	4516	.75	74C160	1.20
4014	55	4046	.90	4518	1.25	74C161	1.15
4015	55	4047	.90	4520	70	74C163	1.15
4016	30	4049	40	4553	2.75	74C165	1.25
4017	30	4050	.40	74C00	27	74C173	1.30
4018	.50	4051	.80	74C02	.27	74C174	1.30
4019	.45	4052	.75	74C08	30	74C175	1.20
4020	.70	4053	75	74C10	27	74C192	1.30
4021	55	4066	.50	74C14	1.20	74C901	.50
4022	80	4069	.20	74C20	27	74C914	1.75
4023	20	4071	25	74C32	.45	74C926	5.50
4024	45	4072	20	74C73	75		
4025	25	4076	.65				
		4077	35				

SPECIALS

2114L-4 .... $ 1.75
8264-2 + 5V 64K RAM 14.50
8X300 — SIGNETICS 16 BIT MICROCONTROLLER 89.00
4 ea. 2716 (+5V) 22.00
8 ea. 4116-3 RAM'S 16.75
10 ea. 8164E 64K RAM (150NS) .. 99.50
L14H4 IR + VISIBLE DETECTOR 3/$1.00
MM5307 — Baud Rate Generator .. $9.95

RS 232 CABLE

10 Conductor, # 22 color coded wire, gray PVC outer cover, ⅜" diameter
.40 per ft. — 100'/$30.00
Add 20% postage for orders under 100'.
Add 10% postage for orders over 100'.

SPECIALS GOOD THRU DEC. 1981

CRYSTALS $3.45 ea.

2.000 MHz	6.144 MHz
3.000 MHz	10.000 MHz
3.57 MHz	18.000 MHz
4.000 MHz	8.000MHz
5.000 MHz	18.432 MHz
6.000 MHz	20.000 MHz

DIP SWITCHES
CTS 206-4 4 POSITION 1.25
CTS 206-8 8 POSITION 1.50
CTS 206-10 10 POSITION 1.95

MINIATURE MULTI-TURN TRIM PDTS
50, 100, 500, 1K, 5K, 10K, 50K, 250K ... $75 each 3/$2.00

NO. 30 WIRE WRAP WIRE SINGLE STRAND 100' $1.40

40 CONDUCTOR 3M CABLE. #28 WIRE .... $ 75/FT

SCR's

	1.5A	6A	35A	110A
100	.45	.60	1.40	
200	.70	.80	1.90	9.00
400	1.20	1.40	2.60	12.00
600		1.80	3.60	15.00

TRIAC's

PRV	1A	10A	25A
100	45	.80	1.55
200	84	1.30	2.10
400	1.30	1.90	3.10
600	2.00	2.75	4.30

FP 100 PHOTO TRANS .... $ .50
RED, YELLOW, GREEN or AMBER LARGE LED's 2" .... 6/$1.00
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IL-5 OPTO ISOLATOR .... $ .45
1 WATT ZENERS: 3.3, 4.7, 5.1, 5.6, 6.8, 8.2, 9.1, 10, 12, 15, 18, or 22V .... 6/$1.00

SFC 3301 — 50 PRV 30A
FAST RECOVERY DIODE (35ns) .. $2.25
20KV 250MA DIODE $1.90

SILICON POWER RECTIFIERS

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.35	.90	4.25	6.00
200	.07	.20	.40	1.30	5.25	9.00
400	.09	.25	.65	1.50	6.50	12.00
600	.11	.30	.80	2.00	8.50	15.00
800	.15	.35	1.00	2.50	10.50	18.00
1000	.20	.45	1.25	3.00	12.50	26.00

CLOCK CHIPS
MM5314 ..... $4.75 MM5316 ..... $4.95
MM5387AA 5.95

.5V at 800ma SOLAR CELLS
3" diameter $4.35

7 SEGMENT DISPLAYS

FSC8024-4 digit		DL-707 C.A. .3"	$ .75
C.C. 8" display	$5.95	DL 747 C.A. .6"	$1.50
FND 503 C.C. .5"	$ .85	FND810 .8" CA	$1.95
FND 510 C.A. .5"	$ .85	FND803 .8" CC	$1.95
DL-704 .3" C.C.	$ .85	MAN 5 C.C. Green	$ .75
		MAN 82 C.A. Yellow	$ .75

TRANSISTOR SPECIALS

2N1307 PNP GE TO-5 .... $ .40
2N404A PNP GE TO-5 .... 3/$1.00
HEP G6014 — PNP GE TO-3 .... $ .85
TIP 111 .... $ .50 TIP 145 .... $1.35
2N6233-NPN SWITCHING POWER $1.95
MRF-8004 CB RF TRANSISTOR NPN .... $ .75
2N3772 NPN Si TO-3 .... $1.00
2N4908 PNP Si TO 3 .... $1.00
2N3137 NPN Si RF .... $ .55
2N3919 NPN Si TO 3 RF $1.50
2N1420 NPN Si TO 5 .... 3/$1.00
2N2222 NPN Si TO-18 .... 5/$1.00
2N2907 PNP Si TO-18 .... 5/$1.00
2N3055 NPN Si TO 3 .... $ .60
2N3904 NPN Si TO 92 .... 6/$1.00
2N3906 PNP Si TO 92 .... 6/$1.00
2N5296 NPN Si TO-220 .... $ .55
2N6109 PNP Si TO 220 .... $ .55
TIP 31B NPN Si TO 220 .... $ .60
TIP 32B PNP Si TO-220 .... $ .65
TIP 34 PNP Si .... $ .95
TIP 121 PNP Si U84 .... $ .60
TIP 141 NPN Si U97 .... $1.00
NJE 3055 .... $ .85

TTL IC SERIES

7400	.17	7474	.40	74165	60
7401	.17	7475	.40	74166	.70
7402	.17	7476	.40	74170	1.60
7403	.17	7480	.45	74173	.75
7404	24	7483	.50	74174	.65
7405	.24	7485	.65	74175	.60
7406	33	7486	.42	74176	75
7407	.35	7490	.45	74177	.75
7408	.27	7491	.45	74180	.75
7409	.24	7492	45	74181	1.90
7410	17	7493	.45	74182	45
7411	.22	7494	.60	74190	.70
7413	.42	7495	.60	74191	.75
7414	50	7496	.60	74192	.70
7416	.33	74107	.35	74193	.79
7417	.37	74121	.35	74194	.85
7420	.17	74122	39	74195	.45
7425	.30	74123	.42	74196	.75
7426	.33	74125	.45	74197	.75
7427	.30	74126	.45	74273	.85
7430	.17	74145	.75	74279	.60
7432	.27	74148	1.25	74365	.65
7437	27	74150	1.10	74367	.65
7438	27	74151	.50	74368	.65
7440	.17	74153	40	74390	90
7442	45	75154	1.10	75324	2.25
7445	70	74155	.50	75492	1.05
7446	75	74157	.50	8T31	2.06
7447	65	74160	85	8T32	2.75
7450	17	74161	.65	8T98	1.20
7472	.35	74162	.60	9312	.60
7473	35	74163	.60	9601	75
		74164	.60	9602	.75

FULL WAVE BRIDGE

PRV	2A	6A	25A
100			1.40
200	80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

12V DC RELAYS TTL SIZE
S.P. 1200 ohm coil 95
D.P. 400 ohm coil 1.25

DIP SOCKETS

8 PIN	.17	22 PIN	30
14 PIN	20	24 PIN	.35
16 PIN	22	28 PIN	40
18 PIN	25	40 PIN	60

74LS SERIES

74LS00	.17	74LS93	.39	74LS196	85
74LS01	.18	74LS96	.56	74LS197	85
74LS02	.22	74LS109	.38	74LS221	80
74LS03	22	74LS112	38	74LS240	89
74LS04	22	74LS113	45	74LS241	89
74LS05	22	74LS114	55	74LS242	89
74LS08	20	74LS123	59	74LS243	89
74LS09	22	74LS124	1.25	74LS244	89
74LS10	20	74LS125	.45	74LS245	1.50
74LS11	22	74LS126	45	74LS247	75
74LS12	22	74LS132	50	74LS248	1.10
74LS13	45	74LS136	.45	74LS251	.56
74LS14	40	74LS138	.48	74LS253	56
74LS15	35	74LS139	48	74LS257	56
74LS20	18	74LS151	.40	74LS258	55
74LS21	18	74LS153	.40	74LS273	1.15
74LS22	25	74LS155	.60	74LS279	.48
74LS26	.35	74LS156	.70	74LS280	1.80
74LS27	.28	74LS157	.48	74LS283	75
74LS28	45	74LS158	48	74LS290	72
74LS30	18	74LS160	70	74LS293	.38
74LS32	35	74LS161	.58	74LS365	.52
74LS37	.30	74LS162	70	74LS366	52
74LS38	.30	74LS163	58	74LS367	52
74LS40	40	74LS164	.58	74LS368	.52
74LS42	44	74LS168	1.25	74LS373	1.25
74LS47	65	74LS169	1.75	74LS374	1.25
74LS51	20	74LS170	1.50	74LS377	1.25
74LS54	20	74LS173	59	74LS386	.50
74LS73	.35	74LS174	45	74LS390	.98
74LS74	35	74LS175	.40	74LS393	.98
74LS75	.35	74LS181	1.95	74LS670	1.60
74LS76	45	74LS190	72	81LS97	1.10
74LS83	75	74LS191	.72	81LS98	1.10
74LS85	.85	74LS192	.65		
74LS86	40	74LS193	.60		
74LS90	.39	74LS194	1.10		
74LS92	.45	74LS195	90		

LINEAR CIRCUITS

LM201	.75	LM348	90	709	25
LM301 748	.30	LM358	.50	710	45
741CV	.25	LM361	1.75	711CH	40
741C	35	LM377	1.60	LM1808	1.75
747	50	LM380	1.25	LM1889	1.95
1456	80	LM382	80	CA758	1.75
1458	50	LM383	2.50	CA3018	1.95
4136	85	LM386	80	CA3046	85
3900	45	LM387	1.25	CA3078	1.50
LM307	30	LM393	1.00	CA3140	1.50
LM308	.75	LM553	2.25	CA3086	.95
LM324	.65	LM555	45	CA3094	2.25
LM339	65	LM556	.85	LM2901	95
LF351	75	5648	3.95	8038CC	3.90
LF353	1.25	565	95	N5596A	1.50
LF355	1.25	566	1.40	TL062 CP	.95
LF356	1.35	567	.85	TL064 CN	1.50
LM311	50				
LM318	1.00				

REGULATORS

LM317T	$1.50	78L05	$ .45
LM337	$2.50	LM305G	$ .75
79HGKC-5V at 5A	$6.95	340K-12, 15 or 24V	$1.50
723	$ .50	340T-5, 6, 8, 9, 12, 15, 18 or 24V	$ .85
320T 5, 12 or 15V	$ .90		
78M05	$ .35	LAS1412 + 12V 3A	$3.95

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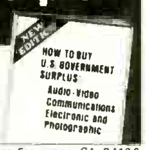

COMMAND HQ-3, Custom House POB-26348, San Francisco, CA 94126

"HOW To Break Into The Computer Field." Valuable new handbook for computer career seeker. $8.95. Moneyback guarantee. **CARRON PUBLISHERS,** 205-GB Ridgewood, Easton, PA 18042

PRINTED circuit boards: Your artwork, quick delivery, reasonable. Quantity discounts. **ATLAS CIRCUITS,** Box 892, Lincolnton, NC 28092 (704) 735-3943

COMPLETE line of **microwave television converters** and accessories to suit your needs. Converters have a one year warranty backed by a 3 year reputation. Call or write for complete specifications and pricing. **Dealer inquiries invited. TRITON MARKETING,** 1933 Rockaway Parkway, Brooklyn, NY 11236 (212) 531-9004

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MICROWAVE receiver system. Write: "Dealers Wanted," Dept. RE, POB 440668, Aurora, CO 80044. (303) 620-9736

2150 megahertz downconverters $99.95 up, assembled. Details for SASE. **GW ELECTRONICS,** POB 688, Greenwood, IN 46142

RESISTORS ¼W, ½W 5% carbon films 3¢ ea. **no minimums.** 1% metal films. Send for details. Bulk pricing available. **JR INDUSTRIES,** 5834-C Swan-creek, Toledo, OH 43614

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VIDEO cassette color recorder only $99.00. Recorder will connect to camera or play prerecorded movies. Tuner available for off-air recording. Movies available, regular or adult. **MEDIA ASSOCIATES,** 616 National Ave., Mt. View, CA 94043 415/968-2444

FREE speaker catalog! Woofers, mids, tweeters, hardware, crossovers, grille cloth, plans, kits, information, much more. Discount prices. **UNIVERSAL SOUND,** Dept. RE, 2253 Ringling Blvd., Sarasota, FL 33577, (813) 953-5363

TEST equipment. Reconditioned/calibrated. Tektronix, H-P, etc. Catalog 50¢. **ALDONICS,** Box 2980, Stn. D, Ottawa Canada KIP 5W9

TEST equipment, new and used. Catalog $1.00. **PTI,** Box 8756, White Bear Lake, MN 55110. (612) 429-2975

OCTATRACE—Converts any oscilloscope to display 8 channels. PC bd. & case $21.00. **AB COMPUTER PRODUCTS,** P.O. Box 571, Jackson, NJ 08527

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SAVE up to 50% on name brand test equipment. Free catalog and price list. **SALEN ELECTRONICS,** Box 82-F, Skokie, IL 60077

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OUTDOOR AUTOMATIC LIGHTING WITH PASSIVE INFRARED

SECURITY LIGHT CONTROL

Amazing infrared device detects and foils intruders, welcomes guests, prevents accidents and saves energy!

Your family is sound asleep. An intruder is stealthily approaching your darkened house. But when he enters the detection pattern, the SLC senses his body heat and ZAP! Your outside lights come on instantly, destroying his cover of darkness before he ever gets to your door. A crime is prevented. And when you finally arrive home that same SLC automatically turns on your driveway and porch lights for a safe, warm welcome.

HOW IT WORKS

This exciting new product incorporates the latest advances in heat-sensing infrared technology. Manufactured by Colorado Electro-Optics, the leading producer of infrared security devices in the US, the SLC detects the heat energy of any person or vehicle that enters its invisible detection pattern. It will then automatically turn on up to 500 watts of outside lighting. These lights will remain on until four minutes after the last person leaves the detection area. No timers, no switches, no all-night flood lights.

SLC NEVER FORGETS

Unlike timers that respond only to preset programs, the SLC reacts to the presence of human beings. It is now possible to have your lights on when and only when you really need them, all automatically. In addition to a reliable security device, the SLC can provide your family with increased safety, convenience and home energy savings. No more stumbling over unseen objects, tripping on dark stairs, or fumbling with your keys. No more wasted energy from forgetting to turn off the lights. And your guests will appreciate the automatic welcome your home always provides.

SAFE, EASY TO INSTALL

The SLC does not emit energy of any kind and is totally harmless to living things. Rugged, weather resistant, UL listed and good looking, a low-cost SLC should be put near every entryway. The sensor is adjustable to cover an area 35 feet by 25 feet. Installing the SLC is as simple as wiring a switch, an easy job for the do-it-yourselfer.

Your home is an important investment, and your family is irreplaceable. They deserve the sophisticated protection of the Security Light Control.

SLC ORDER FORM

If not completely satisfied I may return the SLC within 60 days of purchase for a full refund. The unit carries a limited one year warranty.

Please Print

NAME ____________________

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CITY ____________________

STATE __________ ZIP __________

Please send me ____ Security Light Control(s) at $199 each, totalling $ ________

For my convenience, Colorado Electro-Optics will pay surface shipping charges.

Enclosed is my ☐ Money Order
☐ MasterCard or ☐ Visa

ACCOUNT NO ____________________

EXPIRATION DATE ____________________

☐ Personal Check
☐ Ship COD to above address (10% deposit enclosed)

☐ Please send more information.

SIGNATURE ____________________

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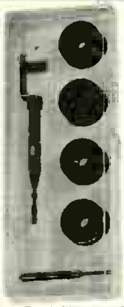
TO__ FREE ORDERING NUMBER 1-(800) 423-7144

PRODUCTS

JUST WRAP KIT



Just Wrap tool for daisy chain wiring. Tool strips as it wraps and cuts. Includes one 50 foot spool of wire.

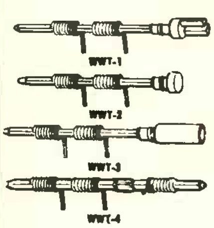
Part No.	Description	Price
JW-1*	Just Wrap Tool	$14.95
JWK-6	Tool w/4 Spools and JUW1	24.95
R-JW*	50 Ft. Replacement Wire	3.49
JUW-1	Unwrapping Tool	3.49

*Specify Color: Red, Blue, White or Yellow.

HAND WRAP TOOL

Part No.	Description	Price
WSU30	Regular	$6.95
WSU30M	Modified	7.95

TERMINALS

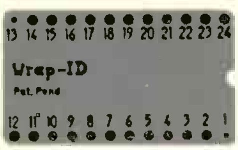


- .025 (0,63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated

25 PER PKG.

Part No.	Description	Price
WWT-1	Slotted Terminal	$4.98
WWT-2	Single Sided Terminal	2.98
WWT-3	IC Socket Term.	4.98
WWT-4	Double Sided Terminal	1.98
INS 1	Insertion Tool for above	2.49

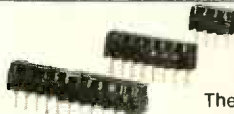
SOCKET WRAP — ID



Slipped onto socket before wrapping to identify pins.

Part #	Price	Bulk Price	Part #	Price	Bulk Price
14ID	1.49/10	5.50/100	22ID	1.49/5	5.95/50
16ID	1.49/10	5.95/100	24ID	1.49/5	5.95/50
18ID	1.49/10	5.00/50	28ID	1.49/5	6.50/50
20ID	1.49/5	5.00/50	40ID	1.49/5	5.00/25

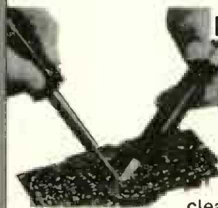
P.C.B. TERMINAL STRIPS



The TS strips provide positive screw activated clamping action, accommodate wire sizes 14-30 AWG (1,8-0, 25mm). Pins are solder plated copper, .042 inch (1mm) diameter, on .200 inch (5mm) centers.

Part No.	Description	Price
TS- 4	4-Pole	$1.69
TS- 8	8-Pole	2.59
TS-12	12-Pole	3.49
TS6MD	2-Pole Interlocking	3/1.79

DESOLDERING PUMP



Easy one hand operation. Rugged all metal construction. Replaceable TEFLON® Tip. Self cleaning on each stroke. Suction precisely regulated for reliable desoldering without damage to delicate circuitry.

DSPI	Desoldering Pump	$9.95

LOGIC PROBE

Compatible with all logic families using a 4 to 15V power supply. Thresholds automatically programmed. Visual indication of logic levels to show high, low, bad level or open circuit logic pulses.

- 10 N sec. pulse responses
- 120 K input impedence.
- Automatic resetting memory.
- Includes tip with protective cap & coiled cord.

PRB-1 $36.95

LOGIC PULSER

Superimposes a pulse train (20 pps) or a single pulse onto the circuit node under test without un-soldering IC's.

- Automatic polarity sensing
- 2 us pulse width
- Finger tip push button actuated
- Includes tip with protective cap & coiled cord.

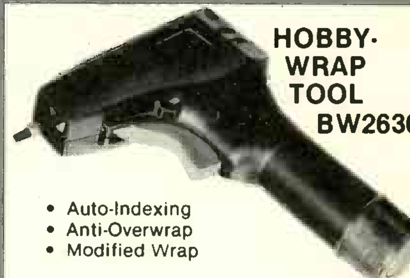
PSL-1 $48.95

VACUUM VISE

Unique vacuum-based light duty vise for precision handling of small components and assemblies. Rugged ABS construction. 1½" (32mm) travel for maximum versatility. Also features screw lugs for permanent installation.

VV1	Vacuum Vice	$3.49

HOBBY-WRAP TOOL BW2630



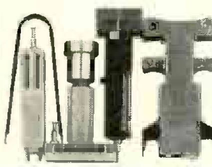
- Auto-Indexing
- Anti-Overwrap
- Modified Wrap

Part No.	Description	Price
BW2630	Tool	$19.85
BT30	#30 Bit (not incl.)	3.95
BT2628	#28 Bit (not incl.)	7.95
BC1	Batteries & Charger	14.95

INSERTION/EXTRACTION TOOLS

Part No.	Description	Price
INS1416	14-16 pin Inserter	$3.49
MOS1416	14-16 pin MOS Safe Inserter	7.95
MOS2428	24-28 pin MOS Safe Inserter	7.95
MOS40	40 pin MOS Safe Inserter	7.95
EX1	14-16 pin IC Extractor	1.49
EX2	24-40 pin IC Extractor	7.95

WK-7 IC INSERTION KIT



Complete IC Inserter/ Extractor Kit Individual Components (listed above) $22.95

IC DISPENSER

Allows IC's to be dispensed from their tube 1 at a time and picked up by insertion tools above.

• Dispenses 8-42 pin IC's • Compatable with all IC carrying tubes • Use with WK7 for MOS safe insertion. •

Part No.	Description	Price
MDD1	1 Chan. Dispenser	$21.85
MDD5	5 Chan. Dispenser	83.43
MDD10	10 Chan. Dispenser	160.45

* * *No Discount.

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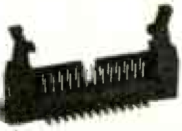
IDC CONNECTORS



RIGHT ANGLE HEADERS

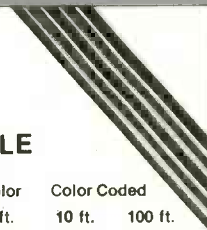
	SOLDER TAIL		WIRE WRAP	
Size	Part No.	Price	Part No.	Price
10	IDH10SRB	$1.20	IDH10WRB	$2.60
20	IDH20SRB	1.90	IDH20WRB	4.15
26	IDH26SRB	2.75	IDH26WRB	5.35
34	IDH34SRB	3.75	IDH34WRB	6.25
40	IDH40SRB	3.75	IDH40WRB	7.35
50	IDH50SRB	4.75	IDH50WRB	9.20

.1" Spacing. Mounts on PC Board & Mates with IDS Socket below. Ejector Bars - 4/1.00.

EDGE CARD CONNECTORS

Size	Part No.	Price
10	IDE10B	$3.95
20	IDE20B	4.35
26	IDE26B	5.00
34	IDE34B	6.05
40	IDE40B	6.90
50	IDE50B	7.50

.1" Spacing. Crimps onto cable with ordinary vise & mates with standard .062" Card Edge.



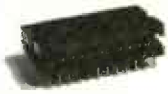
RIBBON CABLE

	Solid Color		Color Coded	
Size	10 ft.	100 ft.	10 ft.	100 ft.
10	2.90	17.00	4.00	30.00
14	3.40	23.80	5.00	42.00
16	3.70	27.20	5.60	48.00
20	4.40	34.00	7.00	60.00
24	5.00	40.80	8.00	72.00
26	5.40	44.20	8.60	78.00
34	6.80	57.80	11.00	102.00
40	7.80	68.00	13.00	120.00
50	9.50	85.00	16.00	150.00

25 PIN "D" CONNECTORS

Solder Style	Part No.	Price
Male	DB25P	$2.95
Female	DB25S	3.95
Cover	DB25C	1.50
IDC Style		
Male	IDB25P	6.25
Female	IDB25S	6.60
Cover	IDB25C	1.60

Solder Style solders onto cable, IDC Style crimps onto cable with vise. 9, 15, 37 and 50 pin available also.



CABLE PLUGS

Size	Part No.	Price
14	IDP14B	$1.45
16	IDP16B	1.65
24	IDP24B	2.50
40	IDP40B	4.15

.1" Spacing. Crimps onto cable with ordinary vise & plugs into standard IC Socket.

SOCKETS

Size	Part No.	Price
10	IDS10B	$1.88
20	IDS20B	2.75
26	IDS26B	3.50
34	IDS34B	4.50
40	IDS40B	5.40
50	IDS50B	6.50

.1" Spacing. Crimps onto cable with ordinary vise & mounts to header sold above.

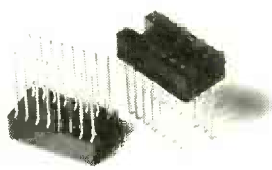
WIRE WRAP SUPPLIES

WIRE WRAP WIRE

#30 Wire Wrap Wire

Length	100/Bag	500/Bag	1K/Bag
2.5"	$1.38	$3.94	$6.81
3.0"	1.43	4.25	7.46
3.5"	1.51	4.57	8.11
4.0"	1.56	4.88	8.73
4.5"	1.63	5.21	9.39
5.0"	1.69	5.54	10.04
5.5"	1.74	5.92	10.69
6.0"	1.82	6.23	11.34
6.5"	2.11	7.08	12.99
7.0"	2.19	7.44	13.68
7.5"	2.29	7.78	14.40
8.0"	2.35	8.12	15.10
8.5"	2.40	8.46	15.80
9.0"	2.46	8.92	16.51
9.5"	2.53	9.15	17.22
10.0"	2.63	9.58	17.91

All lengths are overall, including 1" strip on each end. Choose from colors; Red, Blue, Black, Yellow, White, Green, Orange, and Violet.



Size	Part No.	Each	Tube
08	ICN083WBSG	.44	52x .39 = $20.28
14	ICN143WBSG	.53	30x .46 = $13.80
16	ICN163WBSG	.58	26x .50 = $13.00
18	ICN183WBSG	.78	23x .68 = $15.64
20	ICN203WBSG	1.00	21x .85 = $17.85
22	ICN224WBSG	1.07	19x .92 = $17.48
24	ICN246WBSG	1.09	17x1.09 = $15.98
28	ICN286WBSG	1.43	15x1.23 = $18.45
40	ICN406WBSG	1.85	10x1.60 = $16.00

Selective Plating provides gold in contact where it counts. 3-level wrap. Save by buying sockets by the tube. All gold available at ½¢/pin extra charge.

* * * No Discount

WIRE KITS

Kit No. 1 — $9.95

250	3"	100	4½"
200	3½"	100	5"
100	4"	100	6"

Kit No. 2 — $24.95

250	2½"	250	5"
500	3"	100	5½"
500	3½"	100	6"
500	4"	100	6½"
250	4½"	100	7"

Kit No. 3 — $34.95

250	2½"	500	4½"
500	3"	500	5"
500	3½"	500	5½"
500	4"	500	6"

Kit No. 4 — $59.95

500	2½"	1000	4½"
1000	3"	1000	5"
1000	3½"	1000	5½"
1000	4"	1000	6"

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Prepaid orders over $50 shipped prepaid via UPS. All others add $3.00 for handling. VISA, MC, COD's and open account orders will be charged freight. $15 minimum order. $100 minimum open account order.

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Order Amount	Net
$15 - 99	Net
100 - 199	less 10%
200 - 499	less 15%
500 - 999	less 20%
1000 up	less 25%

Discount and the name of this magazine must be mentioned at time of order to get discount. Discount applies on all items except as noted, "No Discount."

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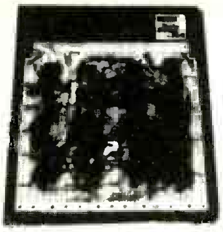
PRIORITY ONE ELECTRONICS

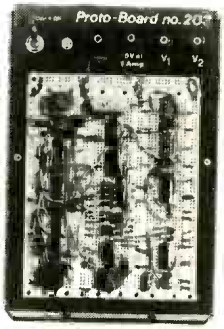


PROTO-BOARD UNITS

All the speed and convenience of QT sockets and Bus Strips plus backplanes and binding posts in both kits and pre-assembled units. Assemble, test and modify circuits as fast as you can think.

Part No.		Dip Capacity	Board Size Inches	Price
GSCPB6	Kit	10(14's)	6x4x¼	$19.95
GSCPB100	Kit	10(14's)	4½x6x¼	21.95
GSCPB101	ASM	10(14's)	6x4½x¼	28.95
GSCPB102	ASM	12(14's)	7¼x4½x¼	34.95
GSCPB103	ASM	24(14's)	9x6x¼	59.95
GSCPB104	ASM	32(14's)	9⅛x8x¼	77.00

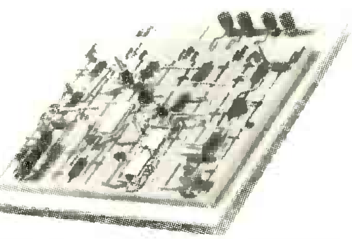
PROTO-BOARD PB-203 · HOLDS 24 14-PIN IC'S



Fully assembled breadboard contains built-in, short-proof, fused, 5VDC at 1 amp, regulated power supply, in addition to three QT-59S sockets, four QT-59B bus strips, one QT-47B bus strip and four binding posts. Capacity for most digital and many analog projects. **SIZE:** 9.75" LG, 6.6" w, 3.25" h **WEIGHT:** 5 lbs.

GSCPB203 .... List Price ... $133.00
Our Price **$125.00**
GSCPB203A ... All features plus ±15VDC @ 500mA ... $174.00
Our Price **$160.00**
GSCPB203AK .... Kit version of the 203A $149.95
Our Price **$138.00**

ALL-CIRCUIT EVALUATORS



- ACE for fast, solderless, plug in circuit building and testing. Plug in any components with leads up to 0.032" diameter. Interconnect with solid wire up to 20 gauge. Gold-anodized aluminum base/ground. Non corrosive nickel silver terminals. 4 rubber feet.

PART NO.	ACE MODEL NO.	DIP CAPACITY	TIE POINTS	NO. BUSES	NO. POSTS	PRICE EACH
923333	200-K (kit)	8	728	2	2	$22.75
923332	208 (assem)	8	872	8	2	$30.70
923334	201-K (kit)	12	1032	2	2	$29.95
923331	212 (assem)	12	1224	8	2	$37.05
923326	218 (assem)	18	1760	10	2	$49.80
923325	227 (assem)	27	2712	28	4	$63.55
923324	236 (assem)	36	3648	36	4	$84.75

Hot Vac® Desoldering Systems

Ungar

HOT VAC Model 2000A is the economical, no-compromise, non-magnetic desoldering system designed for use with shop air.

- A solid-state control adjusts tip temperatures from 500 to 1000 F
- The load modulated heater assures instantaneous recovery.
- Transient spikes are fully suppressed.
- The continuous, high flow vacuum is actuated by a switch conveniently built into the handle.
- Biomechanically designed handle reduces fatigue and increases productivity.

	LIST PRICE	OUR PRICE
UNG44	$399.00	$375.00

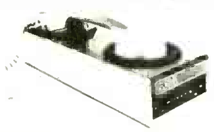
Includes UNG6966 Heat Gun ($65.00) Included FREE!

ZENITH LIST PRICE $159.00

OUR PRICE $139.00

The new Zenith ZVM-121 features a P31 green phosphor tube along with 15 MHz bandwidth. Switch selectable for 40/80 character screen. Fully compatable with 80 column Apple cards. 20 lbs.

STAR MODEM FROM PRENTICE



LIST PRICE $199.00
OUR PRICE $149.00

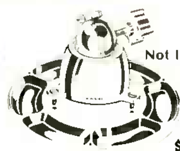
0 to 300 bauddate rate. Compatible with Bell 103 and 113. Answer/Orignate. Full/Half Duplex. Special self test features

PRN-STAR
RS232, DB25P, EIA

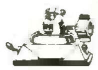
CND-RS2328F Class 1 Cable 8 con. 8 ft. **$19.95**

PANAVISE

LOW-PROFILE BASE $13.95 PNV-305
SH. WT. 2lbs

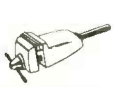


Not Included
$13.95
PNV-312 TRAY BASEMOUNT



SH.WT 2 lbs
VACUUM BASE $21.95 PNV-380

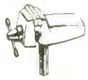
PNV-304 $18.45



HORIZONTAL JAW VISE HEAD

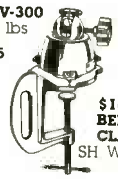
PNV-371 SOLDER & IRON HOLDER 8 oz. $5.95

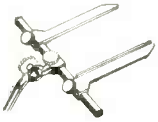
STANDARD VISE HEAD $16.95 PNV-303
SH. WT. 2lbs



PNV-333 $39.95
sh. wt. 8 lbs
RAPID ASSEMBLY CIRCUIT BOARD HOLDER

STANDARD BASE PNV-300
SH. WT. 2 lbs
$13.95

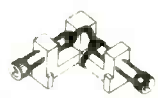




$16.95 BENCH CLAMP
SH. WT. 3lbs

PNV-315 $19.95
SH. WT. 1lb.

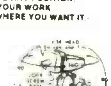
P.C. BOARD HOLDER with 14" bar
FITS S-100 BOARDS



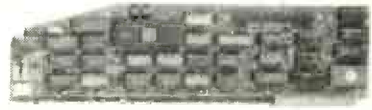
DUAL 90 CORNER CLAMPS
PNV-390 $6.95 (pair) 8 oz.

SELF CENTERING 9" WIDE OPENING VISE HEAD $20.95

PNV-376
PANAVISE TILTS, TURNS, AND ROTATES TO ANY POSITION IT HOLDS YOUR WORK EXACTLY WHERE YOU WANT IT



Vista APPLE DOUBLE DENSITY 8" DISK CONTROLLER

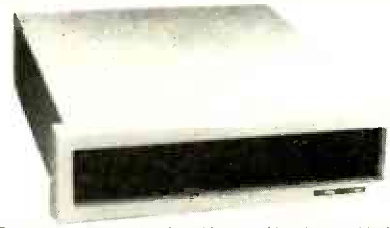


Vista introduces high-speed, DMA data transfer, and high-capacity IBM compatible single and double-density data storage to the Apple II® computer with the A800 Eight-Inch Floppy Disk Controller.

- High Speed DMA Transfer of Data (1 Microsecond/Byte).
- Complete Documentation Provided—Includes Theory of Operation, Source Code for DOS Enhancement Utilities, Schematics and Diskette
- Uses All Standard Apple DOS Commands (OPEN CATALOG, LOCK, DELETE, LOAD...etc.) Except for INIT Which Has Been Improved and Enhanced in a Vista Format Routine.
- Compatible With Apple DOS 3.2/3.3, Pascal 1.1 and CPM 2.2 (With the Z80 Soft Card by Microsoft)
- Interfaces to All Shugart/ANSI Standard Eight-Inch Floppy Disk Drives.
- 2Kx8 PROM Contains Autoboot Functions and All Eight-Inch Floppy Driver Code Allowing Complete Memory UsageMap Compatibility with Apple DOS 3.2/3.3
- 120 Days Parts and Labor Warranty.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
VISA800	Controller and disk	$595.00	$559.00
VISA800	When purchased simultaneously with one of the "PDB" Vista and TEI disk specials below		$525.00

VISTA DUAL 8" DISK CABINET



- Features modular construction with removable sub-assembly that allows easy cabinet positioning and mounting.
- Drives pull out for easy service and maintenance.
- Deluxe chassis with internal slide allows easy access for drive positioning and mounting.
- Built to mechanically and electrically accommodate single sided drives, double sided drives—including the most popular 8-inch Winchester and Shugart floppy disk drives, and 8-inch streaming tape cartridge units.
- Industrial quality cabinet with die cast front bezel.
- Meets all UL and OSHA standards.
- Additional Savings! Front and rear retma rail mounts provided at no extra charge (no external slides)
- Desk or rack mountable
- Internal power and data cables.

		List Price	OUR PRICE
VISV100	Disk Drive Cabinet	$495.00	$449.00

Shipping Weight: 35 lbs.

BUY THE CABINET AND SHUGART 801Rs OR QUME DT-8s AND SAVE

with ONE drive

PDBV100S1	With Shugart 801R	$ 900.00
PDBV100Q1	With Qume DT-8	$1045.00

with TWO drives

PDBV100S2	With Shugart 801R	$1300.00
PDBV100Q2	With Qume DT-8	$1600.00

Due to UPS shipping regulations, disk drives will be shipped separately from the cabinet. Don't forget to include shipping for each drive. 16 lbs. ea.

PRI50SKSK External data Cable **$19.95**

SPECIAL PURCHASE GOLD 16 PIN LOW PROFILE IC. C95 SOOKETS

TIG-16LP pkg of 100 .... $16.00
TIG-16LP pkg. of 1000 .... $120.00
OEMS Stock up at this LOW PRICE

PRIORITY ONE ELECTRONICS
9161 DEERING AVE., CHATSWORTH, CA 91311
ORDER TOLL FREE (800) 4235922 CA, AK, HI CALL (213) 709546

VISA master charge

Terms. U.S.VISA. MC, BAAC,Check Money Order,U.S. Funds Only. CA residents add 6% Sales Tax. MINIMUM PREPAID ORDER $15.00. Include MINIMUM SHIPPING & HANDLING of $2.50 for the first 3 lbs. plus 25¢ for each additional pound. Orders over 50 lbs. sent freight collect. Just in case, please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru December, 1981. SOCKET and CONNECTOR prices based on GOLD, not exceeding $700.00 per oz. Sales Prices Valid only if **YOU** mention publication and month. Credit Card orderw will be charged appropriate freight.

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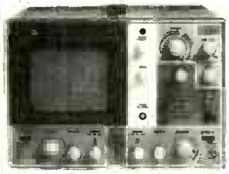
PRIORITY ONE ELECTRONICS

BUY WITH CONFIDENCE
From the Nation's Largest
HITACHI Distributor
Hitachi Denshi, Ltd.

Single and dual trace, 15 thru 100 MHz. All high sensitivity Hitachi oscilloscopes are built to demanding Hitachi quality standards and are backed by a 2-year warranty. They're able to measure signals as low as 1mV/division (with X5 vertical magnifier). It's a specification you won't find on any other 15 or 30 MHz scopes. Plus: Z-axis modulation, trace rotation, front panel X-Y operation for all scopemodels, and X10 sweep magnification. And 30 thru 100 MHz oscilloscopes offer internal signal delay lines. For ease of operation, functionally related controls are grouped into three blocks on the color coded front panel. Now here's the clincher: For what you'd expect to pay more, you actually pay less. Check our scopes before you decide. All scopes complete with probes.

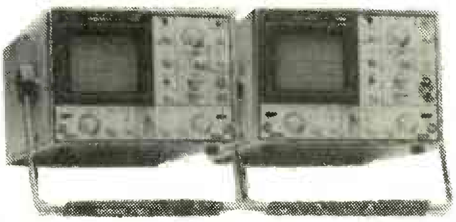
HITV302B List $995.00
Our Price: $859.00



- TV sync-separator circuit
- High-sensitivity 1mV/div (5MHz)
- Sweep-time magnifier (10 times)
- Z-axis input (intensity modulation)
- Signal delay line
- Complete with 2 probes
- CH1, CH2, DUAL, ADD DIFF, Vertical Deflection Modes
- X-Y operation
- Trace Rotation

30 MHz DUAL TRACE OSCILLOSCOPE

Hitachi . . . The measure of quality.
HITV152B DUAL TRACE 15MHZ (no delay)
LIST $735.00 **OUR PRICE $629.00**



HIT-V352
35MHz DUAL TRACE WITH DELAY
LIST PRICE: $1150.00
OUR PRICE: $998.00

Economically priced dual trace oscilloscope
Square CRT with internal graticule (illuminated scale)
High-accuracy voltage axis & time axis set at ±3% (certified at 10° to 35° C)
High-sensitivity 1mV/div.
Low drift
2 Year Warranty

HIT-V202
20MHz DUAL TRACE
LIST PRICE: $850
OUR PRICE: $765

Dynamic range 8 div.
TV sync separator circuit
Built-in signal delay line (V-352)
X-Y operation
Sweep-time magnifier (10 times)
Trace rotation system
Fine adjusting, click-positioning function

50 MHz & 100 MHz DUAL TRACE WITH CALIBRATED TIME DELAY

HIT V550B	HIT V1050
50MHz with 3rd TRACE TRIGGER VIEW	100MHz with 3rd & 4th TRACE TRIGGER VIEW
LIST $1745.00	LIST $2390.00
SALE CALL	SALE CALL

The HITACHI V550B (50mHz) and V1050 (100mHz) offer all the capabilities you might expect from a lab grade oscilloscope. Capabilities such as 3rd trace trigger view, a bright 6" square CRT, and a max sweep rate of 2ns/div (V1050) 5ns/div (V550B). Also, fatures you may not expect like, sensitivity of 1mv/div (V550B) .5m/div (V1050) @ 10mHz, automatic focus correction.

OKIDATA MICROLINE PRINTERS

WITH FRICTION AND TRACTOR FEED

- BI-DIRECTIONAL - 120 CPS
- 9 x 9 Matrix (Alphanumeric)
- 6 x 9 or 12 Matrix for Graphics
- 5, 8.3, 10, 16 Characters Per Inch
- 6 or 8 Lines Per Inch
- 80 CPL @10 CPI for 82A
- 132 CPL @ 10 CPI for 83A
- Parallel and Serial I/O
- 110 Through 1200 Baud
- Self Test
- Out of Paper Switch
- Friction or Tractor Feed
- 3" to 14" Top of Form (Switch Selectable)
- 10 Different Character Sets

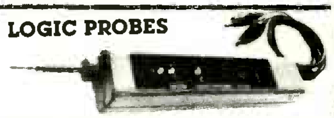
OKIDAT82AT 80 CPL @ 10 CPI **$575.00**
OKIDAT83AT 132 CPL @ 10 CPI **$775.00**

FLUKE® DMM

Nine functions:
1. dc voltage
2. ac voltage
3. dc current
4. ac current
5. resistance
6. diode test
7. conductance (1/R)
8. logic level and
9. temperature (K-type thermocouple)
10. Peak hold on voltage and current functions
11. Selectable audible indicator for continuity or level detection
12. 3½-digit resolution
13. 0.1% basic accuracy
14. LCD display
15. Overload protection
16. Safety designed test leads

FLU-D800	(Funct. 1-6)	**$125.00**
FLU-D802	(Funct. 1-7)	**$189.00**
FLU-D804	(Funct. 1-9)	**$249.00**
FLU-D810	(RMS Bench 10A)	**$269.00**
FLU-D811	(RMS Bench w/Batt.)	**$309.00**
FLU C90	(Case for D800, 802, 804)	**$10.00**
FLUY-8205	(Case for D810, 811)	**$35.00**

GLOBAL LOGIC PROBES



LP-1 LOGIC PROBE—Hand-held logic probe provides instant reading of logic levels for TTL, DTL, HTL, or CMOS. **Input Impedance:** 100,000 Ohms. **Min. Detectable Pulse:** 50 ns. **Max. Input Signal (Frequency):** 10 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stores.
GSCLP1 .... List $50.00 **OUR PRICE $45.00**

LP-2 LOGIC PROBE—Economy version of Model LP-1. Safer than a voltmeter. More accurate than a scope. **Input Impedance:** 300,000 Ohms. **Min. Detectable Pulse:** 300 ns. **Max. Input Signal (Frequency):** 1.5 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** none.
GSCLP2 .... List $32.00 **OUR PRICE $30.00**

LP-3 LOGIC PROBE-High speed logic probe. Captures pulses as short as 10 ns. **Input Impedance:** 500,000 Ohms. **Minimun Detectable Pulse:** 6 ns. **Max Input Signal (Frequency):** 60 MHz **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.
GSCLP3 .... List $77.00 **OUR PRICE $69.00**

DIGITAL PULSER
GSDCPI .... List $83.00 **OUR PRICE $76.00**

GSCLTC-1 Logical Analysis Kit—Complete with LP-1 logic Probe, DP-1 Logic Pulser, LM-1 Logic Monitor wiring accessories, manuals and molded case. **OUR PRICE $220.00**

GSCLTC-2 Logical Analysis Kit—For high-speed and memory analysis. Same as Model LTC-1, except substitutes LP-3 High-Speed Logic Probe **OUR PRICE $245.00**

The Industry Challenge: Make it smaller. Make it better Make it cost less

Non-Linear Systems has done it for three decades

MS-230. A whale of a miniscope
With our ingenious new MS-230, 30-megahertz, battery- operated dual-trace miniscope, portability's suddenly not a problem anymore. At 3 lbs 10 oz., its the smallest lightest miniscope in the field today.
The state-of-the art MS-230 works wonders on site or in the shop Anywhere there's a need to accurately test or measure electronics equipment.
The versatile MS-230 is perfect for TV repairmen Services micro-computer systems when the chips are down. Maintains avionics equipment with flying colors. And diagnosis sophisticated medical equipment with the precision of a surgeon.
However, if your budget or needs demand something more economical or less sophisticated, chances are the MS-215 dual-trace orMS-15 single-trace will fit the bill.

PART #	LIST PRICE	OUR PRICE
* **NLSMS230** 30 MHz DualTrace Miniscope	$649.00	$579.00
* **NLSMS215** 15 MHz Dual Trace Miniscope	$497.00	$439.00
* **NLSM15** 15 MHz Single Trace Miniscope	$389.00	$345.00

*Typical 3 dB point is 8 MHz at 2-division deflection. Typical maximum frequency for full scale (4div) deflection is 2 MHz.

NLS41141 Deluxe 10 to 1 100MHz probe	$30.00
NLS41140 Leather case for MS15 & MS215	$45.00
NLS41180 Leather case for MS230	$45.00

The remarkable Touch Test 20 DMM.
With theTouch Test 20, Non-Linear Systems introduces the 2 lb. 4 oz. test lab. Now with 20 keytest functions at your fingertips (plus the ability to measure 10 electrical parameters and 44 ranges). you can take one lab to the field instead of a cumbersome collection of individual testers.
Another bright idea. The Touch Test 20is the only DMM with light pressure touch function selection. No more dials to fiddle, with. Instead, an LED shows the function you choose. And when you switch, you get an audible bleep and visual blip to let you know.
This small wonder is miniaturization at its best. The new Touch Test 20 is the most innovative portable/bench-type multimeter in the industry today.
TOUCH/TEST 20 comes complete with Test Leads, Temperature Probe, and component Test Adaptor. (LED Display)

PART #	LIST PRICE	OUR PRICE
NLS TT20	$435.00	$390.00
NLS TT20B	$467.00	$420.00
LCD Display (B Models with rechargeable batteries & charger).		
NLS TT21	$495.00	$455.00
NLS TT21B	$525.00	$475.00
NLS 41140 Leather Carrying Case		$45.00

DISCOUNT COUPON

From Our December **RADIO ELECTRONICS AD**

- ☐ $100 - $149.99 .... Deduct $10.00
- ☐ $150 - $199.99 .... Deduct $15.00
- ☐ $200 - $299.99 .... Deduct $20.00
- ☐ $300 - $399.99 .... Deduct $30.00
- ☐ $400 - $499.99 .... Deduct $40.00
- ☐ $500 & UP .... Deduct $ 10%

SAVE UP TO 10%
VALID ON PREPAID U.S. MAIL ORDERS RECEIVED BEFORE DECEMBER 31, 1981
OR PRESENT THIS COUPON AT OUR RETAIL STORE BEFORE DECEMBER 31, 1981
Coupon valid only when attached to face of order.

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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.

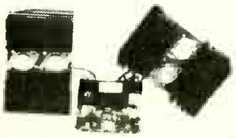
ONLY $44.50
X'former
$4.50 ea.

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-100KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: ± 40V @ 5 amp
- One channel, needs two for stereo



TA-1000KIT
$51.95
Power transformer
$24.00 each

50 WATTS AUTO STEREO BOOSTER BY VERTRONIX

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.

Model V-Amp 500
REG. PRICE $119.00 EACH
OUR SPECIAL PRICE $55.00 EACH

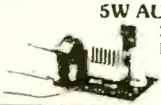
"FISHER" 30 WATT STEREO AMP

MAIN AMP (15W x 2)

Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not included). Power band with (KF 1% ± 3dB). Voltage gain 33dB. 20Hz-20KHz.

Super Buy Only $18.50

5W AUDIO AMP KIT

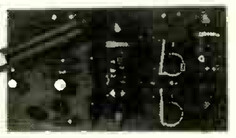


2 LM 380 with Volume Control Power Supply 6 18V DC

ONLY $6.00 EACH

2 WATT AUDIO AMP

Pre assembled units. All you need is to hook up the speaker and the volume control. Supply voltage from 9~15V D.C. measures only 2" x 3½", making it good for portable or discrete applications. Comes with hook up data.



BUY 2 FOR $4.99

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.

NEW MARK III 9 Steps 4 Colors LED VU

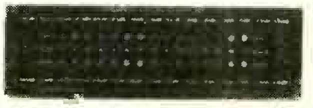
Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large from −30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V-9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output!

IN KIT FORM $18.50

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!

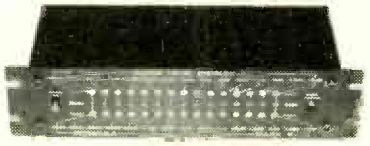
Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.



MARK IV KIT
$31.50

MARK V 15 STEPS LED POWER OUTPUT INDICATOR KIT

All functions same as Mark IV but this is with heavy duty aluminum front plate and case. Can be easily slot into the front panel of your auto, truck or boat. Operates on 12V DC.



$41.50 EACH KIT

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: G3Hz: 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

ELECTRONIC DUAL SPEAKER PROTECTOR

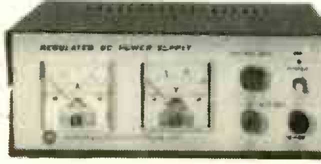
Cutt off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.

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

± 4 ~ 30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.

$12.50 PER KIT

POWER SUPPLY KIT

0-30V D.C. REGULATED

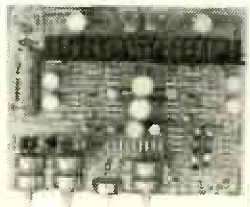
Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts. Tranformer for Power Supply. 2 AMP 24V x 2 **$9.50**

0-30 Power Supply
$10.50 each

TA-323 6 WATTS TOTAL 30W + 30W STEREO AMP KIT

★ **SPECIAL** ★

EXCELLENT PRICE!



MODEL 001-0034
Transformer (Optional)

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 VET 2.5 amp transformer. T.H.D. of less than 0.1% between 100 Hz and 10KHz at full power. (30 Watts + 30 Watts loaded by 8~).

$29.50 PER KIT
$10.50 EACH

POCKET STEREO CASSETTE PLAYER WITH STEREO HEAD PHONE

This unit is a high fidelity stereo player which will give you years of listening pleasure and follow you wherever you go. Made by the same company in Japan who use the "Big Name."

Complete set comes with 1 Stereo headphone, 3 AA size alkaline batteries, 1 leather like carrying case for player and 1 carrying case for storage of 4 cassette tapes and 1 demo tape.

MODEL SWM-33
OUR DIRECT IMPORT PRICE **$67.50**

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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 2⅝" x 1¼" x ¾". Supply voltage 15V D.C. Sound I.F. = 58.0 MHz. Video I.F. = 62.5 MHz.

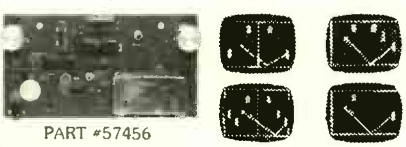
All units are brand new from Sanyo.
MODEL 115-B-405A
$35.00 EACH

Tuner is the most important part for the circuit. Don't let those $19.00 tuners fool you!

TV GAME BOARD

PLAYS 4 GAMES: TENNIS: HOCKEY: HANDBALL AND JAI-ALAI.

All boards complete with all parts ready to play. Requires 6C size batteries and a small speaker for sound effects. The boards were surplus from a famous game manufacturer. They will play on all US standard black and white or color TV sets. (Regular price for these games were $39.50 each) **OUR PRICE ONLY $6.50 EACH**



PART #57456

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

ELECTRONIC MUSICAL TELEPHONE REST KIT

This telephone rest can be used 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.

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NOW ONLY $12.94 MODEL VEQ 0143

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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

13 FUNCTIONS LCD TIME MODULE

- Displays month, date and day of the week
- Displays hour, minute and second
- AM, PM Indicator
- Alarm 1 and Alarm 2 (Independent)
- 10 Hours Stop Watch
- 12 Hours presettable count down time
- Hour Charm Indicator
- Back light by touch of the switch

MODEL 001-0062
$7.94 EACH

These modules are brand new and made by LITRONIX. Designed for a man's watch. Can be used for many applications. Comes with 2 silver batteries and the ceramic round transducer.

MATCHED PAIR POWER TRANSISTORS BY MOTOROLA

MJ2955 PNP 150 Watts 2N3055 NPN	BV=60 V	I.C.=15 A	$3.50 per pair
MJE2955 PNP 90 Watts MJE3055 NPN	BV=60 V	I.C.=10 A	$3.00 per pair
MJ15003 NPN 250 Watts MJ15004 PNP	BV=140 V	I.C.=20 A	$12.00 per pair

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MODEL MF505
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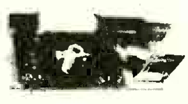
12V DC POWERED



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

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT

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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!

Model F-179

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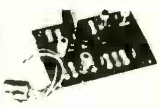
No FCC license required.
OUR PRICE $49.50
ADDITIONAL MICROPHONE (TRANSMITTER) AVAILABLE AT **$28.00** EACH

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

SUPER FM WIRELESS MIC KIT—MARK III

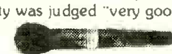


This new designed circuit uses high FEQ. FET transistors with 2 stages pre amp. Transmits FM Range (88-120 MHz) up to 2 blocks away and with the ultra sensitive condensor microphone that comes with the kit, allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, OSC coils, and P.C. Board. Power supply 9V D.C.

FMC-105 **$11.50 PER KIT**

WEM-36 FM WIRELESS MICROPHONE

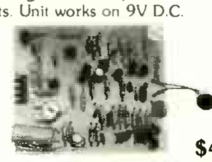
TEET MODEL WEM-36 is a factory assembled FM wireless microphone powered by two AA size batteries. Transmits in the range of 88-108 MHz with 3 transistor circuits to meet with F.C.C. part 15 regulations. Element is built in a plastic tube type case with an omni-directional electret condenser microphone 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**

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

ULTRASONIC SWITCH KIT

Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC. **$15.50**

ELECTRONIC SWITCH KIT

CONDENSER TYPE
Touch On Touch Off
uses 7473 I.C. and
12V relay

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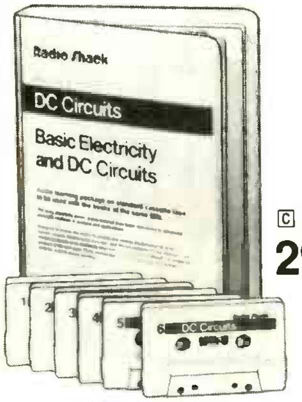
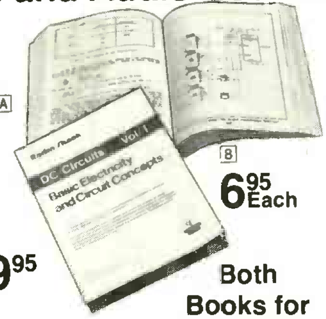
DC Circuits Books and Audio Course

[A] [B] **6.95** Each

[C] **29.95**

Both Books for **10.88**

Save $3.02

Developed for Radio Shack by Texas Instruments Learning Center

[A] **DC Circuits Volume I.** Introduction to electricity, voltage, Ohm's law, parallel circuits and more. Fully illustrated. 460 pages.
62-2019 .... 6.95

[B] **DC Circuits Volume II.** Voltage dividers, capacitors, inductors and more. Illustrated. 508 pages. **62-2020** 6.95

[C] **DC Circuits Audio Learning Package.** Six standard cassettes for use with Volumes I and II above. **62-2401** 29.95

D to A Converter

4.49 **NEW!**

16-Pin With Data

DAC801. Produces varying output voltages up to 20V p-p with 8-bit input. Works with all logic families.
276-1791 .... 4.49

A to D Converter

2.59 8-Pin With Data **NEW!**

TL507. Converts analog processes to digital signals — up to 1000 operations per second. I^2L technology.
276-1789 .... 2.59

Semiconductor Reference Guide

2.99 **NEW!**

1982 Edition. Complete data on Shack® ICs and discrete devices, plus over 82,000 substitution listings
276-4005 .... 2.99

V to F, F to V IC

14-Pin With Data

NEW!

Ideal for Modems And Tone Decoders **3.49**

9400. Converts input voltage to proportional frequency or vice versa. Linearity: 0.05%. Works up to 100 kHz. Single or dual supply.
276-1790 .... 3.49

SPST Switch With LED Indicator

Rated 5 Amps! **2.99**

- *LED in Handle Glows When "On"*
- *Ideal for Use In Vehicles*

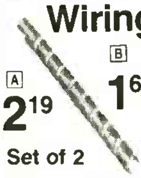
Heavy-duty toggle requires a 7/16" mounting hole. 12VDC use only.
275-680 .... 2.99

Magnet Wire

Set of 3 Spools **4.49**

Ideal for coils and chokes. 40 ft. of 22-gauge, 75 ft. of 26-ga., 200 ft. of 30-ga.
278-1345 .... 3-Spool Set/4.49

Wiring Aids



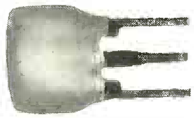

[A] **2.19** Set of 2

[B] **1.69** Set of 10

[A] **Spiral Wrap.** Neatly bundles wiring. 5 ft. clear, 5 ft. black.
278-1638 .... Set, 2.19

[B] **Universal Cable Clip.** Accepts wire up to 1/2" dia. Self adhesive.
278-1639 .... Set of 10, 1.69

10.7 MHz IF Filter



NEW! **1.99** Pkg. of 2

Full-Spec Device!

SFE10.7MA5-A. For updating FM IFs, CB to 10-meter FM conversions, more. In/out Z: 330 ohms. Bandwidth: 280 KHz at 3 dB down points.
272-1301 .... Pkg. 2/1.99

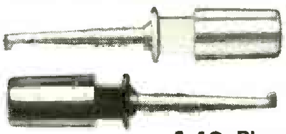
100k-Ω Joystick

For Video Games, RC Vehicles and Microcomputers

4.95

Two linear taper controls with one removable 1"-long shaft.
271-1705 .... 4.95

Micro Test Clips

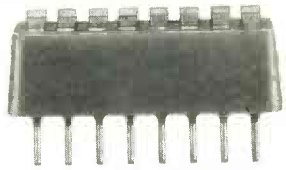


NEW! **1.49** Pkg. of 2

Spring-action, 1½"-long. Ideal for testing on high-density boards. One red, one black.
270-370 .... Set, 1.49

SPST DIP Switch

Fits 16-Pin DIP Socket **1.99**



8-Position. For digital or low-current uses. **275-1301** 1.99

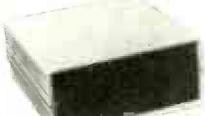
Mini 12VDC Buzzer

With Leads

1.69

Small enough to hide, loud enough to get attention! 1 1/16" mtg. centers. **273-055** 1.69

"Designer" Box



NEW!

Slots Inside for Two 4¾x2" PC Boards **7.95**

Modern two-tone styling, easy-to-work end panels. 2¼x5x5¼".
270-218 .... 7.95

Direct-Etch Transfers

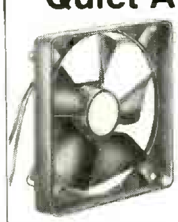
2.49 Set

NEW!

With Instructions

Just rub circles, strips, and pads onto PC board and you're ready to etch! Set of four sheets.
276-1577 .... Set, 2.49

Quiet AC Fan



15.95

- *Diecast Venturi*
- *Delivers Up To 70 CFM*

Ideal for power supplies, computers, Ham rigs. 4⅔x4⅔x1/2".
273-241 .... 15.95

Tri-Color LED

1.39

Ideal Status Indicator!

Glows red on DC, green on reverse DC, yellow on AC! T-1 ¾ size. 2.2V at 25 milliamps.
276-035 .... 1.39

Retail prices may vary at individual stores and dealers

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V-1000 Vista "V-DRIVE"

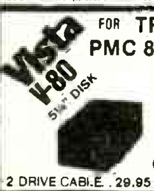
Qume DATATRAK 8

THE LAST WORD IN 8" FLOPPY-DISK ENCLOSURES

THE VISTA V-1000 FLOPPY DISK DRIVE SUBSYSTEM ● Deluxe chassis with internal slide easy access for drive positioning and mounting ● Built to mechanically and electrically accomodate single sided drives—including the most popular 8-inch Winchester and Shugart floppy disk drives, and 8-inch streaming tape units ● Storage capacity from 0.5 to 40 megabytes ● Industrial quality cabinet with die cast front bezel ● Meets all UL and OSHA standards ● Additional Savings! Front and rear retma rail mounts provided at no extra charge (no external slides) ● Desk or rack mountable ● Features modular construction with removeable sub-assembly that allows easy cabinet positioning and mounting ● Drives pull out for easy service and maintenance.

DISCOUNT PRICES

CABINET	$ 395
CABINET with (2) single sided drives (including power supply & cable)	$1495
CABINET with (2) double sided drives (including power supply & cable)	$1995



Vista V-80 5¼" DISK

FOR TRS 80® MODEL I, PMC 80, ZENITH H89, S-100, etc.

ONLY 310⁰⁰ ea.

MODEL V-801, 80 TRACKS, SS

ONLY 425⁰⁰ ea.

2 DRIVE CABLE.. 29.95 4 DRIVE CABLE.. 39.95

MOSTEK MK4015 4K Dynamic RAM

Refresh while supply lasts only .49¢

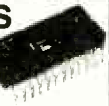
Pin equivalent to MK4027 except has 1 ms.

S-100 WW

$2.99 each

FIRST QUALITY AT SURPLUS PRICE

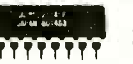
2708 EPROMS



PRIME-450 Ns.

8 for $29.95

4K STATIC RAM SELL-OFF



Zilog 6104-4

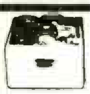
Same as TMS 4044 but designed specifically for Z-80 based systems. This is full-spec 4K x 1 RAM, 450 Ns.

While supply lasts $1.49 each.

SPECIAL PURCHASE

$59.95 Limited Supply $59.95

16K Altair RAM Boards. Fully Populated as is.



FLOPPY DISK DRIVES

OUME' Datatrack 8
- Double Sided
- Double Density

ACP LOW PRICE $569.95

Tandom TM100-1 5¼" Disk Drive	249.95
MPI B51-5¼", 40 tracks	239.95
Shugart SA400-5¼" 35 tracks	295.00
Shugart 800/801R 8"	449.00
Siemens Shugart Compatible Model FDD-120-8D	429.00
PERSCI Model 277 Dual	1195.00
MPI B52 5¼" Dual	348.00
WANGO/SIEMENS 82	290.00
MPI 91 Double Track Density Single Side, 80 Tracks	375.00
MPI 92 Double Track Density Double Side, 160 Track	475.00

6800 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Arith Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod.	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

$24.95 TRS-80/APPLE $24.95

MEMORY EXPANSION KITS.

4116's, 16K (200/250 ns.)

16K 8 pcs for $24.95 Specify Computer **RAM**

Call For Volume Pricing

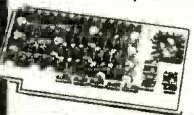
CENTRONICS PRINTER

Model 737
- Centronics complete printer
- The 737 has everything. Check and compare the features.
- New low price **$835.00**

32K STATIC RAM BOARD

2 or 4 MHz Expandable uses 2114L's

S-100



16K 4 MHz Kit	159.95
16K 4 MHz A&T	217.95
32K MHz Kit	289.95
32K 4 MHz A&T	339.00
Bare Board	39.95
Bare Bd. w/all parts less mem	99.95

NEW! from Zilog

Z-8 CPU comes with Tiny Basic & debug program on the I.C.

$69.95 w/data

BIPOLAR CPU SALE

Signetics 8 x 300 8 bit CPU

While stock lasts 14.95 ea.

UV "Eprom" Eraser

Model UVs-11E $69.95

Holds 4 Eproms at a time

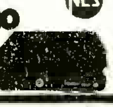
Backed by 45 years experience

Model S-52T... $325.00

Professional Industrial Model

NON-LINEAR SYSTEMS, INC. NLS

TOUCH-TEST 20



DIGITAL MULTIMETER **$319⁹⁵**

BECKMAN DIGITAL MULTIMETERS

AS LOW AS 100⁰⁰

TECH 300 Digital Multimeter	$110
TECH 310 Digital Multimeter	$140
TECH 330 Digital Multimeter	$189
VC-201 Vinyl Carrying Case	$10
DC-202 Deluxe Carrying Case	$24
HV-211 High Voltage Probe	$35
RP-221 RF Probe	$35
Ct-231 AC Current Clamp	$42
DL-241 Delxue Test Lead Kit	$10
TL-242 Square Test Leads	$6

INTERSYSTEMS

The Preferred S-100 Box

The new Series II CPU Board features a 4 MHz Z-80A CPU and full-feature front panel. 20-slot actively terminated mother-board, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan).

DPS-1, List **$1795**

ACP Price **$1499**

SYSTEM 2A

with Z-80A CPU 4 MHz, 64K RAM, I/O Board, 20 slots, front panel, double density disk controller board. Full 1-year warranty.

List $3795 ACP Price **$2995**

NEC PC-8000 Series Microcomputer System.

NEW INTRO PRICING $1099.00

- Z-80A CPU 4 MHz
- 5 user programmable function keys
- 82 Keys with numeric keypad
- 160x100 resolution
- 80 character screen

PC-8001A Microcomputer w/32KRAM	$1295.00	1099.00
PC-8012A I/O Unit w/32K RAM, Expansion slots	795.00	699.00
PC-8031A Dual Mini-Disk Drive Unit	1295.00	1099.00
PC-8032A Add-On Dual Mini-Disk Drive Unit	1095.00	949.00
PC-8023A Impact Matrix Printer, Tractor/Friction Feed	860.00	769.00
PC 8094A Cable for PC 8023A Printer	49.95	44.95
JB-1201M(A) High Resolution Green Monitor	265.00	239.00
JC-1202DH(A) High Resolution Color Monitor w/RGB Input	1195.00	1049.00
PC-8091A RGB Cable for JC-1202DH(A) Color Monitor	19.95	17.95
Basic Language Learning Guide		19.95
PC 8001A Microcomputer Reference Manual		19.95
PC 8012A I/O Unit User's Manual		14.95
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Z8001 16 bit to 8Mb	$189.00
Z8002 16 bit to 64K	149.00
Z80	9.95
Z80A	13.95
F-8 (3850)	16.95
2650	16.95
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6800	11.75
6800B 2.0 MHz	19.95
6802P	17.95
8035	14.95
8039	19.95
INS 8073N	24.95
8755	49.95
8748	69.95
6809	37.95
8086	69.95

ADVANCED SUPPORT

AM9511 Arith. Processor	175.00
9512 Arith Processor	175.00
9513 Univ. Timing	79.95
AM9517 DMA Controller	18.95
AM9519 Universal Interrupt	18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	38.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHZ	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

8155/8156 I/O	24.95
8755 I/O with Eprom	64.95
8202 Dyn. Ram Cont.	34.95
8205/74S 138 Decoder	3.95
8212 8 bit I/o	2.75
8214 Priority Int.	5.25
8216 Bus Driver	2.75
8224 Clock Gen.	2.95
8224-4 (4MHz)	9.75
8226 Bus Driver	2.95
8T26 Bus Driver	2.95
8228 Sys. Control	4.50
8238 Sys. Cont.	5.50
8243 I/O Exp.	9.50
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8251 Prog. I/O	8.95
8253 Int. Timer	12.95
8255 Prog. I/O	8.50
8257 Prog. DMA	16.95
8259 Prog. Int.	15.95
8275 CRT Controller	45.95
8279 Prog. Keyboard	15.95

6800 SUPPORT CHIPS

6810 128 x 8 Ram	4.75
6820	6.50
6821	6.50
6828 Priority Int.	10.75
6834-1 512 x 8 Eprom	16.95
6845/HD46505 CRT Cont.	29.95
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6850 ACIA	5.95
6852 Serial Adapter	5.95
6860 Modem	10.95
6862 Modulator	11.95
6871A 1.0MHz OSC	25.95
6875	6.95
6880 Bus Driver	2.19
MC68488	19.95
68047	24.95

6502 SUPPORT CHIPS

6520 PIA	7.50
6522 Mult	11.95
6530-002,003 004,005	21.95
6532	19.95
6551	19.95

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We do Custom Programming

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82S123/5610/74S288 (32x8)TS	4.25
82S126/5603/74S387 (256x4)OC	4.25
82S129/5623/74S287 (256x4)TS	4.25
82S130/5604/74S570 (512x4)OC	6.50
82S131/74S571 (512x4)TS	6.95
82S137/74S573 (1024x4)TS	12.95
82S141/3624/74S474 (512x8)TS	12.95
82S147/74S472 (512x8)TS	12.95
74S471/6309 (256x8)TS	7.95

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2764 (8Kx8)TS	89.95
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2716/2516 5V (2Kx8)TS	8.95
TMS2716, ± 5V, 12V	17.95
2758 5V, (450NS)	7.50
2708 (450Ns)	5.75
2708 (650Ns)	5.25
1702A	5.75
MM5203AQ	14.50
MM5204Q	9.95

CHARACTER GEN.

2513-001 (5V) Upper	9.50
2513-005 (5V) Lower	10.95
2513-ADM3 (5V) Lower	14.95
MCM66710 Ascii Shifted	12.95
MCM66740 Math Symbol	13.45
MCM66750 Alpha Control	13.45

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TR1602B (5V, 12V)	3.95
AY51013 (5V, 12V)	4.95
AY51014A/1612 (5-14V)	6.95
AY51015A/1863 (5V)	6.95
IM6402	7.95
IM6403	8.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	9.95
MC14411	11.95
4702	14.95
WD1941	9.95
COM 5016	16.95
INS 8250	15.95

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75

STATIC RAMS

SALE 2102 .89

	1-24	25-99	100
21L02 450ns	1.30	1.25	.99
21L02 250ns	1.59	1.55	1.15
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114N (450 NS.)	3.75	3.50	3.25
2114L-250ns (4045)	6.50	5.95	5.50
2114L-450ns. (4045)	4.75	4.25	3.95
4044 250 ns	8.95	7.50	6.90
4044 450ns	5.95	5.95	4.75
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125/93425 (45ns.)	9.95	8.35	8.25
6518 1K x 1 CMOS	7.95	7.95	7.25
2147 Low Power 4K Static	9.95	8.95	6.95
93415	9.95	8.95	8.50

DYNAMIC RAMS

416/4116 16K (16 Pin)	2.49
Set of 8 416's 200 Ns.	24.95
4115 8K (16 Pin)	2.49
4050 4K x 1 (18 Pin)	4.95
4060 4K x 1 (22 Pin)	4.95
4096 4K x 1 (16 Pin)	3.95
2104 4K x 1 (16 Pin)	4.75
4027 4K x 1 (16 Pin)/UPD 414	4.95

5261	1.95	1103	.95
5262	1.95	4008L	4.95
5270	4.95	6605	7.95
5280	4.95	6604	4.95
		6002	1.50

64K RAMS $19.95

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Wire Wrap 3 Level Gold
8	15	32	45
14	19	36	59
16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	1.10
24	38	85	1.20
28	43	1.10	1.49
36	58	1.25	1.69
40	60	1.40	1.89

ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

LED READOUTS

Part No	Size	Color	Description	Price
DL704	300	Red	Comm. Cathode	99
DL707	300	Red	Comm. Anode	99
FND357	357	Red	Comm. Cathode	99
FND501	500	Red	Comm. Cathode (+1)	99
FND503 (500)	500	Red	Comm. Cathode	99
FND507 (510)	500	Red	Comm. Anode	99
FND508	500	Red	Comm. Anode (+1)	99
FND530	500	Green	Comm. Cathode	1.49
FND550	500	Orange	Comm. Cathode	1.49
FND803 (800)	800	Red	Comm. Cathode	1.75
FND807 (810)	800	Red	Comm. Anode	1.75
HP5082-7340	600	Red	4 x 7 Hexidecimal	25.95
HP5082-7300	600	Red	4 x 7 Sgl. Digit RHD	18.95
HP5082-7731	300	Red	Comm. Anode	75
TIL305		Red	Array 5 x 7	7.95
TIL308	270	Red	Numerical Display	10.95
TIL309	270	Red	Numerical Display	9.95
TIL311	270	Red	4 x 7 Hexidecimal	10.95
MAN2A	320	Red	Array	5.95
MAN10A	270	Red	Alpha Numeric	8.95
XAN3061	300	Red	Comm. Anode Right DP	1.25
XAN3062	300	Red	Comm. Anode Left DP	1.25
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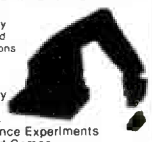

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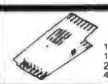

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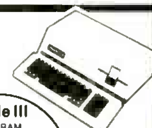

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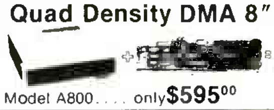

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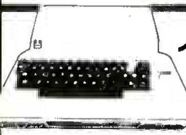

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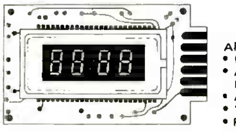

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Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto. display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

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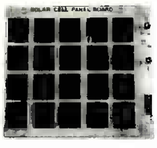

Features:
- Output: 10VDC, to 100mA In Series; 5VDC, to 200mA In Parallel
- Panel may be easily connected for Series or Parallel out
- Over 11 square inches of active cell surface
- Voltage line tap @ 0.5V increments
- Provision for charging batteries
- Overall panel size: 4¾"L x 4½"H x ⅛"D

The JE305 Solar Cell Panel Kit contains 20 each solar cells. On the panel board are power line taps which allow the user to select voltages (one voltage at a time) from 0.5VDC to 10VDC. The applications of each panel can be further expanded by coupling additional panels in series for more voltage or in parallel for more current. The premium grade solar cells provide the current necessary for the operation of most portable transistor radios, small battery powered cassette tape players and unlimited experimental solar projects.

JE305 . . . . $39.95

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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.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11EL Replacement Bulb $16.95

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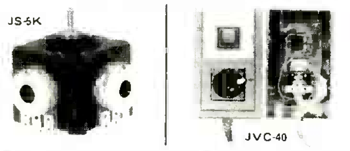

JS-5K	5K Linear Taper Pots	$5.25
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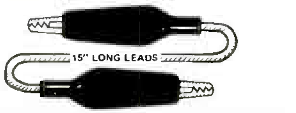
JVC-40	40K (2) Video Controller in case	$4.95

ALLIGATOR CLIP TEST LEADS



Heavy-duty leads, color coded. Insulated alligator clip on each end. 15" long. Two each black, red, blue, white and yellow.

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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:
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- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
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JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)

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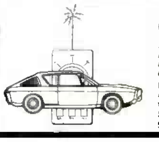

Ideal to use for: Toys, hobby crafts, robots, trains, burglar alarms, IR data link, remote slide projector control, consumer remote data links, energy-saving remotely switched lighting systems

LM1871N R.C. Encoder/Transmitter Chip $5.49
A complete 6-channel dig. encoder and R.F. transmitter, low power, all freq. of 27MHz or 49MHz, a field strength of 10,000uV meter at 3 meters. 9V operation on chip RF oscillator/transmitter, on chip 4.6V reg. Up to 80MHz carrier freq. operation

LM1872N R.C. Receiver/Decoder Chip $5.49
A complete R.F. receiver/decoder, used at either 27, 49 or 72MHz. It provides 4 independent channels when used w/LM1872 (2 analog, 2 dig.) operates from 4-1.5V cells. Crystal controlled

SRX1504 49.435MHz Crystal (LM1872N) $4.95
SRX1505 49.890MHz Crystal (LM1871N) $4.95

JE608 PROGRAMMER
2704/2708 EPROM PROGRAMMER

GENERAL APPLICATIONS:
- To program EPROMS 2704 and 2708.
- Developmental system for microcomputer circuits
- To read the contents of a pre-programmed EPROM
- To compare EPROM(s) for content differences
- To emulate a programmed EPROM
- To store program in RAMS for alterations
- Three separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2^0-2^9) for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip. Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board. Rapid checking verification of programmed data changes. User may move data from a master to RAM's or write into RAM's with keyboard entries. Allows manual stepping manipulation (up and down) at any address location. Stand-alone EPROM Programmer consisting of: A 19-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W. Compact desk-top enclosure: Color-coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¼"H x 11"W x 8¾"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board w/25 IC's & Includes power supplies of: -5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel board are separate assemblies within the system.

JE608K Kit $399.95
JE608A Assembled and Tested $499.95

JE608-16K ADAPTER BOARD
FOR 2716/2758 EPROMS

GENERAL DESCRIPTION:
The JE608-16K Adapter Board allows the JE608 Programmer to be modified for the additional programming of the 2716 and 2758 EPROMS. The adapter provides for adding an address switch for the 2^{11} bit and also for selecting the proper power and timing pulses to be applied to the EPROM. Programming and emulating the 2716 (16K) EPROM is done separately to each half (1024x8) of the EPROM because of the existing 8K RAM capacity in the JE608 Programmer.

JE608-16K	Adapter Board Kit	$29.95
JE608-Upgrade	(Send assembled JE608 to factory for adapter installation of the JE608-16K Adapter Board Kit)	$99.95
JE608A-16K Mod.	Assembled JE608 w/Adapter (JE608-16K) Installed	$599.95

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30001	National CMOS Data Book (640 pages) 74C, CD4000, and A/D Converters	$6.95
30002	National Interface Data Book (704 pages) DP, DS8000, DS3600, DS75000, etc.	$6.95
30003	National Linear Data Book (1376 pages) LM, LF, ADC, DAC, LH Series	$8.95
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	$8.95
30006	Buy above (3) 30001,3,5 as a set	$19.95/lot
30009	Intersil Data Book (1074 pages)	$6.95
010400	Intel Component Data Catalog — Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1328 pages)	$10.00
205610	Intel Peripheral Design Handbook — Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$7.50

AC and DC Wall Transformers

Ideal for use with clocks, games, power supplies or any other type of AC or DC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95
AC1000	117V/60Hz	12 VAC 1 amp	$5.95
AC1700	117V/60Hz	9 VAC 1.7 amp	$3.95
DV 9200	117V/60Hz	9 VDC 200mA	$3.25
DC 900	120V/60Hz	9 VDC 500mA	$3.95

CONNECTORS

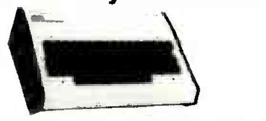
DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
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. Rams (*NS)
★ Documentation for Conversion

TRS-16K2	*150NS	$29.95
TRS-16K3	*200NS	$24.95
TRS-16K4	*250NS	$19.95

JE610 ASCII Encoded Keyboard Kit



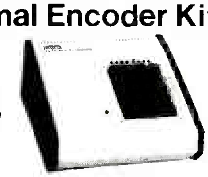
The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 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 — 3¼"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 8¼"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"Hx8¼"Wx8¾"D) **$44.95**

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74LS42	.89	74LS158	.89	74LS298	1.25
74LS47	.89	74LS160	1.15	74LS352	1.29
74LS48	1.15	74LS161	1.15	74LS353	1.29
74LS49	1.15	74LS162	1.15	74LS365	.69
74LS51	.35	74LS163	1.15	74LS366	.69
74LS54	.35	74LS164	1.15	74LS367	.69
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74S02	.45			74S244	3.25
74S03	.45	74S124	3.95	74S251	1.45
74S04	.55	74S133	.55	74S253	1.45
74S05	.55	74S134	.69	74S257	1.35
74S08	.50	74S135	1.19	74S258	1.35
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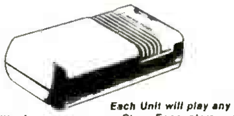
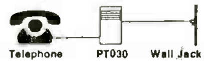
As Seen on "Good Morning America"

Replaces the Telephone Ringer Bell with a Selection of 30 Familiar Tunes





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- Colonel Bogey
- Westminister Chimes
- Mexican Hat Dance
- Twinkle, Twinkle Little Star
- Deutschlandlied
- God Save the Queen
- Close Encounters
- Happy Birthday
- Wedding March
- Jingle Bells
- Auld Lang Syne
- Soldiers Chorus
- Sailor's Hornpipe
- Charge!
- Greensleeves
- Loreiei
- Eyes of Texas
- Star Spangled Banner
- Oranges and Lemons
- Wilhelmus
- Mozart Sonata
- Pomp & Circumstance
- William Tell Overture
- Bach Toccata In D Minor
- Shave and a Haircut
- Blue Danube Waltz
- Beethoven's 5th
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FEATURES

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PT030 Phone Tunes **$49.95**
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XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1
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D.D. — Double Digit
C.C. — Common Cathode
RHD — Right Hand Decimal

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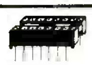
MAN 2	5x7 D.M.—red	.300	4.95	DL704	C.C.—red	.300	1.25
MAN 3	C.C.—red	.125	.25	DL707	C.A.—red	.300	1.25
MAN 52	C.A.—green	.300	.99	DL728	C.C.—red	.500	1.49
MAN 54	C.C.—green	.300	.99	DL741	C.A.—red	.600	1.25
MAN 71	C.A.—red	.300	.75	DL747	C.A.—red	.600	1.49
MAN 72	C.A.—red	.300	.75	DL750	C.C.—red	.600	1.49
MAN 74	C.C.—red	.300	1.25	DLO847	C.A.—orange	.800	1.49
MAN 82	C.A.—yellow	.300	.49	DLO850	C.C.—orange	.800	1.49
MAN 84	C.C.—yellow	.300	.99	DL33B	C.C.—red	.110	.35
MAN 3620	C.A.—orange	.300	.49	FND358	C.C. ± 1	.357	.99
MAN 3630	C.A.—orange ± 1	.300	.99	FND357	C.C.	.357	.75
MAN 3640	C.C.—orange	.300	.99	FND500	C.C. (FND503)	.500	.99
MAN 4610	C.A.—orange	.400	.99	FND507	C.A. (FND510)	.500	.99
MAN 6610	C.A.—orange—DD	.560	.99	HDSP-3401	C.A.—red	.800	1.50
MAN 6630	C.A.—orange ± 1	.560	.99	HDSP-3403	C.C.—red	.800	1.50
MAN 6640	C.C.—orange—DD	.560	.99	HDSP-3406	C.C. red ±1	.800	1.50
MAN 6650	C.C.—orange ± 1	.560	.99	5082-7751	C.A., R.H.D.—red	.430	1.25
MAN 6660	C.A.—orange	.560	.99	5082-7760	C.C., R.H.D.—red	.430	1.25
MAN 6710	C.A.—red—DD	.560	.99	5082-7300	4x7 Numeric (RHD)	.600	22.00
MAN 6740	C.C.—red—DD	.560	.99	5082-7302	4x7 Numeric (LHD)	.600	22.00
MAN 6750	C.C.—red ± 1	.560	.99	5082-7340	4x7 Hxdcl. (0-9/A-F)	.600	22.50
DLO304	C.C.—orange	.300	1.25	4N28	Photo Xsistor Opto-Isol.		.69
DLO307	C.A.—orange	.300	1.25	LIT-1	Photo Xsistor Opto-Isol.		.69
DLG500	C.C.—green	.500	1.25	MOC3010	Optically Isol. Triac Driver		1.25

COMPUTER GRADE CAPACITORS

MFD	WVDC	PRICE	MFD	WVDC	PRICE	MFD	WVDC	PRICE
250	150	1.95	10,000	15	2.95	24,000	20	2.95
500	200	2.49	10,000	16	3.95	27,000	10	2.95
1,250	3	.99	11,000	19	4.95	32,500	25	4.95
1,500	25	1.95	11,000	55	5.49	40,000	25	5.95
1,500	50	2.95	11,000	60	5.95	43,000	10	5.95
2,000	10	2.95	13,000	16	2.95	50,000	20	7.95
2,250	100	3.95	14,000	13	2.95	52,000	20	5.95
2,300	33	2.95	14,000	35	3.95	55,000	15	5.95
2,500	15	2.95	18,000	10	3.95	58,000	20	5.95
3,000	25	1.95	20,000	20	2.95	65,000	10	7.95
3,600	40	3.95	20,000	55	3.95	73,800	5	7.95
4,500	50	3.95	21,000	15	3.95	80,000	15	9.95
5,500	25	4.49	23,000	7	1.95	90,000	10	8.95
6,100	40	2.49	23,000	10	2.95	160,000	10	8.95
6,600	50	4.95	23,000	20	3.95			

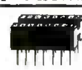
OVER 200 OTHER VALUES AVAILABLE — CALL OR WRITE FOR YOUR REQUIREMENT

LOW PROFILE (TIN) SOCKETS



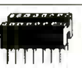
	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)



	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD



	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS –5%

ASST. 1	5 ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50 pcs.	$1.95
ASST. 2	5 ea.	68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm	50 pcs.	$1.95
ASST. 3	5 ea.	470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K 1.2K 1.5K 1.8K 2.2K 2.7K	50 pcs.	$1.95
ASST. 4	5 ea.	3.3K 3.9K 4.7K 5.6K 6.8K 8.2K 10K 12K 15K 18K	50 pcs.	$1.95
ASST. 5	5 ea.	22K 27K 33K 39K 47K 56K 68K 82K 100K 120K	50 pcs.	$1.95
ASST. 6	5 ea.	150K 180K 220K 270K 330K 390K 470K 560K 680K 820K	50 pcs.	$1.95
ASST. 7	5 ea.	1M 1.2M 1.5M 1.8M 2.2M 2.7M 3.3M 3.9M 4.7M 5.6M	50 pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

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Part No.	Function	Price
70451PI	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	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
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			74C221	1.95
74C02	.39	74C95	1.59	74C240	2.25
74C04	.39	74C107	1.89	74C244	2.25
74C08	.39	74C151	2.95	74C373	2.49
74C10	.39	74C154	3.95	74C374	2.59
74C14	.75	74C157	2.25	74C901	.69
74C20	.39	74C160	1.69	74C903	.69
74C30	.39	74C161	1.60	74C911	10.95
74C42	1.39	74C162	1.49	74C912	10.95
74C48	1.95	74C163	1.69	74C915	1.69
74C73	.79	74C164	1.59	74C917	10.95
74C74	.79	74C173	1.39	74C922	5.49
74C85	1.95	74C174	1.39	74C923	5.75
74C86	.99	74C175	1.19	74C925	7.50
74C89	6.95	74C192	1.69	74C926	7.50
74C90	1.29	74C193	1.69	80C95	.79
74C93	1.29	74C195	1.59	80C97	.79

LINEAR

LH0002CN	6.85			LM702H	.79
LM10CLH	4.50			LM703CN	.89
LM11CLH	4.75	LM340T-5	1.25	LM709N	.29
LH0070-OH	4.95	LM340T-12	1.25	LM710N	.79
TL071CP	.79	LM340T-15	1.25	LM711N	.79
TL072CP	1.39	LM341P-5	.75	LM723N	.69
TL074CN	2.49	LM341P-12	.75	LM733N	1.00
LH0082CD	35.80	LM341P-15	.75	LM739N	1.19
TL082CP	1.19	LM342P-5	.69	LM741CN	.35
TL084CN	2.19	LM342P-12	.69	MC1741SCG	3.00
LH0094CD	36.80	LM342P-15	.69	LM747N	.79
LM300H	.99	LM348N	1.25	LM748N	.59
LM301CN	.35	LM350K	5.75	LM1014N	2.75
LM302H	1.95	LF351N	.60	LM1310N	1.95
LM304H	1.95	LF353N	1.00	LM1458CN	.59
LM305H	.99	LF355N	1.10	LM1488N	1.25
LM307CN	.45	LF356N	1.10	LM1489N	1.25
LM308CN	1.00	LM358N	1.00	LM1496N	1.95
LM309H	1.95	LM359N	1.79	LM1556V	1.75
LM309K	1.25	LM370N	4.49	LM1800N	2.95
LM310CN	1.75	LM373N	3.25	LM1871N	5.49
LM311/CN	.90	LM377N	2.95	LM1872N	5.49
LM312H	2.49	LM380N	1.25	LM1877N-9	3.25
LM317MP	1.15	LM381N	1.95	LM1889N	3.20
LM317T	1.75	LM382N	1.79	LM1896N	1.75
LM317K	3.95	LM384N	1.95	LM2002T	1.49
LM318CN	1.95	LM386N-3	1.29	LM2877P	2.05
LM319N	1.95	LM387N	1.45	LM2878P	2.25
LM320K-5	1.35	LM389N	1.35	LM2896P-1	2.25
LM320K-12	1.35	LM392N	.69	LM3189N	2.95
LM320K-15	1.35	LF398N	4.00	LM3900N	.69
LM320T-5	1.25	LM399H	5.00	LM3905CN	1.25
LM320T-12	1.25	TL494CN	4.49	LM3909N	1.15
LM320T-15	1.25	TL496CP	1.75	LM3914N	3.95
LM323K	5.95	NE510A	6.00	LM3915N	3.95
LM324N	.99	NE529A	4.95	LM3916N	3.95
LM329DZ	.65	NE531H	3.95	RC4136N	1.25
LM331N	3.95	NE536H	6.00	RC4151NB	3.95
LM334Z	1.30	NE540H	6.00	RC4194TK	6.95
LM335Z	1.40	NE544N	4.95	RC4195TK	5.49
LM336Z	1.75	NE550A	1.30	LM4500A	3.25
LM337T	1.95	NE555V	.39	ICL8038B	4.95
LM337MP	1.15	LM556N	.99	LM13080N	1.29
LM338K	6.95	NE564N	3.95	LM13600N	1.49
LM339N	.99	LM565N	1.25	75138N	1.95
LM340K-5	1.35	LM566CN	1.95	75450N	.89
LM340K-12	1.35	LM567V	1.25	75451CN	.39
LM340K-15	1.35	NE570N	4.95	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
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

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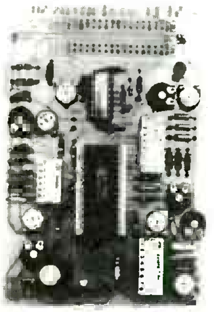
Sound Effects Kit $18.50



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 3¼" 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.

AY3-8910 PROGRAMMABLE SOUND GENERATOR

The AY3-8910 is a 40 pin LSI chip with three oscillators, three amplitude controls, programmable noise generator, three mixers, an envelope generator, and three D/A converters that are controlled by 8 BIT WORDS. No external pots or caps required. This chip hooked to an 8 bit microprocessor chip or Buss (8080, Z80, 6800 etc.) can be software controlled to produce almost any sound. It will play three note chords, make bangs, whistles, sirens, gunshots, explosions, bleets, whines, or grunts. In addition, it has provisions to control its own memory chips with two IO ports. The chip requires +5V @ 75ma and a standard TTL clock oscillator. A truly incredible circuit.

$12.95 W/Basic Spec Sheet (4 pages)
60 page manual with S-100 interface instructions and several programming examples, **$3.00 extra**

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If you have trouble sleeping and you would like the rest of the neighborhood to share your misery then this little kit will be for you! There is no way to accurately describe the unearthly howls, screams and tones that come out of this kit. Four separate tone oscillators are mixed, cancelled and stepped at a varying rate. 10 Watts of crazy sounds. A great fun kit or a practical burglar alarm. Complete with PC board and all necessary components less speaker. For 6-12 VDC. ORDER DA-02.

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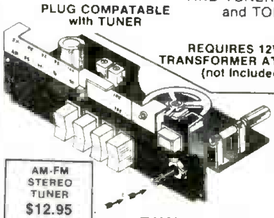
SMALL, SINGLE HYBRID IC AND COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP. LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT

Stereo AMP/Power Supply Board

Takes low level audio and drives 8 ohm speakers ON-BOARD Rectifiers and Filter supply power for AMP AND TUNER, VOLUME, BALANCE, and TONE SLIDE CONTROLS

PLUG COMPATABLE with TUNER



REQUIRES 12VAC TRANSFORMER AT 400 MA (not included)

$6.95 AMP ONLY

FEATURES: AM, FM Stereo, Phono Input, Aux Input, AC Cord, 300 Ohm Antenna Input AM Loopstick Antenna, Standard Turntable Plugs.
BUY 3 SETS (Tuner Amp combos) for **$50.00**

AM-FM STEREO TUNER **$12.95** Requires 12VDC
TUNER ONLY

- NO C.O.D.'s
- SEND CHECK M.O. OR CHARGE CARD NO.
- PHONE ORDERS ACCEPTED ON VISA AND MASTERCHARGE ONLY.
- ADD 5% FOR SHIPPING
- TX. RES. ADD 5% STATE SALES TAX
- ALL FOREIGN ORDERS ADD 30% FOR SHIPPING CHARGES.
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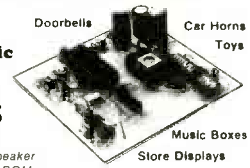
The Greatest Breakthrough In Electronic Music Ever!

The Super Music Maker
REVISION 2
$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 **$15.00** 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.
★ "Next tune" feature allows sequential playing of all songs.
★ On board inverter allows single voltage (+12) operation.

OPTIONAL ACCESSORIES

DIP Switches One 8 pos., One 5 pos. (Can be **directly soldered** to PC Bd. to access tunes)		2.00/Set
Rotary Switches Two 5 position (For **remote wiring** to PC Bd. to access tunes)		2.50/Set
Attractive	**Plastic Case**	6.50
Wallplug Transformer (For operation on 117VAC house voltage)		3.00

PMC PERSONAL COMPUTER

Ideal for small businesses, schools, colleges, homes, etc. Suitable for the experienced, inexperienced, hobbyist, teacher, etc.

EG3000 Series
WITH NEW EXTRA KEYS!

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POSTAGE $20

● 16K user RAM plus extended 12K Microsoft BASIC in ROM ● Fully TRS-80 Level II software compatible ● Huge range of software already available ● Self contained, PSU, UHF modulator, and cassette ● Simply plugs into video monitor or UHF TV ● Full expansion to disks and printer ● Absolutely complete — just fit into mains plug.

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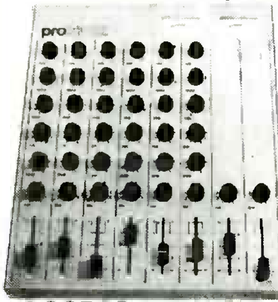

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9 DIGITS 600 MHz $129.95 WIRED

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:

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CT-70 Kit, 90 day parts warranty	84.95
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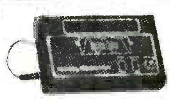
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED



PRICES:

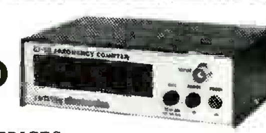
MINI-100 wired, 1 year warranty	$79.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

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:

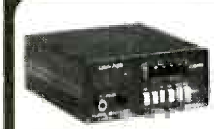
Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

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
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Accuracy:	0.1% basic DC volts
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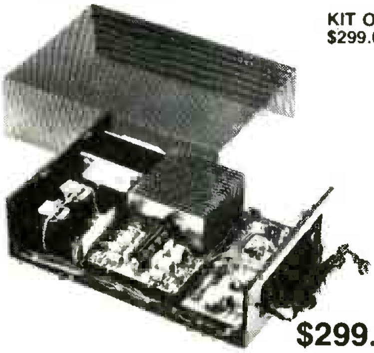

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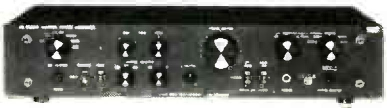

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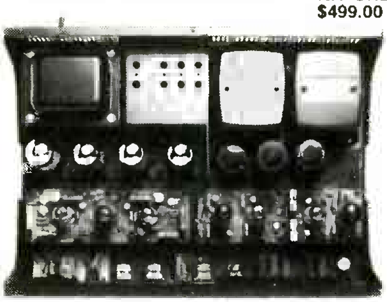

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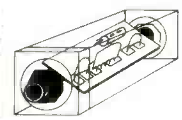

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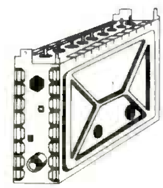

Freq. Range UHF470 - 889MHz
Antenna Input 75 ohms
Channels 14-83 Output Channel 3

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74LS00	.25	74LS164	.95
74LS01	.25	74LS165	.95
74LS02	.25	74LS166	2.40
74LS03	.25	74LS168	1.75
74LS04	.25	74LS169	1 75
74LS05	.25	74LS170	1.75
74LS08	.35	74LS173	.80
74LS09	.25	74LS174	.95
74LS10	.25	74LS175	.95
74LS11	.35	74LS181	2 15
74LS12	35	74LS189	9.95
74LS13	.45	74LS190	1.00
74LS14	1.00	74LS191	1.00
74LS15	.35	74LS192	.85
74LS20	.25	74LS193	.95
74LS21	.35	74LS194	1 00
74LS22	.25	74LS195	.95
74LS26	.35	74LS196	.85
74LS27	.35	74LS197	85
74LS28	35	74LS221	1.20
74LS30	.25	74LS240	1.85
74LS32	.35	74LS241	1.85
74LS33	.55	74LS242	1.85
74LS37	.55	74LS243	1.85
74LS38	.35	74LS244	1.75
74LS40	.25	74LS245	2.85
74LS42	.55	74LS247	.76
74LS47	.75	74LS248	1.25
74LS48	75	74LS249	.99
74LS49	75	74LS251	1.30
74LS51	.25	74LS253	.85
74LS54	.35	74LS257	.85
74LS55	.35	74LS258	.85
74LS63	1.25	74LS259	2.85
74LS73	.40	74LS260	.65
74LS74	.45	74LS266	55
74LS75	.50	74LS273	1.65
74LS76	.40	74LS275	3 35
74LS78	.50	74LS279	.55
74LS83	.75	74LS280	1.98
74LS85	1.15	74LS283	1.00
74LS86	.40	74LS290	1.25
74LS90	.65	74LS293	1.85
74LS91	.89	74LS295	1.05
74LS92	.70	74LS298	1.20
74LS93	.65	74LS324	1.75
74LS95	.85	74LS352	1.55
74LS96	.95	74LS353	1.55
74LS107	40	74LS363	1.35
74LS109	.40	74LS364	1.95
74LS112	.45	74LS365	95
74LS113	.45	74LS366	95
74LS114	.50	74LS367	.70
74LS122	.45	74LS368	.70
74LS123	.95	74LS373	1 85
74LS124	2.99	74LS374	1 80
74LS125	95	74LS377	1.45
74LS126	.85	74LS378	1.18
74LS132	.75	74LS379	1.35
74LS136	.55	74LS385	1 90
74LS137	.99	74LS386	.65
74LS138	.75	74LS390	1.90
74LS139	.75	74LS393	1.90
74LS145	1 20	74LS395	1.65
74LS147	2 49	74LS399	1.70
74LS148	1.35	74LS447	.37
74LS151	.75	74LS490	1.95
74LS153	.75	74LS668	1.69
74LS154	2.35	74LS669	1.89
74LS155	1.15	74LS670	2.20
74LS156	.95	74LS674	9.65
74LS157	.75	74LS682	3.20
74LS158	.75	74LS683	2.30
74LS160	.90	74LS684	2.40
74LS161	.95	74LS685	2.40
74LS162	.95	74LS688	2.40
74LS163	.95	74LS689	2.40

8200

8202	45.00
8205	3.50
8212	1.95
8214	3.90
8216	1.85
8224	2.50
8226	1.85
8228	4.95
8237	19.95
8238	4.95
8243	4.50
8250	14.95
8251	5.50
8253	9.85
8253-5	9.85
8255	5.25
8255-5	5.25
8257	9.00
8259	7.00
8272	39.95
8275	29.95
8279	10.50
8279-5	10.50
8282	6.65
8283	6.65
8284	5.80
8286	6.65
8287	6.65
8288	25.00
8289	49.95

6800

6800	6.95
6802	11.95
6809	37.95
6810	4.60
6820	4.95
6821	4.95
6828	9.95
6834	16 95
6840	14.95
6843	42.95
6844	44.95
6845	29.95
6847	15.95
6850	4.75
6852	5.75
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8156	11.95
8185	29.95
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8741	39.95
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Z80	8.95
Z80A	9.95
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Z80-PIO	6.50
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2716	2048 x 8	(450ns)(5v)	5.95	5.50
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TMS2716	2048 x 8	(450ns)	9.95	8.95
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2732	4096 x 8	(450ns)(5v)	16.50	15.95

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21L02-1	1024 x 1	(450ns)(LP)	1.29	1.15
2111	256 x 4	(450ns)	2.99	2.49
2112	256 x 4	(450ns)	2.99	2.79
2114	1024 x 4	(450ns)	8/17 95	2.10
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2114L-3	1024 x 4	(300ns)(LP)	8/21.95	2.45
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TMS4044-4	4096 x 1	(450ns)	3.49	3.25
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TMM2016	2048 x 8	(200ns)	CALL	
HM6116	2048 x 8	(200ns)	CALL	

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4116-200	16,384 x 1	(200ns)	8/17.50	1.95
4116-300	16,384 x 1	(300ns)	8/16.95	1.85
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LM317T	1.95	MC1330V	1 89
LM317K	3 95	MC1350V	1.29
LM318	1.49	MC1358	1.79
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LM324	.59	LM1458V	.69
LM337K	3.95	LM1488	99
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LM565	.99	LM3915	3.95
LM566V	1.49	LM3916	3.95
LM567V	1.29	75451V	.39
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T=TO-220 V=8 PIN K=TO-3

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7808T	.99	7912T	.99
7812T	.89	7915T	1.19
7815T	.99	7924T	1.19
7824T	.99		
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1 39	79L05	.79
78L05	69	79L12	.79
78L12	.69	79L15	.79
78L15	.69	LM317K	3.95
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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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		
8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80

WW = WIREWRAP

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74C04	.35	74C902	.85	4021	.95	14409	8.95
74C08	.35	74C903	.85	4022	1.15	14410	8.95
74C10	.35	74C905	10.95	4023	.35	14411	9.95
74C14	1.50	74C906	.95	4024	.75	14412	12.95
74C20	.35	74C907	1.00	4025	.35	14419	2.95
74C30	.35	74C908	2.00	4026	1.65	4502	.95
74C32	.50	74C909	2.75	4027	.65	4503	.65
74C42	1.75	74C910	9.95	4028	.80	4508	1.95
74C48	2.10	74C911	10.00	4029	.95	4510	.95
74C73	.65	74C912	10.00	4030	.45	4511	.95
74C74	.85	74C914	1.95	4034	2.95	4512	.95
74C76	.80	74C915	2.00	4035	.85	4514	1.25
74C83	1.95	74C918	2.75	4040	.95	4515	2.25
74C85	1.95	74C920	17.95	4041	1.25	4516	1.55
74C86	.95	74C921	15.95	4042	.75	4518	1.25
74C89	4.50	74C922	5.95	4043	.85	4519	1.25
74C90	1.75	74C923	5.95	4044	.85	4520	1.25
74C93	1.75	74C925	6.75	4046	.95	4522	1.25
74C95	1.75	74C926	7.95	4047	.95	4526	1.25
74C107	1.00	74C927	7.95	4049	.55	4527	1.95
74C150	5.75	74C928	7.95	4050	.55	4528	1.25
74C151	2.25	74C929	19.95	4051	.95	4531	.95
74C154	3.25	74C930	19.95	4053	.95	4532	1.95
74C157	1.75	4000	.35	4060	1.45	4538	1.95
74C160	2.00	4001	.35	4066	.75	4539	1.95
74C161	2.00	4002	.25	4068	.40	4543	2.70
74C162	2.00	4006	.95	4069	.35	4555	.95
74C163	2.00	4007	.29	4070	.35	4556	.95
74C164	2.00	4008	.95	4071	.30	4581	1.95
74C165	2.00	4009	.45	4072	.30	4582	1.95
74C173	2.00	4010	.45	4073	.30	4584	.95
74C174	2.25	4011	.35	4075	.30	4585	.95
74C175	2.25	4012	.25	4076	.95	4702	12.95
74C192	2.25	4013	.45	4078	.30	4724	1.50
74C193	2.25	4014	.95	4081	.30	80C07	.95
74C195	2.25	4015	.95	4082	.30	80C95	.85
74C200	5.75	4016	.45	4085	.95	80C96	95
74C221	2.25	4017	1.15	4086	.95	80C97	.95
74C373	2.75	4018	.95	4093	.95	80C98	1.20

74S00 SERIES

74S00	.44	74S74	.69	74S163	3.75	74S258	1.49
74S02	.48	74S85	2.39	74S168	4.65	74S260	1.83
74S03	.48	74S86	1.44	74S169	5.44	74S274	19.95
74S04	.79	74S112	1.59	74S174	1.09	74S275	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S280	2.90
74S08	.48	74S114	1.50	74S181	4.47	74S287	4.75
74S09	.98	74S124	2.77	74S182	2.95	74S288	4.45
74S10	69	74S132	1.24	74S188	3.95	74S289	6.98
74S11	.88	74S133	.98	74S189	14.95	74S301	6.95
74S15	.70	74S134	.69	74S194	2.95	74S373	3.45
74S20	.68	74S135	1.48	74S195	1.89	74S374	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S381	7.95
74S30	.48	74S139	1.25	74S197	4.25	74S387	5.75
74S32	.98	74S140	1.45	74S201	14.95	74S412	2.98
74S37	1.87	74S151	1.19	74S225	8.95	74S471	9.95
74S38	1.68	74S153	1.19	74S240	3.98	74S472	16.85
74S40	.44	74S157	1.19	74S241	3.75	74S474	17.85
74S51	.78	74S158	1.45	74S251	1.90	74S482	15.60
74S64	.79	74S161	2.85	74S253	7.45	74S570	7.80
74S65	1.25	74S162	3.70	74S257	1.39	74S571	7.80

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74S387	(82S126)	OC	256 x 4	5.75
74S471		TS	256 x 8	9.95
74S472	(82S147)	TS	512 x 8	16.85
74S474	(82S141)	TS	512 x 8	17.85
74S570	(82S130)	OC	512 x 4	7.80
74S571	(82S131)	TS	512 x 4	7.80

7400 SERIES

7400	.19	74128	.55
7401	.19	74132	.45
7402	.19	74136	.50
7403	.19	74141	.65
7404	.19	74142	2.95
7405	.22	74143	2.95
7406	.22	74144	2.95
7407	.22	74145	.60
7408	.24	74147	1.75
7409	.19	74148	1.20
7410	.19	74150	1.35
7411	.25	74151	.65
7412	.30	74152	.65
7413	.35	74153	.55
7414	.55	74154	1.40
7416	.25	74155	.75
7417	.25	74156	.65
7420	.19	74157	.55
7421	.35	74159	1.65
7422	.29	74160	.85
7423	.29	74161	.70
7425	.29	74162	.85
7426	.29	74163	.85
7427	.29	74164	.85
7428	.45	74165	.85
7430	.19	74166	1.00
7432	.29	74167	1.95
7433	.45	74170	1.65
7437	.29	74172	5.95
7438	.29	74173	.75
7440	.19	74174	.89
7442	.49	74175	.89
7443	.65	74176	.89
7444	.69	74177	.75
7445	.69	74178	1.15
7446	.59	74179	1.75
7447	.69	74180	.75
7448	.69	74181	2.25
7450	.19	74182	.75
7451	.23	74184	2 00
7453	.23	74185	2 00
7454	.23	74186	18.50
7460	.23	74190	1.15
7464	.39	74191	1.15
7465	.39	74192	.79
7470	.35	74193	.79
7472	.29	74194	.85
7473	.34	74195	.85
7474	.35	74196	.79
7475	.49	74197	.75
7476	.35	74198	1.35
7480	.59	74199	1.35
7481	1.10	74221	1.35
7482	.95	74246	1.35
7483	.50	74247	1.25
7484	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
		74490	2.55

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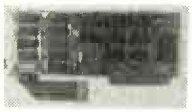

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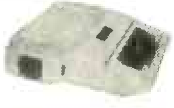

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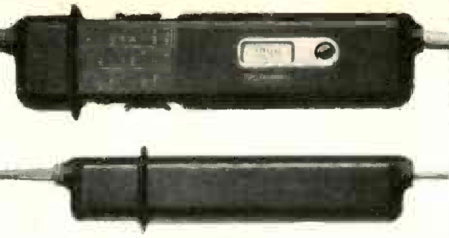

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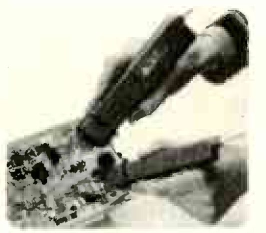
- since you can carry this meter with you at all times, thanks to its small size, without having to transport additional parts such as a lead or battery charger.



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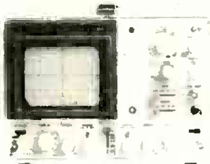

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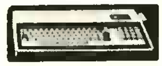

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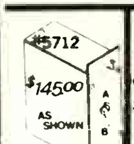

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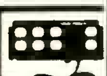

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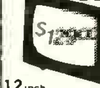

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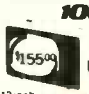

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74LS08	.29	74LS165	65
74LS09	.28	74LS169	1.55
74LS10	.26	74LS170	1.75
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74LS20	.22	74LS175	.86
74LS21	.26	74LS190	.85
74LS26	.40	74LS191	1.25
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74LS28	.37	74LS197	78
74LS30	.29	74LS221	1.25
74LS32	.31	74LS240	1.65
74LS38	.31	74LS241	1.65
74LS42	.63	74LS243	1.55
74LS48	.77	74LS244	1.56
74LS74	.38	74LS245	2.45
74LS75	.55	74LS251	1.25
74LS86	45	74LS253	.85
74LS90	.59	74LS257	.85
74LS93	.65	74LS259	1.95
74LS96	.80	74LS260	.55
74LS107	.43	74LS273	1.55
74LS113	.45	74LS279	.45
74LS122	.45	74LS290	1.25
74LS123	.89	74LS293	1.66
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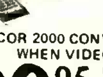

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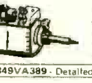

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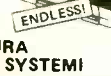

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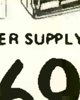

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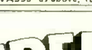

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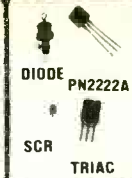

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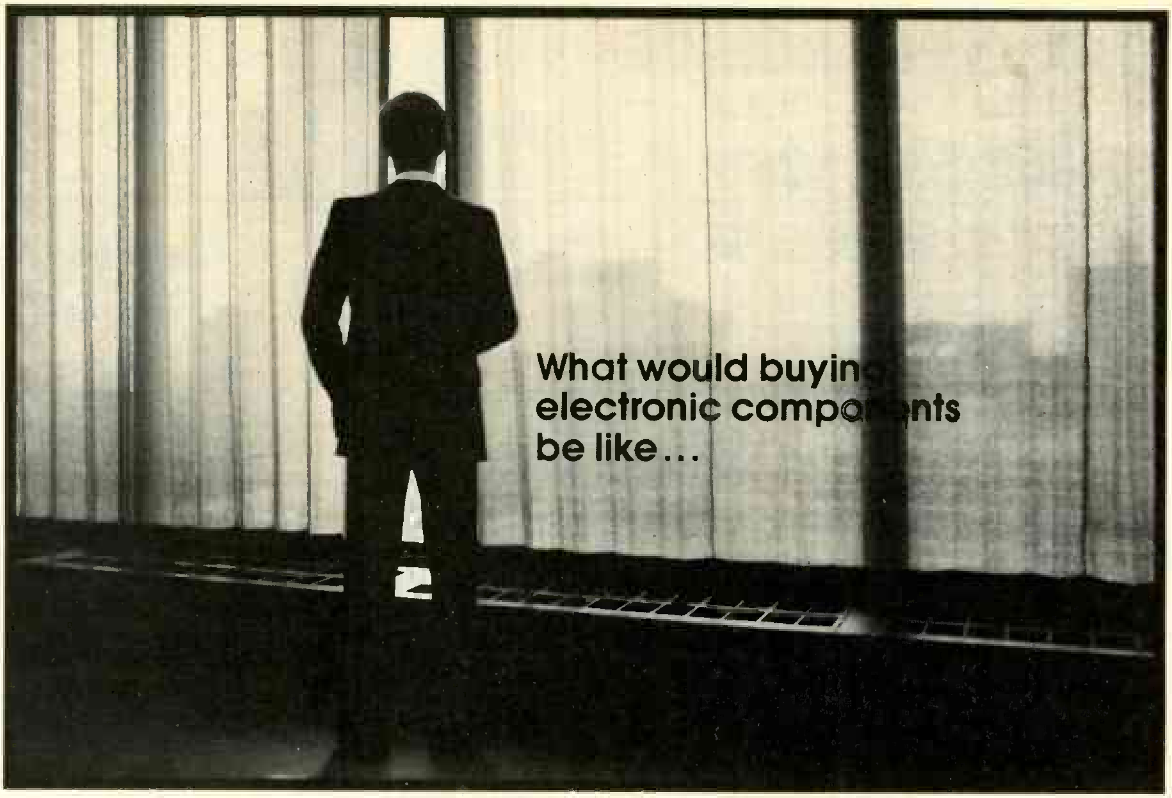

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HI-FI MINI SPEAKER

continued from page 106

ledge around the four sides of the enclosure. (Note: it is easiest to glue the two longer strips to opposing sides of the enclosure first, and then install the remaining two.)

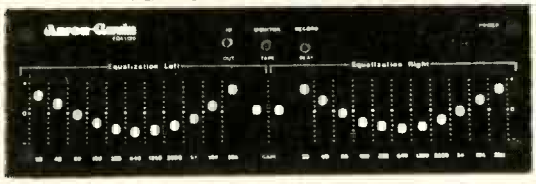
15. Spread some glue evenly on the tops of the four partition mounting strips just installed.
16. Take the assembly prepared in step 5 (partition 6) and lower it through the top of the enclosure (with the partition supports on top) until it sits firmly on the four mounting strips to which glue has just been applied. Make sure that the tube fits into the center hole.
17. Hold the partition-6 assembly in place until the glue has set. Then glue the tube to the center hole of that partition to form an airtight seal.
18. Mount partition 5 on the four partition supports of the partition-6 assembly.
19. Repeat step 14, this time using the remaining partition strips and the partition-1, 2, 3, and 4 assemblies.
20. Mount the woofer on the enclosure top as shown in Fig. 6. Note that it is attached *inside* the enclosure.
21. Attach the top to the rest of the enclosure.
22. Make the electrical connections to the woofer.
23. Attached the top plate to the four top supports.
24. Attach the bottom plate to the four bottom supports.
25. Mount and connect the tweeter as shown in Fig. 3 or Fig. 4. If a horn-type tweeter is used, you may need to reduce the value of capacitor C1 to 1.0 μF to prevent lower frequencies from being shunted to the tweeter and being distorted.

That completes construction of the mini-SAFE speaker system. Use it with a good medium-power (15-20 watts-per-channel) amplifier, and you'll have performance worth many times more than what you paid for the components. **R-E**

Aaron-Gavin Kits

Equalizers Mixers LED Meters

FEATURING THIS MONTH $114.94 (Kit)



The first 11 Band Stereo Equalizer with truly unique LINEAR Mirror Image Circuitry. Totally eliminates snap-on. Generates a TRUE ± 15db Boost and Cut on EVERY BAND without band to band phase cancellation or rainbow effect.

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31 Band Mono EQ	☐ $157.05	☐ $322.53
21 Band Stereo EQ	☐ $205.02	☐ $421.02
21 Band Mono EQ	☐ $125.05	☐ $258.64
11 Band Stereo EQ	☐ $114.94	☐ $230.00
11 Band Mono EQ	☐ $ 75.84	☐ $151.57
11 Band Stereo EQ (As shown above)	☐ $129.50	☐ $249.80
5 Band Stereo EQ	☐ $ 74.50	☐ $148.99
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LED METERS (All integrated circuits!)
DOT or BAR Pattern, 3 position range switch

Description	Kit	Mfg.
Front panel mount only:		
10 LED (Mono)	$44.40	$55.80
20 LED (Stereo)	$52.20	$68.00
Cabinet or Rack Mount:		
20 LED (Mono)	$50.40	$68.00
40 LED (Stereo)	$67.00	$88.60

Down to − 71dB!

Holiday prices good only to January 1, 1982.

Order with this Coupon or send for product specifications.

Check box for the item of your choice send check, money order, COD or Visa, Master Charge. Your card number________ Exp. date ________

Add $7.00 for shipping and handling. Check Freq. Range: 16Hz-16HKz ☐ 20Hz-20KHz

Check style: Rack Mount ☐ Flat Cabinet ☐ Upright Cabinet

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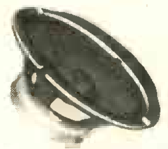
3 Octaves— $79⁰⁰ 4 Octaves- $99⁰⁰



Surplus Musical Instrument SPEAKERS

10" WOOFER SPEAKERS. From the same synthesizer manufacturer; as used in The "ARP- piano" power amplifier. Features heavy duty, low resonance suspension cone. Heavy alloy magnet. Quality built and selected for continuous music power drive. Should easily dissipate over 25 watts RMS.

BRAND NEW! .... **$24.00; 2/$45.00**

QUANTITIES LIMITED!!!

MID-RANGE SPEAKERS

Used with the above woofer in a superior speaker system. 4 inches in diameter, heavy duty, large alloy magnet for music power output.

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SYNTHESIZER SPEAKERS

As used in the ARP 2600 Synthesizer (4 x 6 inches). Plenty of power capability. Great for cars, replacement, or speaker arrays. Heavy magnet, 40 ohms, oval shape.

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Dual suspension with 4 Different spring sizes. Magnetic transducers, shock-damped spring assembly. Approx. 1 foot long springs for superb delay times.

Reverb Assembly (NEW) .. **$16.50ea.**

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20 TURN TRIMMER

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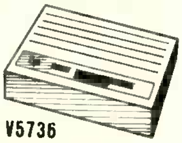
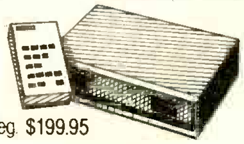
4 pieces & up **$24.95 ea.**
Model V5736



- Allows complete programming of VTR
- Watch or record any combination of standard or Pay-TV programs
- Receives Midband and Superband channels on UHF
- For Beta/VHS type recorders

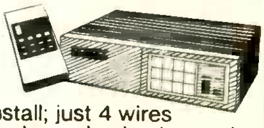
BRUCE 37- Channel Wireless Remote Control TV Tuner
Commander 500

1-5 pcs. **$109.95 ea.**
6 pcs. & up **$99.95 ea.** Reg. $199.95



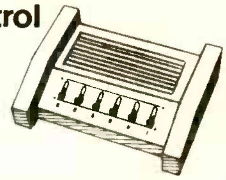
- For all channels; for all TV's
- Red LED channel readout 1-99
- Master power switch and fine tune controls on remote
- Easy to install
- Scan channels up and down

TEKNIKA Wireless Remote Control TV Tuner
$109.95 ea.
Reg.$169.95
Model 6301



- Easy to install; just 4 wires
- Electronic channel selection and indication. VHF: 2-12, UHF: 14-83,
- Ultra-Infrared Beam Control
- Master power switch

Video Control Center
Model VTS-157
$59.95



- No need to change cable to access input to TV set
- One output; 4 inputs
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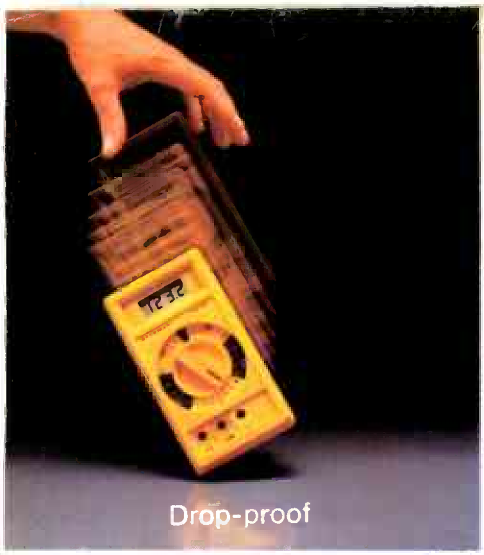

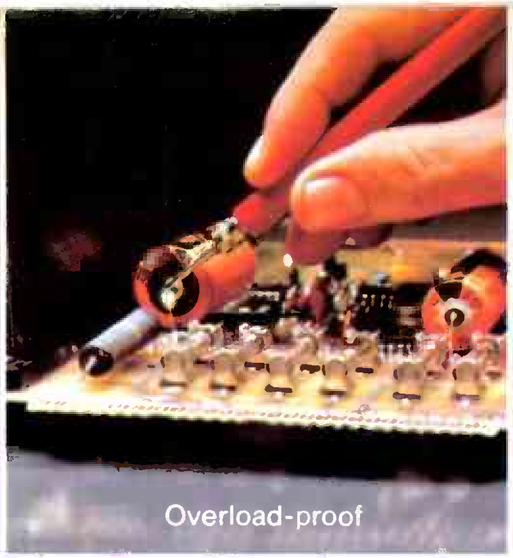

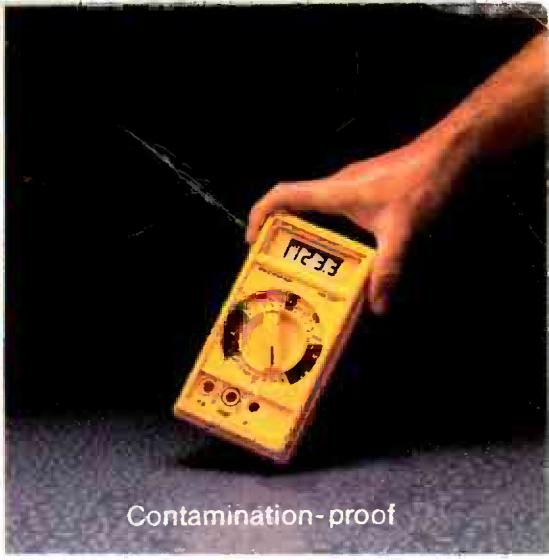

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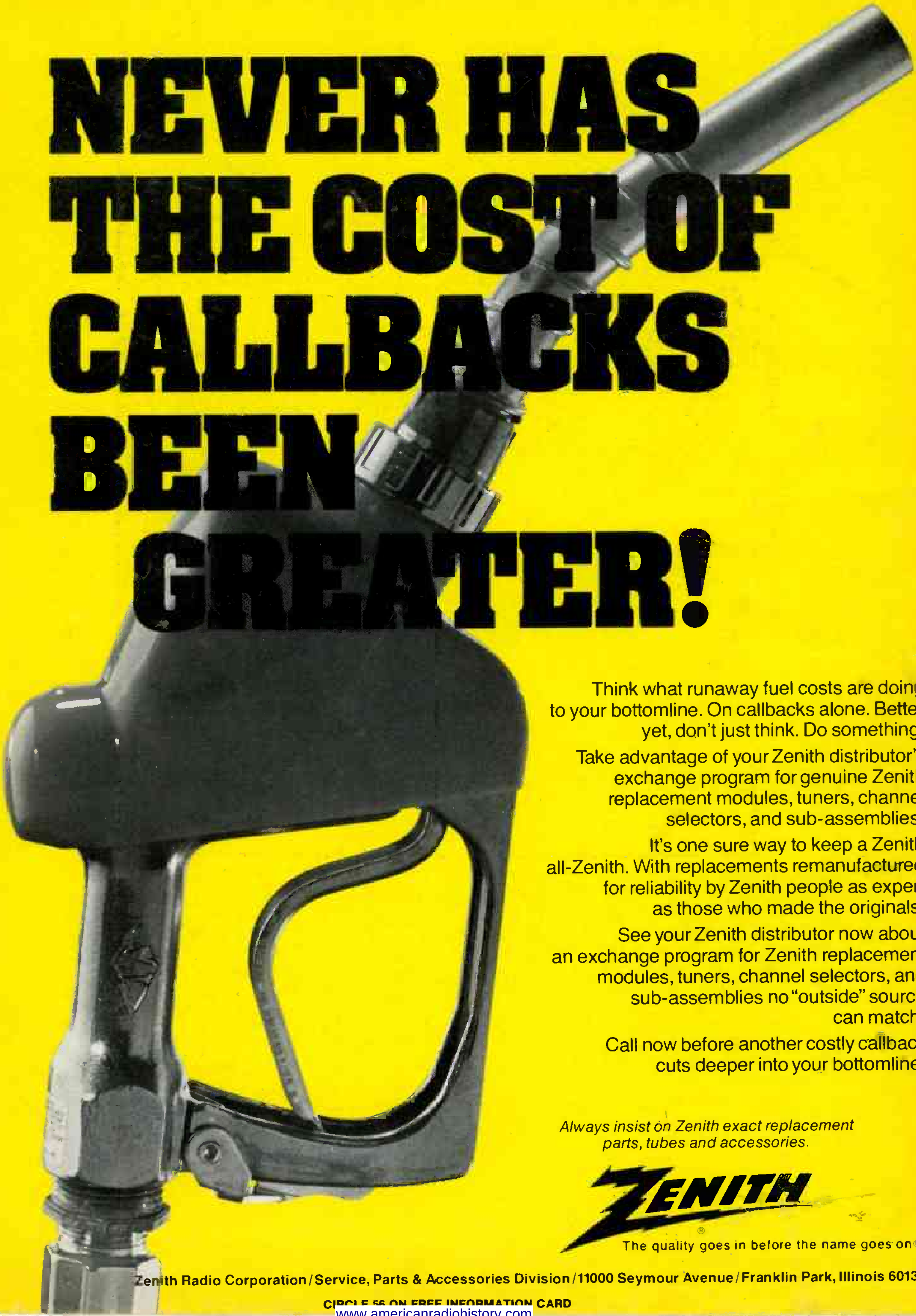

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